B.E. - CSE (Artificial Intelligence and Machine Learning)

CURRICULUM AND SYLLABUS HANDBOOK

Regulation R2019

Approved by Academic Council on 14.10.2024

2024-2025

Sri Eshwar College of Engineering
Coimbatore | Tamilnadu
An Autonomous Institution
Affiliated to Anna University, Chennai

1.0 Vision, Mission and Core Values of the Institution

Vision

"To be recognized as a premier institution, grooming students into globally acknowledged engineering professionals."

Mission

We will achieve the Vision by:

- ✓ Providing outcome and value-based engineering education
- ✓ Nurturing research and entrepreneurial culture
- ✓ Enabling students to be industry-ready and fulfil their career aspirations
- ✓ Grooming students through behavioural and leadership training programs
- ✓ Making students socially responsible

Core Values

The following core values of Sri Eshwar College of Engineering are closely aligned with its vision and mission, supporting the college's goal of developing well-rounded, globally capable, and socially responsible engineering professionals:

1. Pursuit of Excellence,
2. Problem Solving Mindset
3. Spirit of Collaboration
4. Culture of Innovation
5. Responsibility to Society

2.0 Vision and Mission of the Department of CSE–Artificial Intelligence and Machine Learning

Vision

"To become a model hub for Computer Science and Engineering-Artificial Intelligence and Machine Learning education and research by acquiring, disseminating, and generating knowledge in order to meet societal demands."

Mission Statements

M1: Evolve curriculum and delivery approaches to provide broad and wide exposure to the learner to gain adequate knowledge in their field of study.

M2: Provide opportunities for faculties to enhance their domain knowledge and skills required for the programs offered.

M3: connections with local, national and global experts to share, utilize and exchange domain expertise

M4: Conduct Outreach activities for the society that involve the use of artificial intelligence and machine learning solutions to deal with societal issues.

M5: Create and provide a conducive ecosystem and facilities for offering education related to artificial intelligence

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3.0 B.E. CSE (AIML) Program Educational Objectives (PEOs)

PEO1: Graduates will have successful careers in AI and ML-related fields, including positions such as data scientists, machine learning engineers, AI researchers, and consultants.

PEO2: Graduates will recognize the dynamic nature of AI and ML technologies and engage in continuous learning to stay abreast of the latest advancements, tools, and techniques in the field.

PEO3: Graduates will have the knowledge and skills to identify opportunities for applying AI and ML in various domains, potentially founding startups, or contributing to the growth and competitiveness of existing organizations

4.0 Knowledge and Attitude Profile (WK)

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

5.0 B.E. CSE (AIML) Program Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

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PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to the economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Teamwork: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

6.0 B.E. CSE (AIML) Program Specific Outcomes (PSOs)

PSO1: Apply the knowledge of mathematical concepts, programming fundamentals and algorithms for solving complex problems in AI and ML domains.

PSO2: Design, implement, and evaluate end-to-end AI solutions, including data acquisition, pre-processing, model development, deployment, and monitoring, adhering to best practices in software engineering and system design.

7.0 B.E. CSE (AIML) Program Curriculum

7.1. Curriculum Structure

The curriculum structure includes the following course categories:

Humanities and Social Sciences (HS): Technical English, Foreign Languages, Management & Engineering Ethics, and Engineering Economics.

Basic Sciences (BS): Mathematics, Physics, and Chemistry.

Engineering Sciences (ES): Materials Science, Workshop Practices, Drawing, and Fundamentals of Electrical, Electronics, Mechanical, and Computer Engineering.

Professional Core (PC): Courses specific to the chosen specialization or branch.

Professional Electives (PE): Elective courses within the chosen specialization (Vertical).

Open Electives (OE): Courses from other technical or emerging subject areas.

Project Work (PW): Projects involving Design Thinking (Product/Software Development Life Cycle), Innovative/Multidisciplinary Projects, Industry Projects, and other project work.

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Employability Enhancement Courses (EM): Personality Development, Verbal and Soft Skills, Advanced Logical Thinking, and Industry or External Internships.

Mandatory Courses (MC): Heritage of Tamils (**HSMC**), Tamils and Technology (**HSMC**), Environmental Science, and Universal Human Values.

Optional Courses (OC): NCC Credit Course Level I, NCC Credit Course Level II, NCC Credit Course Level III and Honours Courses.

Student Induction Program (SIP)

The Student Induction Programme (SIP) is an essential three-week orientation tailored for first-year undergraduate students enrolled in BE/B.Tech programs. Held annually, this programme is designed to facilitate a smooth transition from secondary education to collegiate life, ensuring that students effectively integrate into both the academic and social environments of the institution.

Program Components

- ✓ Universal Human Values
- ✓ Health
- ✓ Department Familiarization
- ✓ Interactive Lectures
- ✓ Proficiency Modules
- ✓ Local Visits
- ✓ Cultural Activities

The SIP plays a pivotal role in setting the stage for a successful and fulfilling college experience, providing students with the tools and support necessary for a smooth transition into their academic and social life

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7.2 Curriculum

SEMESTER I

Sl. No.	Course Code	Course Name	Cate-gory	Periods/ Week			TC	C
				L	T	P		
Theory Courses								
1	**R19MA101**	Matrix Algebra and Calculus	**BS**	3	1	0	4	4
2	**R19PH201**	Physics for Information Science	**BS**	3	0	0	3	3
3	**R19CS101**	Problem solving using C	**ES**	3	0	0	3	3
4	**R19EC103**	Electronics and Microprocessor	**ES**	3	0	0	3	3
Theory cum Practical Course								
5	**R19HS151**	Technical English	**HS**	2	0	2	4	3
Practical Courses								
6	**R19PH211**	Physics Laboratory	**BS**	0	0	2	2	1
7	**R19GE111**	Engineering Practices Laboratory	**ES**	0	0	4	4	2
8	**R19CS111**	Problem solving using C Laboratory	**ES**	0	0	4	4	2
Professional Development Course								
9	**R19EM101**	Soft Skills	**EM**	0	0	2	2	1
Total				14	1	14	29	22

SEMESTER II

Sl. No.	Course Code	Course Name	Cate-gory	Periods/ Week			TC	C
				L	T	P		
Theory Courses								
1	**R19MA104**	Linear Algebra	**BS**	3	1	0	4	4
2	**R19CS201**	Data Structures	**PC**	3	0	0	3	3
3	**R19CY101**	Engineering Chemistry	**BS**	3	0	0	3	3
4	**R19CS104**	Application Design and Development	**ES**	2	2	0	4	4
5	**R19HS55X**	Language Elective	**HS**	3	0	0	3	3
Theory cum Practical Course								
6	**R19CS151**	Python Programming	**ES**	3	0	2	5	4
Practical Courses								
7	**R19CS211**	Data Structures Laboratory	**PC**	0	0	4	4	2
8	**R19CY111**	Chemistry Laboratory	**BS**	0	0	2	2	1
Mandatory Course								

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9	R19MC101	தமிழர் மரபு/ Heritage of Tamils	HSMC	1	0	0	1	1
Total				18	3	8	29	25

SEMESTER III

Sl. No.	Course Code	Course Name	Category	Periods / Week			TC	C
				L	T	P		
Theory Courses								
1	R19MA203	Discrete Mathematics	BS	3	1	0	4	4
2	R19CS205	Design and Analysis of Algorithms	PC	3	0	0	3	3
3	R19CS202	Database Management Systems	PC	3	0	0	3	3
4	R19CS203	Object Oriented Programming using Java	PC	3	0	0	3	3
Theory Cum Practical Course								
5	R19AD251	Data Science	PC	3	0	2	5	4
Practical Courses								
7	R19CS215	Design and Analysis of Algorithms Laboratory	PC	0	0	4	4	2
8	R19CS212	Database Management Systems Laboratory	PC	0	0	2	2	1
9	R19CS213	Object Oriented Programming using JavaLaboratory	PC	0	0	2	2	1
Mandatory Courses								
10	R19MC201	Environmental Science	MC	1	0	0	1	NC
11	R19MC102	தமிழரும் தமிழில் நுட்பமும் /Tamils and Technology	HSMC	1	0	0	1	1
Project Work								
12	R19AM281	Innovative / Multi-Disciplinary Project	PW	0	0	6	4	3
Total				18	3	8	29	25

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SEMESTER IV

Sl. No.	Course Code	Course Name	Category	Periods/ Week			TC	C
				L	T	P		
Theory Courses								
1	**R19MA206**	Probability and Statistics	**BS**	3	1	0	4	4
2	**R19AM301**	Machine Learning	**PC**	3	0	0	3	3
3	**R19AD201**	Artificial Intelligence	**PC**	3	0	0	3	3
4	**R19CS204**	Operating Systems	**PC**	3	0	0	3	3
Theory cum Practical Course								
5	**R19EC253**	Computer Networks	**PC**	3	0	2	5	4
Practical Courses								
6	**R19AM311**	Machine Learning Laboratory	**PC**	0	0	2	2	1
7	**R19AD211**	Artificial Intelligence Laboratory	**PC**	0	0	2	2	1
8	**R19CS214**	Operating Systems Laboratory	**PC**	0	0	2	2	1
Project Work								
9	**R19AM282**	Project with Design Thinking (Product / Software Development Life Cycle)	**PW**	0	0	2	2	1
Professional Development Course								
10	**R19EM201**	Logical Thinking	**EM**	0	0	2	2	1
	R19EM203	Summer Internship	**EM**	-	-	-	-	NC
Mandatory Course								
11	**R19MC202**	Indian Constitution and Tradition	**MC**	1	0	0	1	NC
Total				18	1	12	31	24

SEMESTER V

Sl. No.	Course Code	Course Name	Category	Periods /Week			TC	C
				L	T	P		
Theory Courses								
1	**R19AM302**	Deep Learning for Computer Vision	**PC**	3	0	0	3	3
2	**R19XXXXX**	Professional Elective I	**PE**	3	0	0	3	3
3	**R19XXXXX**	Professional Elective II	**PE**	3	0	0	3	3
4	**R19CS206**	Full Stack Development	**PC**	3	0	0	3	3
Theory cum Practical Courses								
4	**R19AD252**	Data Exploration and visualization	**PC**	2	0	2	4	3

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5	R19EC252	Digital Principles and Computer Organization	ES	3	0	2	5	4
Practical Courses								
6	R19AM313	Deep Learning for Computer VisionLaboratory	PC	0	0	2	2	1
7	R19CS216	Full Stack Development Laboratory	PC	0	0	2	2	1
Professional Development Course								
8	R19EM202	Advanced Logical Thinking	EM	0	0	2	2	1
Total				17	0	10	27	22

*- Electives Structure: 3 0 0 3 / 2 0 2 3

SEMESTER VI

Sl. No.	Course Code	Course Name	Cate-gory	Periods/ Week			TC	C
				L	T	P		
Theory Courses								
1	R19IT303	Cryptography and Cyber Security	PC	3	0	0	3	3
2	R19XXXX	Professional Elective III	PE	3	0	0	3	3
3	R19XXXX	Open Elective I*	OE	3	0	0	3	3
Theory Cum Practical Courses								
4	R19EC352	Embedded System & IoT	ES	3	0	2	5	4
5	R19AM351	Natural Language Processing	PC	2	0	2	4	3
Practical Course								
6	R19IT312	Cryptography and Cyber Security Laboratory	PC	2	0	0	2	1
Project Work								
7	R19AM384	Project on Robotics using AI	PW	0	0	6	6	3
Total				16	0	10	26	20

***Electives Structure: 3 0 0 3 / 2 0 2 3**

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SEMESTER VII

Sl. No.	Course Code	Course Name	Cate-gory	Periods/ Week			TC	C
				L	T	P		
Theory Courses								
1	**R19HS401**	Principles of Mangemennt and professional Ethics	**HS**	3	0	0	3	3
2	**R19XXXX**	Professional Elective IV	**PE**	3	0	0	3	3
3	**R19XXXX**	Open Elective II*	**OE**	3	0	0	3	3
Theory cum Practical Course								
4	**R19IT451**	Blockchain Technologies	**PC**	3	0	2	5	4
Project Work								
5	**R19AM485**	Project Work-Phase I	**PW**	0	0	8	8	4
Total				9	0	10	19	14

SEMESTER VIII

Sl. No.	Course Code	Course Name	Cate-gory	Periods /Week			TC	C
				L	T	P		
Project Work								
1	**R19AM486**	Industry Internship/Project work - Phase II	**PW**	0	0	20	20	10
Total				0	0	20	20	10

L→Lecture; T→Tutorial; P→Practical; TC→Total Classes/wk; C→Credit

Total Number of Credits: 163

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CREDIT SUMMARY

SUMMARY											
Sl. No.	Course Category	Credits per Semester								Credits	
		I	II	III	IV	V	VI	VII	VIII		
1	HS	3	3	-	-	-	-	3	-	9	5.4
2	BS	8	8	4	4	-	-	-	-	24	14.5
3	ES	10	8	-	-	4	4	-	-	26	15.7
4	PC	-	5	17	16	7	7	4	-	56	33.0
5	PE	-	-	-	-	6	3	3	-	12	7.2
6	OE	-	-	-	-	-	3	3	-	6	3.6
7	PW	-	-	3	1	4	3	4	10	25	15.3
8	EM	1	-	-	1	1	-	-	-	3	1.8
9	NC	-	-	-	-	-	-	-	-	0	0
10	MC	-	-	NC	NC	-	-	-	-	0	0
11	HSMC	-	1	1	-	-	-	-	-	2	1.2
	Total	22	25	25	22	22	16	19	12	163	100

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7.3 Professional Elective Courses

VERTICAL 1	VERTICAL 2	VERTICAL 3	VERTICAL 4	VERTICAL 5	VERTICAL 6
MACHINE LEARNING	**DATA SCIENCE**	**CYBER SECURITY AND DATA PRIVACY**	**SOFTWARE ENGINEERING**	**FULL STACK DEVELOPMENT**	**CLOUD COMPUTING**
R19AM511 Time Series Analysis and Forecasting	R19AD511 Health Care Analytics	R19CC521 Ethical Hacking	R19CB531 Software Quality Management	R19CS521 Full Stack Technologies	R19IT521 Cloud Virtualization
R19AM512 Video Analytics	R19AD512 Knowledge Engineering	R19CC522 Digital and Mobile Forensics	R19CB532 Free and Open Source Software	R19CS522 MVC Frameworks	R19IT522 Cloud Economics
R19AM513 Text and Speech Analytics	R19AD513 Soft Computing Techniques	R19CC523 Social Network Security	R19CB533 Agile Software Development	R19CS523 Web Application Security	R19IT523 Cloud Networking and Connectivity
R19AM514 Statistical Analysis and Computing	R19AD514 Social Media Analytics	R19CC524 Modern Cryptography	R19CB534 Software Testing	R19CS524 MongoDB and MySQL	R19IT524 Security on Cloud
R19AM515 Data Warehousing and Mining	R19AD515 Cognitive Science	R19CC525 Engineering Secure Software Systems	R19CB535 Software Architecture	R19CS525 Flutter and Dart	R19IT525 Compute Solutions and Serverless Services
R19AM516 Generative AI	R19AD516 Ethics and Artificial Intelligence	R19CC526 Cryptocurrency and Blockchain Technologies	R19CB536 Software Requirement Engineering	R19CS526 Cloud Services Management	R19IT526 Cloud Storage Solutions
R19AM517 Multi-Prompt Engineering	R19AD517 Information Retrieval	R19CC527 Malware Analysis	R19CB537 Continuous Integration and Continuous Deployment	R19CS527 User Experience Design	R19IT527 Cloud Native Development and Containers
R19AM518 Robot Kinematics and Dynamics	R19AD518 Business Intelligence	R19CC528 Network Security	R19CB538 Software Reliability Metrics and Models	R19CS528 Docker and Kubernetes	R19IT528 Data Analytics on Cloud
R19AM519 Robotic Process Automation	R19AD519 Big Data Analytics	* * * * * *	R19CB539 Software Project Management	R19CS529 UI Design with Figma	* * * * * *
* * * * * *	R19AD520 Data Exploration and Visualization	* * * * * *	* * * * * *	R19CS530 Groovy on Grails	* * * * * *
-	R19AD252 - Data Visualization &Exploration	-	-	-	

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7.4 Professional Elective Courses with Credits:

Sl. No.	Course Code	Course Name	Cate-gory	Periods/ Week			TC	C
				L	T	P		
Vertical 1— Machine Learning								
1	R19AM511	Time Series Analysis and Forecasting	PE	3	0	0	3	3
2	R19AM512	Video Analytics	PE	3	0	0	3	3
3	R19AM513	Text and Speech Analytics	PE	3	0	0	3	3
4	R19AM514	Statistical Analysis and Computing	PE	3	0	0	3	3
5	R19AM515	Data Warehousing and Mining	PE	3	0	0	3	3
6	R19AM516	Generative AI	PE	3	0	0	3	3
7	R19AM517	Multi – Prompt Engineering	PE	3	0	0	3	3
8	R19AM518	Robot Kinematics and Dynamics	PE	3	0	0	3	3
9	R19AM519	Robotic Process Automation	PE	3	0	0	3	3
Vertical 2— Data Science								
1	R19AD511	Health Care Analytics	PE	3	0	0	3	3
2	R19AD512	Knowledge Engineering	PE	3	0	0	3	3
3	R19AD513	Soft Computing Techniques	PE	3	0	0	3	3
4	R19AD514	Social Media Analytics	PE	3	0	0	3	3
5	R19AD515	Cognitive Science	PE	3	0	0	3	3
6	R19AD516	Ethics and Artificial Intelligence	PE	3	0	0	3	3
7	R19AD517	Information Retrieval	PE	3	0	0	3	3
8	R19AD518	Business Intelligence	PE	3	0	0	3	3
9	R19AD519	Big Data Analytics	PE	3	0	0	3	3
10	R19AD520	Data Visualization & Exploration	PE	3	0	0	3	3
Vertical 3— Cyber Security and Data Privacy								
1	R19CC521	Ethical Hacking	PE	3	0	0	3	3
2	R19CC522	Digital and Mobile Forensics	PE	3	0	3	3	3
3	R19CC523	Social Network Security	PE	3	0	0	3	3
4	R19CC524	Modern Cryptography	PE	3	0	0	3	3
5	R19CC525	Engineering Secure Software Systems	PE	3	0	0	3	3
6	R19CC526	Cryptocurrency and Blockchain Technologies	PE	3	0	0	3	3
7	R19CC527	Malware Analysis	PE	3	0	0	3	3

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8	R19CC528	Network Security	PE	3	0	0	3	3
Vertical 4— Software Engineering								
1	R19CB531	Software Quality Management	PE	3	0	0	3	3
2	R19CB532	Free and Open-Source Software	PE	3	0	0	3	3
3	R19CB533	Agile Software Development	PE	3	0	0	3	3
4	R19CB534	Software Testing	PE	3	0	0	3	3
5	R19CB535	Software Architecture	PE	3	0	0	3	3
6	R19CB536	Software Requirement Engineering	PE	3	0	0	3	3
7	R19CB537	Continuous Integration and ContinuousDeployment	PE	3	0	0	3	3
8	R19CB538	Software Relability Metrics and Models	PE	3	0	0	3	3
9	R19CB539	Software project Management	PE	3	0	0	3	3
Vertical 5— Full Stack Development								
1	R19CS521	Groovy on Grails	PE	3	0	0	3	3
2	R19CS522	MVC Frameworks	PE	3	0	0	3	3
3	R19CS523	Web Application Security	PE	3	0	0	3	3
4	R19CS524	Flutter and Dart	PE	3	0	0	3	3
5	R19CS525	Cloud Services Management	PE	3	0	0	3	3
6	R19CS526	UI Design with Figma	PE	3	0	0	3	3
7	R19CS527	Docker and Kubernetes	PE	3	0	0	3	3
Vertical 6— Cloud Computing								
1	R19IT521	Cloud Virtualization	PE	3	0	0	3	3
2	R19IT522	Cloud Economics	PE	3	0	0	3	3
3	R19IT523	Cloud Networking and Connectivity	PE	3	0	0	3	3
4	R19IT524	Security on Cloud	PE	3	0	0	3	3
5	R19IT525	Compute Solutions and Serverless services	PE	3	0	0	3	3
6	R19IT526	Cloud storage solutions	PE	3	0	0	3	3
7	R19IT527	Cloud Native development and Containers	PE	3	0	0	3	3
8	R19IT528	Data and Analytics on Cloud	PE	3	0	0	3	3

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7.5 Open Elective Courses

Sl. No.	Course Code	Course Name	Category	Periods/ Week			TC	C
				L	T	P		
1	R19AD651	Data Science Essentials	OE	2	0	2	4	3
2	R19AD652	Exploratory Data Analysis and Visualization	OE	2	0	2	4	3
3	R19AD653	Machine Learning Techniques	OE	3	0	0	3	3
4	R19AD654	Foundations of Artificial Intelligence	OE	3	0	0	3	3
5	R19CC651	Network Protocols	OE	2	0	2	4	3
6	R19CC601	High Speed Networks	OE	3	0	0	3	3
7	R19CC602	Introduction to Industrial Networking	OE	3	0	0	3	3
8	R19CC603	Basics of Mobile Communication	OE	3	0	0	3	3
9	R19CC604	Introduction to Wireless Communication Networks	OE	3	0	0	3	3
10	R19CB601	Algorithmic Trading Strategies	OE	3	0	0	3	3
11	R19CB602	Business Simulation	OE	3	0	0	3	3
12	R19CB603	Principles of Taxation	OE	3	0	0	3	3
13	R19CB604	Strategic Business Leader	OE	3	0	0	3	3
14	R19CB605	Information Systems Control and Audit	OE	3	0	0	3	3
15	R19CS651	Application Development using Java	OE	2	0	2	4	3
16	R19CS652	Database Technologies	OE	2	0	2	4	3
17	R19CS653	Full Stack Technologies	OE	2	0	2	4	3
18	R19CS654	Fundamentals of Python Programming	OE	2	0	2	4	3
19	R19CS655	Competitive Coding Techniques	OE	2	0	2	4	3
20	R19EC601	Discrete Time Signal Processing	OE	3	0	0	3	3
21	R19EC602	Principles of Analog and Digital Communication	OE	3	0	0	3	3
22	R19EC603	Digital Systems and VLSI Design	OE	3	0	0	3	3
23	R19EC604	Introduction to IoT	OE	3	0	0	3	3

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Sl. No.	Course Code	Course Name	Category	Periods/ Week			TC	C
				L	T	P		
24	R19EC605	Basics of Biomedical Instrumentation	OE	3	0	0	3	3
25	R19EC606	Introduction to Image processing	OE	3	0	0	3	3
26	R19EC607	Microcontroller and Embedded Systems	OE	3	0	0	3	3
27	R19EC608	Introduction to Wireless Sensor Networks	OE	3	0	0	3	3
28	R19EC609	Introduction to Robotics and Automation	OE	3	0	0	3	3
29	R19EC610	Medical Electronics	OE	3	0	0	3	3
30	R19EE601	Solid State Electronics	OE	3	0	0	3	3
31	R19EE602	Non Conventional Energy Sources	OE	3	0	0	3	3
32	R19EE603	Energy Conservation Practices	OE	3	0	0	3	3
33	R19EE604	Energy Auditing and Management	OE	3	0	0	3	3
34	R19EE605	Introduction to Hybrid and Electric Vehicles	OE	3	0	0	3	3
35	R19EE606	Design of Solar Photovoltaic Systems	OE	3	0	0	3	3
36	R19EE607	PLC and SCADA	OE	3	0	0	3	3
37	R19IT601	Introduction to Software Engineering	OE	3	0	0	3	3
38	R19IT602	Web Programming	OE	3	0	0	3	3
39	R19IT603	Basic of Software Testing	OE	3	0	0	3	3
40	R19IT604	Introduction to Block Chain Technology	OE	3	0	0	3	3
41	R19IT605	Soft Computing Technologies	OE	3	0	0	3	3
42	R19IT606	Fundamentals of IT Infrastructure Management	OE	3	0	0	3	3
43	R19IT607	Mobile Application Development	OE	3	0	0	3	3
44	R19IT651	Basics of Cloud Technology	OE	2	0	2	4	3
45	R19IT652	Introduction to Computer Networks	OE	2	0	2	4	3
46	R19IT653	Game Programming Fundamentals	OE	2	0	2	4	3

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Sl. No.	Course Code	Course Name	Category	Periods/ Week			TC	C
				L	T	P		
47	R19ME601	Product Design and Innovation	OE	3	0	0	3	3
48	R19ME602	3D Printing and Tooling	OE	3	0	0	3	3
49	R19ME603	Quality Management	OE	3	0	0	3	3
50	R19ME604	Enterprise Resource Planning	OE	3	0	0	3	3
51	R19ME605	Micro Electro Mechanical Systems	OE	3	0	0	3	3
52	R19ME606	Quality Control Tools and Techniques	OE	3	0	0	3	3
53	R19ME607	World Class Manufacturing	OE	3	0	0	3	3
54	R19ME608	Industrial Safety Engineering	OE	3	0	0	3	3
55	R19ME609	Introduction to Industry 4.0	OE	3	0	0	3	3
56	R19ME610	Lean Six Sigma and Supply Chain Management	OE	3	0	0	3	3
57	R19ME611	Business Organization and Development	OE	3	0	0	3	3
58	R19ME612	Product Distribution and Promotion Management	OE	3	0	0	3	3
59	R19ME613	Business Ethics, Corporate Social Responsibilities and Governance	OE	3	0	0	3	3
60	R19PH601	Laser Technology	OE	3	0	0	3	3
61	R19PH602	Nano Materials and Applications	OE	3	0	0	3	3
62	R19PH603	Physics for Solar PV System	OE	3	0	0	3	3
63	R19PH604	Medical Physics	OE	3	0	0	3	3
64	R19CY601	Chemical Sensors and Biosensors	OE	3	0	0	3	3
65	R19CY602	Energy Storing Devices	OE	3	0	0	3	3
66	R19CY603	Chemistry Forensic Science	OE	3	0	0	3	3
67	R19CY604	Industrial and Material Chemistry	OE	3	0	0	3	3
68	R19HS601	English for Competitive Examinations	OE	3	0	0	3	3

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Sl. No.	Course Code	Course Name	Category	Periods/ Week			TC	C
				L	T	P		
69	R19HS602	Personality Development and Interpersonal Skills	OE	3	0	0	3	3
70	R19HS603	Communication Techniques for Employability	OE	3	0	0	3	3
71	R19HS604	Mass Communication	OE	3	0	0	3	3

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8.0 Syllabus

SEMESTER I

R19MA101	Matrix Algebra and Calculus	L	T	P	C
		3	1	0	4

1. Course Description:

Matrix algebra and calculus are fundamental mathematical subjects that find widespread applications in various fields, including physics, engineering, computer science, economics and more. Differential calculus emphasizes the understanding of rate of changes and integration spreads its wings in finding areas under curves, volumes of solids of revolution, and applications in engineering. The course enhances critical thinking and analytical skills.

2. Course Objectives:

1. Explore matrix techniques and its applications.
2. Enhance thier knowledge in infinite series and their convergence.
3. Familiarize the student with functions of several variables and its extremum.
4. Cultivate knowledge in double integration.
5. Inculcate the knowledge of triple integrals and their applications.

3. Syllabus:

Unit-I: Matrices

Eigen values and eigen vectors:Eigen values and eigen vectors of a real matrix;Properties ;Cayley Hamilton theorem (statement only); Orthogonal transformation: Orthogonal transformation of a symmetric matrix to diagonal form, reduction of quadratic form to canonical form by orthogonal transformation.

Unit-II: Sequences and Series

Sequences: Definition and examples; Series: Types and convergence, series of positive terms; Tests of convergence: Comparison test, integral test and D'Alembert's ratio test; Alternating series: Leibnitz's test,Series of positive and negative terms, absolute and conditional convergence.

Unit-III: Multivariable Calculus

Functions of several variables: Partial derivatives,total derivative,differentiation of implicit functions, Jacobian,properties of Jacobians,Taylor's series, maxima and minima of functions of two variables, Lagrange's method of undetermined multipliers.

Unit-IV: Double Integration

Double integrals: Evaluation of double integrals, change of order of integration,double integrals in polar coordinates,area enclosed by plane curves.

Unit-V: Integration and its Application

Triple integrals: Evaluation of triple integrals, Volume as triple integral: simple problems, volume of solid, Gamma and Beta functions.

Text Books:

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1. Grewal. B. S, "Higher Engineering Mathematics", 44th Edition, Khanna Publications, Delhi, 2015.
2. Erwin Kreyszig, "Advanced Modern Engineering Mathematics", 10th Edition, John Wiley and Sons (Asia) Ltd, Singapore, 2017.

References:

Reference Books:

1. H. K. Dass, "Advanced Engineering Mathematics", S. Chand & Company LTD, New Delhi, Reprint 2009.
2. John Bird, "Higher Engineering Mathematics", An imprint of Elsevier, Burlington, Reprint 2010.
3. Bali. N. P and Manish Goyal, "A Text book of Engineering Mathematics", 8th Edition, Laxmi publications Ltd, 2011.
4. Veerarajan. T, "Engineering Mathematics", 3rd edition, Tata Mc Graw Hill Education Pvt. Ltd, New Delhi, 2011.

Journal References:

1. International Journal of Applied Mathematics:
   https://www.diogenes.bg/ijam/
2. An International Journal for Theory and Applications:
   https://link.springer.com/journal/13540

Web Resources:

1. https://www.simplilearn.com/introduction-to-derivatives-rrt3co36vd364-video
2. https://www.khanacademy.org/math/calculus-home/integration-techniques-calc/trigonometric- substitution-calc/v/integrals-trig-substitution-1
3. http://www.dnatube.com/video/11238/What-Are-Conic-Sections
4. https://www.youtube.com/watch?v=AjmWR4kRtVk

MOOC/NPTEL/SWAYAM Courses:

1. nptel.ac.in/courses/111104092/
2. http://www.cdeep.iitb.ac.in/webpage_data/nptel/Core%20Science/Mathematics%20I/TOC-middle-M14.html

3. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19MA101.1	Determine inverse, higher integral powers by Cayley Hamilton theorem

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	and convert quadratic form to canonical form by orthogonal transformation.
R19MA101.2	Test the convergence or divergence of series of positive terms and alternating series by various techniques.
R19MA101.3	Classify the extreme values of functions of two variables and functional dependence.
R19MA101.4	Apply integration concepts to compute area of the given surfaces, integrals in cartesian and polar coordinates.
R19MA101.5	Apply triple integration concepts to compute volume of the given surfaces and solid structure and area, volume of the surface using Gamma and Beta functions.

R19PH201	Physics for Information Science	L	T	P	C
		3	0	0	3

1. Course Description:

Physics for information science is a fundamental course designed to provide engineering students with a strong foundation in the field of crystal structures, semiconductors, magnetic as well as superconducting materials and their applications in the realm of information science to cater the need of non-circuit branch students to realize the feasible solutions involving latest technologies and related services.

2. Course Objectives:

1. Inculcating the significance of crystal growth techniques and various crystal structures.
2. Enabling the learners to gain an understanding on the electrical and superconductivity of materials.
3. To set up a thorough insight on basics of semiconducting materials and their engineering applications.
4. To acquire a complete grasp of the fundamentals of magnetic materials and storage applications.
5. Instilling knowledge on performance of modern optoelectronic materials and how they can be utilized in engineering.

3. Syllabus:

Unit-I: Crystal Structure and Crystal Growth

Single crystalline, polycrystalline and amorphous materials, unit cell, crystal systems, Bravais lattices; Miller indices: directions and planes in a crystal, Interplanar distance for a cubic crystal; Coordination number and packing factor for SC, BCC, FCC, HCP structures; Growth of single crystals: Bridgman, Czochralski methods.

Unit-II: Introduction to Solid State

Classical free electron theory: Fermi-Dirac distribution function; Density of energy states; Expression for electrical conductivity, Thermal conductivity, Wiedemann-Franz law, Success and failures; Electrical resistivity of materials: Classification; Superconductors: properties and applications of superconductors.

Unit-III: Review of Semiconductor Physics

Elemental and Compound semiconductors; Intrinsic semiconductor: Carrier concentration derivation, Fermi level, variation of Fermi level with temperature, electrical conductivity, band gap determination; Extrinsic semiconductors: Carrier concentration derivation in n-type

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and p-type semiconductor, variation of Fermi level with temperature, impurity concentration; Hall effect: Determination of Hall Coefficient, applications.
Unit-IV: Magnetic Properties and Data Storage
Origin of magnetic moment, Bohr magneton; Properties of dia, para, ferro, antiferro magnetic materials; Ferromagnetism: Domain theory of Ferromagnetism, different types of energies involved in the domain growth, Hysteresis, Hard and soft magnetic materials, applications; Magnetic semiconductors, Magnetic principle in computer data storage, Magnetic hard disc (GMR sensor).
Unit-V: Modern Optoelectronic Devices
Quantum dot lasers; Photo-transistors; Photodiodes: PIN diodes; APDs; Opto-electronic switches; Solar cells; CCDs; Optoelectronic integrated circuits.
Text Books:
1. Kasap, S.O., "Principles of Electronic Materials and Devices", McGraw-Hill Education, 2007. 2. Umesh K Mishra and Jasprit Singh, "Semiconductor Device Physics and Design", Springer, 2008. 3. Wahab, M.A., "Solid State Physics: Structure and Properties of Materials", Narosa Publishing House, 2009.
References:
Reference Books 1. Halliday, D., Resnick, R. and Walker, J, "Principles of Physics", Wiley, 2015. 2. Avathanulu, M.N. and Kshirsagar, P.G., "Engineering Physics", S. Chand and company, 2014. 3. Arthur Beiser, "Concepts of Modern Physics", Tata McGraw Hill, 2009. 4. Pillai, S.O., "Solid State Physics", New age International Publishers, 7th Edition, 2015. **Journals:** 1.https://journals.sagepub.com/home/jis 2. https://scholars.direct/journal.php?jid=information-science **Video References:** 1. https://www.youtube.com/watch?v=KMcsjCXfLQw&list=PLfIFNJ1DPG4nRLP5qsXn1UWTgAyysZE6- 2. https://www.youtube.com/watch?v=YYgE1fXOT_U **MOOC/NPTEL/SWAYAM Courses:** 1. https://onlinecourses.nptel.ac.in/noc21_ph14/preview 2. https://study.com/academy/lesson/crystalline-structure-definition-structure-bonding.html 3. https://onlinecourses.nptel.ac.in/noc22_ph37/preview

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19PH201.1	Understand the basics of crystals, their structures and different crystal

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	growth techniques.
R19PH201.2	Identify and solve problems concerning physical parameters related to electrical and superconductivity in different situations.
R19PH201.3	Acquire knowledge on basics of semiconductor physics and its applications in various devices.
R19PH201.4	Gain knowledge on magnetic properties of materials and their suitability in engineering applications.
R19PH201.5	Interpret the knowledge on behaviour of modern optoelectronic materials and their applications.

R19CS101	**Problem Solving using C**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

1. Course Description:

This course introduces students to the fundamental concepts of programming using the C language. The course covers essential topics such as basic C programming constructs, conditional and looping statements, modular programming, and advanced concepts like pointers, arrays, and structures. Through theoretical lectures, practical demonstrations, and coding exercises, students will develop problem-solving skills and learn how to design and implement efficient algorithms to solve a variety of complex problems

2. Course Objectives:

1. Equip students with the skills to write robust, readable, and maintainable code for diverse applications.
2. Instruct students on utilizing control structures and functions to manage program flow, make informed decisions, and automate repetitive tasks.
3. Enhance students' abilities in optimizing memory usage and promoting code reusability.
4. Guide students in efficiently organizing and processing data, enabling them to write clean, well-structured code that addresses real-world challenges.
5. Train the students in effectively working with strings, user-defined data types, and file operations.

3. Syllabus:

Unit-I: C Fundamentals

Basic computer organization, Problem-solving techniques, Algorithm, Flowchart, Pseudocode; Introduction to C programming: Phases of a C program, Features of C, Keywords, Variable Name, Scope, Declaration, Coding Standards, Data Types and sizes: integer, float and character types, constants, Formatted I/O, Operators, Bitwise Manipulations, Expression Evaluation, Type Conversions, Preprocessor Directives

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Unit-II: Control Structures
Conditional and Branching Statements: if, if-else, else-if ladder, nested-if, switch constructs, range using switch, Looping constructs: for, while, do-while -break and continue- goto and Label
Unit-III: Pointers and Functions
Pointer - Types of Pointers: NULL, Dangling, Generic Pointers, Wild pointer, Arithmetic Operations in Pointer, Pointer to pointer, Functions: The anatomy of a function, Types of functions, Pointers and Function Arguments: Call by Value and Call by Reference, Function Pointers, return statement, Recursion, Storage Classes
Unit-IV: Arrays
Arrays: Declaring and initializing 1D arrays, Two-dimensional arrays, Multi-dimensional arrays, Variable Length Arrays, Dynamic Memory Allocation, Passing 1D and 2D Array as arguments, Pointers and Arrays, Array of pointers
Unit-V: Strings, User-Defined Data Types and Files
Strings: Introduction – string handling functions, Two-dimensional array of strings, Structure: Basics of structure- Nested structures–Array of structures – Pointer to structures – Unions - Bit Fields-Files: Basics– File Functions - Random Access Files
Text Books:
1. Herbert Schildt, "C – The Complete Reference", Tata McGraw Hill Publishing Company, New Delhi, 2017. 2. Kernighan B. W. and Ritchie D. M., "C Programming Language (ANSI C)", Prentice Hall of India Private Limited, New Delhi, 2010.
References:
Reference Books: 1. Deitel and Deitel, "C How to Program", Pearson Education, New Delhi, 2011. 2. Simple Program Design: A Step-by-Step Approach, Fifth Edition by Lesley Anne Robertson **Video References:** 1. https://www.youtube.com/watch?v=EjavYOFoJJ0&list=PLdo5W4Nhv31a8UcMN9-35ghv8qyFWD9_S 2: https://www.youtube.com/watch?v=irqbmMNs2Bo **MOOC/NPTEL /SWAYAM Courses:** 1. https://onlinecourses.nptel.ac.in/noc22_cs40/preview 2. https://onlinecourses.nptel.ac.in/noc23_cs53/preview

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome

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R19CS101.1	Understand problem-solving techniques and typical programming constructs C
R19CS101.2	Apply looping and conditional constructs to solve real-world problems
R19CS101.3	Apply arrays and functions effectively to address complex programming challenges
R19CS101.4	Understand and apply best practices in pointers, memory allocation and error handling for modular programming efficiency
R19CS101.5	Choose and implement complex data structures using structures and Unions, applying advanced file operations in C for effective problem-solving

R19EC103	ELECTRONICS AND MICROPROCESSORS	L	T	P	C
		3	0	0	3

1. Course Description:

This course provides a comprehensive introduction to the fundamental concepts of electronics and microprocessors, equipping you with the knowledge and skills to design and build basic embedded systems.

2. Course Objectives:

1. To facilitate understanding of semiconductor theory and diode operation
2. To teach BJT and FET operation and biasing techniques
3. To instruct on 8085 microprocessor architecture and assembly programming
4. To teach 8051 microcontroller architecture and instruction set
5. To explain interfacing principles and peripheral devices of the 8051

3. Syllabus:

Unit-I: Diodes and its Applications

Semiconductor – Commonly used semiconductors - intrinsic and extrinsic semiconductor - p type and n type semiconductor - PN junction diode: properties, biasing and VI characteristics –half wave rectifier with output frequency and center tap full wave rectifier with output frequency - Zener diode - Zener diode as voltage stabilizer.

Unit-II: Transistors and Amplifiers

Transistor – Transistor action - Transistor as an amplifier - CB, CE, CC connections and its comparison – transistor biasing - Field effect transistor: types, JFET, working principle, difference JFET and BJT –JFET as an amplifier and its output characteristics – MOSFET: types, circuit operation of D-MOSFET and E-MOSFET.

Unit-III: Introduction to Microprocessor

Introduction to Microprocessor and Buses - 8086 Architecture –Pin description – interrupt processing – operand addressing – assembler directives - instruction set (commonly used instructions only)

Unit-IV: Peripherals and Interface

8255 Programmable Peripheral Interface – 8251 Universal Synchronous and Asynchronous Receiver Transmitter - 8253 Timer – DAC – ADC.

Unit-V: Introduction to Microcontroller

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Introduction to 8-bit microcontroller: 8051 architecture, memory organization, special function registers - port operation - timer/counters - serial interface - interrupts – operand addressing.
Text Books:
1. V.K.Mehta and Rohit Mehta, "Principles of Electronics" S.Chand, 12/e, 2014 (Unit I & II) 2. Krishna Kant, "Microprocessors and Microcontrollers: Architecture, Programming and System Design 8085, 8086, 8051, 8096", PHI, 2013 (Unit III, IV & V)
Reference Books:
1. Robert Boylestad, Louis Nashelsky, "Electronic devices and Circuit theory", Pearson, 11/e, 2015 2. A.K.Ray and K.M.Bhurchandi, "Advanced Microprocessor and Peripherals", MGH, 3/e, 2017 3. Mohammed Ali Mazidi, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Pearson, 2/e, 2012 **Journals:** 1. IEEE Transactions on Electronics Devices 2. Microelectronics Journal **Web Resources:** 1. https://www.allaboutcircuits.com/ 2. https://www.electronics-tutorials.ws/ **MOOC / NPTEL / SWAYAM Courses:** 1. https://onlinecourses.nptel.ac.in/noc22_ee12/preview 2. https://archive.nptel.ac.in/courses/117/103/117103063/

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19EC103.1	Understand the basics of semiconductor theory and working of diodes
R19EC103.2	Understand the working of BJT and FET and Biasing techniques
R19EC103.3	Apply the architecture of 8086 microprocessor and Use instruction set
R19EC103.4	Understand the working of peripheral ICs and its interface with microprocessor
R19EC103.5	Apply the architecture of 8051 microcontroller and instruction set

R19HS151	Technical English	L	T	P	C
		2	0	2	3
1. Course Description:					
This course aims to educate the first year BE/B.Tech students in basic principles of English language, facilitate them to use vocabulary in different academic and professional contexts.					

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It also cultivates their LSRW skills, namely listening, speaking, reading and writing skills thereby improving their proficiency in oral and written communication in technical English. It also covers all the areas of grammar, word formation, summarizing, report writing, which are necessary for the students of engineering sciences.

2. Course Objectives:

1. Enable learners of Engineering and Technology to develop their basic communication skills in English.
2. Emphasize specially the development of speaking skills amongst learners of Engineering and Technology.
3. Ensure that learners use the electronic media such as internet and supplement the learning materials used in the class room.
4. Inculcate the habit of reading and writing leading to effective and efficient communication.

3. Syllabus:

Unit-I: Basic Language Development

Reading: Types of Reading, Skimming and Scanning, Reading Comprehension
Writing: Word Formation, Sequence Words, Types of Sentences, Hints Development, Informal Letters—Congratulating, apologizing, etc Grammar: Parts of Speech, Articles, Tenses.

Unit-II: Different Strategies of Reading

Reading: Articles from Newspapers & Magazines, Cloze Exercises Writing: Instructions, Recommendations, Paragraph Writing Grammar: Homonyms, Homophones, Homographs, Subject – Verb Agreement, Modal Verbs, Question Types, Wh-type, Yes/ No and Tag Questions.

Unit-III: Group Interaction

Reading: Reading for Specific Information & Identifying Lexical and Contextual Meaning
Writing: Formal Letters—Seeking Permission for Industrial Visit, Letter of Invitation (acceptance/declination), Jumbled Sentences
Grammar: Cause and Effect Expressions, Purpose & Function, Compound Nouns.

Unit-IV: Introduction to Effective Writing

Reading: Summarizing, Paraphrasing, Note Making
Writing: Business Letters (Enquiry, Calling for Quotations & Placing Orders), Email-Etiquette, Writing Emails, Free Writing on any given topic
Grammar: Phrasal Verbs, Single Sentence Definitions.

Unit-V: Technical Writing Practice

Reading: Reading Practice based on Competitive Examinations.
Writing: Preparing Transcript for a Speech, Pictorial Representation (Charts —Flowcharts, Pie Charts, Bar Charts, Tabular Column, etc)
Grammar: Single Word Substitute, Abbreviations & Acronyms, Spotting Errors.

List of Exercises:

1. Listening - Listening Types - Listening to Audio files and answering
2. Listening - Listening for specific information – Listening to announcements and Radio Broadcasts
3. Listening - Listening to TED Talks & News Reading from English News Channels (CNN, NDTV, India
4. Today etc.)
5. Listening - Listening Comprehension and answering accordingly.
6. Listening - Listening to Eminent personality interviews & other forms of interviews
7. Speaking - Introducing oneself & family - Role Play

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8. Speaking – Extempore - Just A Minute (JAM) Sessions
9. Speaking - Group Discussion
10. Speaking - Narrating a story
11. Speaking – Compering, Welcome Address & Vote of Thanks

Text Books:

1. Jack C. Richards, "Interchange Student's Book 1", Cambridge University Press; Fourth Edition, 2015.
2. 2. S. N. Mahalakshmi, "Technical English for Engineers", V. K. Publications; Chennai, Eighth Edition, 2020.

References:

Reference Books:

1. Rizvi M.Ashraf, "Effective Technical Communication", Tata McGraw Hill Publishing Company; New Delhi, 2015.
2. Andrea J.Rutherford, "Pearson Education" Inc. and The Darling Kindersley Publishing Inc., 2020.
3. Raman, Meenakshi and Sharma, Sangeetha "Technical Communication Principles and Practice", 4. Oxford University Press; New Delhi, 2019.
4. Richards C. Jack, "Interchange", Fourth edition; Cambridge University Press, 2020.
5. Butterfield, Jeff, "Soft skills for Everyone", Sixth Indian Reprint, 2018.

Video References:

1. https://www.youtube.com/watch?v=tBtc6rpcMz4
2. https://www.youtube.com/watch?v=Ll23cChDSKE
3. https://www.youtube.com/watch?v=fyAtyAdCStM

Web References:

1. https://leo.stcloudstate.edu/grammar/subverag.html
2. http://www.learningdifferences.com/Main%20Page/Topics/Compound%20Word%20Lists/Compound_Word_%20Lists_complete.htm
3. http://examples.yourdictionary.com/examples-of-active-and-passive-voice.html
4. http://www.perfectyourenglish.com/grammar/numeral-adjectives.htm
5. https://en.wikipedia.org/wiki/Commonly_misspelled_English_words
6. https://www.englisch-hilfen.de/en/grammar/if.htm
7. http://www.englishforeveryone.org/Topics/Reading-Comprehension.htm

MOOC/SWAYAM/NPTEL Courses:

1. https://www.udemy.com/topic/communication-skills/free/
2. https://www.bbc.co.uk/learningenglish/english/course/how-to-speak-english

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19HS151.1	Apply basic reading techniques, construct clear sentences for informal correspondence, and enhance grammar and listening skills for effective communication.
R19HS151.2	Analyze complex texts, formulate precise instructions and recommendations, and utilize advanced grammar in spoken communication.

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R19HS151.3	Simplify specific and contextual information, compose formal letters, and actively engage in group discussions.
R19HS151.4	Interpret and take notes proficiently, compose professional documents and emails, and demonstrate strong listening skills.
R19HS151.5	Analyze and create detailed technical documents and visual aids, and deliver formal presentations and conduct interviews with confidence.

R19PH111	**PHYSICS LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

1. Course Description:

This course is designed to lay a strong foundation in Engineering Physics that forms a basis to various branches of Engineering. It helps the students to perform experiments, to correlate theory with experimental data, analyse using graphical representations and present them as part of a clear, well-organized lab report. At the end of the course, students will be able to demonstrate a working knowledge of fundamentals of Physics and communicate their ideas effectively, both orally and in writing.

2. Course Objectives:

To enable the students to

1. Demonstrate competency and understanding of the basic concepts found in experimental Physics.
2. Estimate the error in measurements and the ability to prepare a valid laboratory record.
3. Understand the measurement techniques and usage of instruments in physics.

List of Experiments:

1. Compute the Young's modulus of the given material using uniform bending.
2. Calculate the Rigidity modulus of the given wire using torsional oscillation method.
3. Determine the coefficient of viscosity of given liquid by Poiseuille's flow method
4. Estimate the wavelength of LASER using diffraction grating.
5. Calculate the energy band gap of a given semiconductor diode.
6. Estimate the thermal conductivity of a bad conductor using Lee's Disc Method
7. Enumerate the wavelength of Mercury spectrum using spectrometer
8. Compute and analyse the energy loss using B-H curve of a ferromagnetic material.

Text Books:

1. In house laboratory manual "Physics Manual" prepared by the faculty members (Physics) –Sri Eshwar College of Engineering – Coimbatore.

References:

1. C. L. Arora, "Practical Physics", S. Chand & Co., New Delhi, 3rd Edition, 2012.
2. Dr.T. Radhakrishna, "Practical Physics for Engineering Students", SM Enterprises, 2nd Edition, 2014.

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4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19PH111.1	Develop skills to impart practical knowledge in real time solutions.
R19PH111.2	Interpret and formulate experiments in engineering physics.
R19PH111.3	Develop skills to impart practical knowledge in real time solutions.
R19PH111.4	Design new experiments with practical knowledge.
R19PH111.5	Apply deep knowledge about the solution to theoretical problems.

R19GE111	Engineering Practices Laboratory	L	T	P	C
		0	0	4	2

1. Course Description

The Engineering Practices Laboratory provides hands-on experience and practical training for students to apply theoretical knowledge in engineering disciplines through experiments and projects. The course plays a crucial role in fostering practical skills, enhancing problem-solving abilities, and bridging the gap between theoretical learning and real-world engineering applications. The course equips engineers with practical skills, critical thinking abilities, and hands-on experience essential for tackling real-world challenges and succeeding in their future careers.

2. Course Objectives:

1. To provide exposure to the students with hands on experience on various basic engineering practices in Computer Science, Mechanical, Electrical and Electronics Engineering.
2. To enhance the problem-solving abilities of the students by bridging the gap between the theoretical learning and real-world engineering application.

3. Syllabus

Group A (Computer Science & Mechanical)

Computer Science and Engineering Practices

Assembly & Disassembly

1. Identifying components of disassembling and assembling the PC

Troubleshooting

1. Basic H/W and S/W troubleshooting

Mechanical Engineering Practices

Plumbing

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1. Construction of pipeline using fittings: joints, gate valves, taps, reducers; examine the functions of the plumbing tools.
2. Develop plumbing connection of a residential building involving minor troubleshooting

Basic Machining

1. Inspect the dimension of the given work piece after executing simple lathe operations

Rapid Prototyping

1. Additive Manufacturing of 3D component without support structure
2. Additive Manufacturing of 3D component with support structure

Study and assemble/ maintenance the following (Demonstration only):

1. Different types of pumps, Dynamic: Centrifugal pump, Submersible pump; Positive Displacement: Reciprocating Pump
2. Experimental learning on basic connections with minor troubleshooting of Refrigeration System.
3. Experimental learning on basic connections with minor troubleshooting of Air-Conditioning System.

Group B (Electrical & Electronics)

Electrical Engineering Practices

a) UPS Connection - Hands on exercise on basic electrical connections with UPS Connection

b) Domestic Wiring - Hands on exercise on basic domestic wiring

c) Safety Precautions - Hands on exercise on electrical earthing and safety precautions

d) Renewable Energy - Design of Solar PV System for Residence (Study)

Electronics Engineering Practices

a) Soldering - Study of Electronic Components & Equipment – Soldering Practice

b) Electronics - Study of components of Smart phones

c) Automation Projects - Projects on home automation

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19GE111.1	Perform the basic troubleshooting of the PC including assembly and disassembly.

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R19GE111.2	Identify minor plumbing troubleshooting in residential buildings and develop 3D component by additive manufacturing
R19GE111.3	Inspect work piece after executing basic machining operations like turning, drilling & tapping and minor troubleshooting, maintenance task in an AC & pump/motor.
R19GE111.4	Perform basic domestic wiring of a residential building with provision of inverter and safety measures and Design solar PV System for residence.
R19GE111.5	Execute basic home automation projects.

R19CS111	**PROBLEM SOLVING USING C LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

1. Course Description:

The Problem Solving Using C Laboratory is a practical course designed to complement theoretical knowledge with hands-on experience in programming using the C language. Through a series of laboratory sessions, students will delve into the basic concepts of C programming, including conditional and looping statements, modular programming, and advanced topics such as pointers, arrays, and structures. By actively engaging in coding exercises and projects, students will develop problem-solving skills, algorithmic thinking, and proficiency in implementing efficient solutions to various computational problems.

2. Course Objectives:

1. Instruct students on developing robust, readable, and maintainable code for a variety of applications.
2. Teach students to effectively use control structures and functions to manage program flow, make decisions, and automate repetitive tasks.
3. Enhance students' ability to optimize memory usage and promote code reusability in their programs.
4. Guide students in organizing and processing data efficiently, enabling them to write clean, structured code that addresses real-world problems.
5. Train students in working proficiently with strings, user-defined data types, and file operations.

3. List of Experiments:

1. Develop flow charts and solve simple real-life or scientific or technical problems (Traffic signal control / Water level controller / Temperature control system / Automatic washing machine control system / Automatic Street light control system / Electricity Billing / Retail shop billing /Computing Electrical Current in Three Phase AC circuits) (Minimum 3 problems) (CO1)

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2. Implementation of applications of input and output statements. (Integer, char, Float, string input and output, ASCII value of character, User details) (CO1)

3. Implementation operators and expressions (Centigrade to Fahrenheit, Quotient and Remainder, Kilometres per hour to miles per hour, Hour and Minutes, Profit Calculator) (CO1)

4. Implementation of real-time applications using conditional statements. (Vowel or Consonant, Eligible for casting vote, Leap year or not, Display the description for the given grade, Display number of days in a month, Calculator, Triangle type, Roots of a quadratic equation) (CO1)

5. Implementation of technical applications using iterative loops (Display first N natural numbers, Read N numbers and find their sum and average, find cube of the number up to a given integer, Multiplication table, Sum of N natural numbers, Sum of N natural odd numbers, Pattern printing) (CO2)

6. Implementation of the one-dimensional array (Display the array elements, Elements in reverse order, Sum of array elements, make a copy of array elements, Maximum and minimum, odd sum and even sum) (CO2)

7. Implementation of a two-dimensional and multi-dimensional array (sum, subtraction, transpose, multiplication, frequency of even numbers, print diagonals, sum of diagonal elements, compare) (CO2)

8. Implementation of Functions in the program (Factorial, largest number, area of shape, sum of digits, prime number or not) (CO2)

9. Implementation of real-time applications using recursion (factorial, Fibonacci series, count digits of number, length of string, prime or not, GCD, sum of all digits, palindrome) (CO2)

10. Implementation of a pointer in applications (swap two numbers, print string, read array elements, double pointer, find the maximum number, palindrome, reverse array, dynamic memory allocation) (CO3)

11. Implementation of strings handling functions with and without library functions (compare two strings, reverse, concatenate, copy, palindrome, count number of characters, number of words, find, replace) (CO4)

12. Implementation of file-handling operations (read, write, append file, compare two files, read student details and store into files) (CO4)

13. Implementations of Structure in real-time applications (Accept & display employee details, Calculate total payment of workers, Library operations, Menu-driven program for employee structure) (CO5)

14. Implementations of Union in programs (Accept & display employee details, Calculate total payment of workers, Library operations, Menu-driven program for employee structure) (CO5)

15. Mini Project: Develop an application for any real-world problem

Reference Books:

1. Herbert Schildt, "C – The Complete Reference", Tata McGraw Hill Publishing Company, New Delhi, 2017.

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2. Kernighan B. W. and Ritchie D. M., "C Programming Language (ANSI C)", Prentice Hall of India Private Limited, New Delhi, 2010.

3. Deitel and Deitel, "C How to Program", Pearson Education, New Delhi, 2011.

4. Simple Program Design: A Step-by-Step Approach, Fifth Edition by Lesley Anne Robertson

Video References:

1. https://www.youtube.com/watch?v=EjavYOFoJJ0&list=PLdo5W4Nhv31a8UcMN9-35ghv8qyFWD9_S
2. https://www.youtube.com/watch?v=irqbmMNs2Bo

MOOC/NPTEL /SWAYAM Courses:

1. https://www.udemy.com/course/c-programming-2019-master-the-basics
2. https://www.tutorialspoint.com/cprogramming

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CS111.1	Design solutions for real world problems with programming constructs
R19CS111.2	Solve complex programming problems with arrays and functions
R19CS111.3	Implement dynamic memory addressing techniques with Pointers
R19CS111.4	Implement various error handling techniques for file operations
R19CS111.5	Implement complex data structures such as structures and unions in C to manage and organize data effectively

R19EM101	SOFT SKILLS	L	T	P	C
		0	0	2	1

1. Course Description:

This course on Soft Skills is designed to enhance the professional development of engineering students by refining essential interpersonal and communication skills. It focuses on cultivating critical attributes such as effective communication, active listening, teamwork, leadership, and time management. The course also emphasizes the importance of professional etiquette, advanced communication techniques, technical writing, and the ability to navigate formal and informal contexts. By integrating these elements, students will develop the competencies necessary for successful collaboration, decision-making, and professional growth in the engineering field.

2. Course Objectives:

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1. Develop foundational language skills by reinforcing key communication principles.
2. Instill positive behavioural traits to prepare students for future interactions in the corporate environment.
3. Equip students with the knowledge and skills needed to communicate ideas on social issues, promoting a sense of responsibility and active citizenship.
4. Enhance leadership abilities, teamwork strategies, and the capacity to foster effective connections through impactful communication.
5. Strengthen confidence and public speaking skills by offering experiential learning and techniques to overcome presentation anxiety and communicate effectively in front of an audience.

3. Syllabus:

Unit-I: PERSONALITY AND PROFESSIONAL DEVELOPMENT SKILLS

Interpersonal skills: communication skills, active listening, teamwork, empathy, leadership, motivation, social skills – effective body language – workplace etiquette – types of speeches: memorized speech, manuscript speech, impromptu, and extempore.

Unit-II: ADVANCED COMMUNICATION SKILLS

Word and sentence stress – clear individual sounds – intonation patterns – pronunciation – mother tongue intrusion – tongue twisters - conversation practice: discourse markers, slang, colloquial expressions, collocation - making mini presentations – extending on conservations – collaborative task.

Unit-III: EFFECTIVE COMMUNICATION SKILLS

Verbal and non-verbal communication - formal and informal English – grammatical features: impersonal passives, nominal compounds, third persons, empty verbs, present tense, imperatives, active voice, jargon, cliches – presentation skills - resume preparation - group discussions – mock interviews.

Unit-IV: TEAM SKILLS AND INTERPERSONAL COMMUNICATION

Personal skills: time management, motivating others, assessing alternatives and making decisions, accurate written work, organisational skills, attention to detail, negotiation and mediation skills – public speaking - panel discussion – debates

Unit-V: ENGINEERING JOURNALISM

Technical writing style: accuracy, conciseness, clarity, objectivity – abstract writing – technical documents writing - blogs - editing - copyrights - plagiarism

References:

Reference Books:

1. Norman Lewis, "Word power made easy".2020.
2. Sylvia Reyes," Team Building: The Ultimate Guide to Build & Manage Winning Teams", MC Graw hill, 2014.
3. Dan Clay, how to write the perfect resume 2018.
4. Tyler Hayden," Communication Activities: A Team Building Activity Book", 2019.
5. Ian Tuhovsky, "Communication Skills Training: A Practical Guide to Improving Your Social Intelligence, 2019.
6. Presentation, Persuasion and Public Speaking (Positive Psychology Coaching Series

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Book, 2015.

Magazine References:

1. The IUP Journal of Soft Skills - https.//iupindia.in/softskills.asp
2. Soft Skills Personality Development for Life Success

https://reader.magzter.com/preview/4lf6by5blmhou4q0k43xgh4388150/438815

Video References:

1.https://youtube.com/playlist?list=PLLy_2iUCG87CQhELCytvXh0E_ybOO1_q&feature=shared

2.https://youtube.com/playlist?list=PLzf4HHlsQFwJZel_j2PUy0pwjVUgj7KlJ&feature=shared

3.https://m.youtube.com/watch?feature=shared&v=DUlsNJtg2L8

4. **Course Outcomes:**

After successful completion of the course, the student should be able to:

CO.No.	Course Outcome
R19EM101.1	Understand and apply interpersonal skills to enhance professional interactions and goal-setting.
R19EM101.2	Demonstrate clear and effective communication in reports and presentations to showcase professional skills.
R19EM101.3	Utilize advanced communication techniques to improve verbal and written effectiveness.
R19EM101.4	Analyze team dynamics and personal skills to enhance individual and group performance.
R19EM101.5	Create accurate and concise technical documents to uphold high standards in engineering journalism

SEMESTER II

R19MA104	Linear Algebra	L	T	P	C
		3	1	0	4

1. Course Description:

This course encompasses matrix theory and linear algebra, focusing on concepts applicable across various disciplines. Linear algebra is a branch of mathematics that studies systems of linear equations and the properties of matrices. The course covers the theory of vector spaces and linear transformations as well as practical methods like diagonalization and row-reduction of matrices that can be used to solve problems in mathematical biology, engineering, and economics. It finds widespread use in machine learning for solving linear regression, eigenvalue problems, orthogonalization, matrix inversionand enhancing numerical stability in various algorithms.

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2. Course Objectives:
1. Enhance the knowledge about matrix method to solve linear equations. 2. Introduce the numerical methods to solve linear equations and applications of principal component analysis. 3. To make an inference about vector space and its properties. 4. Impart the knowledge in linear transformations, diagonalization and to quantify eigen values and eigen vectors. 5. Acquaint knowledge in inner product space.
3. Syllabus
Unit-I: Matrices and its Applications
Introduction to Matrices; Elementary matrices; Hermitian; Skew Hermitian; Unitary matrix; Rank of a matrix; Determinants: Properties without proof; Solution of linear equations: Cramer's rule, matrix inversion method, rank method.
Unit-II: System of Linear Equations
System of linear equations: Gaussian elimination, Gauss Jordan methods; LU decomposition; Single value decomposition: Simple problems; Principal component analysis: Definition, Introduction to their application in image processing and machine learning.
Unit-III: Vector Spaces
Introduction to vectors; Vector spaces; Subspaces; Linear combinations and linear system of equations Linear independence and linear dependence; Bases and dimensions.
Unit-IV: Linear Transformation and Diagonalization
Linear transformation: Matrix representation of a linear transformation; Eigen values and eigen vectors; Diagonalizability.
Unit-V: Inner Product Space
Inner products: Orthogonality of vectors; Projections; Gram-Schmidt orthogonalization; QR decomposition.
Text Books:
1. Gilbert Strang, Introduction to Linear Algebra, 5th Edition, ANE Books, 2016. 2. Friedberg, A.H., Insel, A.J. and Spence, L., "Linear Algebra", 4th Edition, Prentice Hall of India, New Delhi, 2004. 3. Grewal B. S., Higher Engineering Mathematics, Khanna Publication, 2017.
References:
Reference Books:
1. Peter V O'Neil, "Advanced Engineering Mathematics", 7th Edition, Thomson Learning, 2011. 2. Lay, D.C., "Linear Algebra and its Applications", 5th Edition, Pearson Education, 2015.
Journal References:
1. International Journal https://www.scirp.org/journal/paperinformation.aspx?paperid=38103

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2. International journal of SVD: https://www.sciencedirect.com/topics/engineering/singular-value-decomposition 3. SIAM Journal on Matrix Analysis and its Applications: https://www.siam.org/publications/siam-journals/siam-journal-on-matrix-analysis-and-applications/ 4. Linear algebra and its applications: https://www.sciencedirect.com/journal/linear-algebra-and-its-applications
Web Resources:
1. https://www.youtube.com/watch?v=JnTa9Xtvmfl 2. https://www.khanacademy.org/math/linear-algebra 3. https://www.youtube.com/watch?v=kjBOesZCoqc 4. https://www.youtube.com/watch?v=lUUte2o2Sn8 5. https://www.youtube.com/watch?v=WwQpG9kIdL4
MOOC/NPTEL/SWAYAM Courses:
1. https://onlinecourses.nptel.ac.in/noc22_ma45/preview 2. https://archive.nptel.ac.in/courses/111/101/111101115/ 3. https://onlinecourses.nptel.ac.in/noc24_ee48/preview

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19MA104.1	Apply basic concepts of matrix method to solve linear equations.
R19MA104.2	Apply analytical concepts and numerical methods of matrix to solve linear equations
R19MA104.3	Apply the concepts of vector space and its properties to solve engineering problems.
R19MA104.4	Examine the characteristics of a linear system with eigen values and vectors.
R19MA104.5	Apply the vector space techniques to study the behaviour of the system.

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R19CS201	DATA STRUCTURES	L	T	P	C
		3	0	0	3

1. Course Description:

This course provides a comprehensive introduction to data structures. Students will delve into the principles behind organizing and manipulating data efficiently, covering a wide array of topics including lists, stacks, queues, sorting algorithms, searching techniques, hashing, trees, and graphs. Through a combination of theoretical lectures, practical coding exercises, and real-world applications, students will gain a solid understanding of how to select and implement the appropriate data structures and algorithms to solve complex computational problems.

2. Course Objectives:

1. To build and work with linear and nonlinear data structures like arrays, linked lists, stacks, queues, trees, and graphs.
2. To discover data structures to solve real-world problems and scenarios, demonstrating understanding of trade-offs and limitations
3. To equip students skills in designing, implementing, and analyzing tree-based solutions to complex problems
4. To familiarize and working with algorithms, including traversal, shortest paths, and network flow, to solve complex problems
5. To implement and analyze sorting, searching, and hashing techniques to optimize data retrieval and manipulation in various contexts

3. Syllabus

Unit-I: Linked Lists

Arrays vs Linked list; Linked lists: types, singly linked list, doubly linked list, singly circular linked list, doubly circular linked list, operations, insertion, deletion, find, reverse, modifying linked list; Floyd's cycle finding algorithm: slow pointer and fast pointer

Unit-II: Stacks and Queue

Stack: implementation using array and linked list, Operations: push, pop; Applications: infix to postfix conversion, processing function calls; Queue: implementation using array and linked list, enqueue, dequeue, priority queue, circular queue; Applications: call log management

Unit-III: Trees

Terminologies; Binary Trees: implementation, traversals, expression trees, cousins of a binary tree; Binary Search Trees: construction, insertion, deletion, searching, find-min, find-max; AVL Trees: insertion, deletion; Priority Queues: heaps; Applications: dictionary, text processing

Unit-IV: Graphs

Representation; Types; Traversals: Depth First Search (DFS), Breadth First Search (BFS); Dijkstra's algorithm; Topological sort; Minimum Spanning Tree (MST): Prim's, Kruskal's algorithm; Applications: traffic redirection problem, travelling salesman problem

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Unit-V: Sorting, Searching and Hashing
Internal sorting: bubble, insertion, quick; External sorting: merge sort; Searching: linear search, binary search; Hashing: hash table, hash functions, collision resolution techniques; Applications: Telephone Directories, Spell Checker, Design of Game Boards
Text Books:
1. Reema Thareja, "Data Structures Using C", Second Edition, Oxford University Press, 2019 2. Seymour Lipschutz," Data Structures using C", First Edition, McGraw Hill Education, 2017
References:
Reference Books: 1. Narasimha Karumanchi "Data Structures and Algorithms Made Easy" Fifth Edition, Career Monk publications,2023. 2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education, 2020. **Video References:** 1. https://www.geeksforgeeks.org/data-structures 2. https://www.javatpoint.com/data-structure-tutorial 3. https://www.udemy.com/course/datastructurescnepp/ **MOOC/NPTEL /SWAYAM Course:** 1. https://in.coursera.org/learn/data-structures?action=enroll

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CS201.1	Apply the concepts of linked lists by demonstrating and understanding of their implementation and usage to solve given problems
R19CS201.2	Construct stacks and queues using arrays and linked lists and apply these structures to appropriate scenarios
R19CS201.3	Implement tree data structures and their operations to enhance data management and retrieval systems
R19CS201.4	Assess graph-based algorithms to solve complex problems requiring efficient data traversal and manipulation
R19CS201.5	Examine sorting, searching and hashing algorithms to organize and retrieve data effectively

R19CY101	Engineering Chemistry	L	T	P	C
		3	0	0	3
1. Course Description:					
This course provides the Bachelor of Engineering students a solid foundation in the concepts and applications of chemistry that are pertinent to engineering disciplines. The					

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goal of this course is to provide students with the knowledge and abilities required for a variety of engineering specialties By fusing fundamental chemical principles with engineering applications, this course gives an insight to the engineering students for optimum utilization of resources in scientific, research, technological and industrial application.

2. Course Objectives:

1. To gain the abilities necessary to become an ideal engineer and to be flexible enough to adjust to new advancements in Engineering Chemistry.
2. Including the value of water for industrial use, the basic principles of battery chemistry, and the need to prevent corrosion in order to safeguard structures.
3. To study innovative methods and up-to-date chemical knowledge that inspires pupils to communicate well and express themselves.
4. To gain the necessary understanding of engineering materials, such as glass refractories, cement, and Nanomaterials.

3. Syllabus

Unit-I: Electrochemistry and Corrosion

Basics of electrochemistry; Electrochemical cell: Reversible and irreversible cell; EMF measurements; Standard Weston Cadmium cell; Nernst equation and problems; Electrodes: single electrode potential; Types of electrodes: Calomel electrode; Electrochemical series: Significance; Conductometric titration; Potentiometric titration.

Corrosion: Definition, Classification, mechanism; Factors influencing corrosion; Corrosion control: Sacrificial anode and cathodic protection method; Corrosion inhibitors; Electroplating of Nickel and chromium; Paints: Constituents and their function.

Unit-II: Water Technology

Introduction; Hardness of water: Determination of hardness of water by EDTA method; Alkalinity of water: Types of alkalinity, Estimation of alkalinity; Domestic water treatment: Pre-treatment, Removal of suspended impurities, Disinfection methods; Boiler feed water: Requirement of boiler feed water, Boiler troubles: scales and sludges; Treatment of boiler feed water: External treatment: Zeolite process, ion exchange method; Internal treatment method; Desalination: Reverse Osmosis.

Unit-III: Chemical Thermodynamics

Introduction to thermodynamics; Terminologies; Laws of Thermodynamics (only definitions): second law; Entropy as a thermodynamic quantity; Entropy change of an ideal gas: reversible and irreversible process, physical transformations; Clausius inequality theorem; Free energy and work function: Helmholtz and Gibbs free energy function, problems; Gibbs Helmholtz equation, problems; Clausius Clapeyron equation; Maxwell relation; Van't Hoff isotherm and its applications.

Unit-IV: Chemistry of Materials

Refractories; Classification, criteria of good refractory, properties and its application; Manufacture of Alumina, Magnesite and Silicon carbide.

Glass: Manufacture of glass by tank furnace method, Types and properties of glass.

Cement: Portland cement; Comparison and Manufacture by rotary kiln technology; Chemistry of setting and hardening of cement; Role of gypsum.

Nanomaterials; Carbon nano tubes; shape memory alloys; C60 fullerene; Liquid crystals: properties and its application.

Unit-V: Polymer Technology

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Introduction; Terminologies; molecular weight of polymers (only definition); Classification of polymers: natural and synthetic, thermoplastics and thermosetting plastics; Types and mechanism of polymerization: addition (free radical), condensation and copolymerization; Properties of polymers; some commercial thermosetting resin: Phenol formaldehyde resin, Amino resins, Silicone resins; some thermoplastics: Polyethylene, PVC, polyvinyl acetate.

Text Books

1. R.Rathinam.,"Engineering Chemistry", Pearson India Pvt.Ltd,2nd edition,2019.
2. S.Vairam and Subha Ramesh .,"Engineering Chemistry", Wiley India, Delhi, 2015.
3. S P.C.Jain and M.Jain. "Engineering Chemistry", Dhanpat Rai Publishing Company, 16th Edition, New Delhi, 2017.
4. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.

References

Reference Books

1. O.G. Palanna, "Engineering Chemistry" McGraw Hill Education (India) Private Limited, 2nd Edition, 2017.
2. J.C Kuriacase& J Raja ram, Engineering Chemistry, Tata McGraw Hills Co. New Delhi, 2004.
3. S.S. Dara and S.S. Umare., "A Text book of Engineering Chemistry", S. Chand Publishing, 12th Edition, 2014.
4. A. Pahari and B.Chauhan., "Engineering Chemistry", Laxmi Publications, 2nd Edition 2010
5. Devender Singh, Balraj Deshwal, Sathish Kumar.,"Comprehensive Engineering Chemistry", IK International, 2007.
6. H. K. Chopra, A. Parmer., "Chemistry for Engineers", Narosa Publishing House, 2016.

Journals:

1. https://onlinelibrary.wiley.com/journal/15272648
2. https://link.springer.com/journal/10800
3. https://benthamopen.com/TOTHERJ/home/

4 https://www.scimagojr.com/journalsearch.php?q=13540&tip=sid

Video References:

1. https://www.youtube.com/watch?v=l2ENx_Y0dNU

2 https://www.youtube.com/watch?v=hZIMFBuP8zc

3. https://www.youtube.com/watch?v=9GMBpZZtjXM
4. https://www.youtube.com/watch?v=x5OD2KZXd54
5. https://www.youtube.com/watch?v=k_RErdKwaAg

MOOC/SWAYAM/NPTEL Courses:

1. https://nptel.ac.in/courses/113104059/lecture_pdf/Lecture%209.pdf
2. https://nptel.ac.in/courses/Webcourse-contents/IIT-

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KANPUR/wasteWater/Domestic%20Water%20TS.htm

3. https://onlinecourses.swayam2.ac.in/nou24_es03/preview

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CY101.1	Apply the principles of electrochemistry and corrosion in engineering.
R19CY101.2	Understand the quality of water, and its treatment methods.
R19CY101.3	Apply the concepts relevant to thermodynamics.
R19CY101.4	Understand the Engineering materials.
R19CY101.5	Understand the science of polymer and polymer reactions.

R19CS104	APPLICATION DESIGN AND DEVELOPMENT	L	T	P	C
		2	2	0	4

1. Course Description:

Application Design and Development is a comprehensive integrated course that blends theoretical understanding with practical hands-on experience in creating diverse applications. Students will delve into essential web development concepts using HTML, CSS, and JavaScript, mastering the foundations of building interactive and responsive web interfaces. Additionally, they will learn version control using Git and GitHub, enabling collaborative development and effective management of project iterations. Furthermore, students will explore mobile application development using MIT App Inventor, gaming application development with Construct 2, and image/video editing using Blender tools. Through a combination of theoretical lectures, interactive labs, and project-based learning, students will gain the skills necessary to design, develop, and deploy various types of applications.

2. Course Objectives:

1. To design and build visually appealing and interactive web pages using HTML and CSS, creating a strong foundation for web development
2. To make students to create dynamic and interactive web pages using JavaScript, enhancing user experience and adding functionality to web applications
3. To create and manage Git repositories how to collaborate using GitHub, including forking, cloning, and pull requests
4. To develop mobile applications for Android devices using MIT App Inventor's visual blocks programming
5. To create 2D games using Construct 2 and edit multimedia content using Blender

3. Syllabus:

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Unit-I: HTML and CSS
Software Development: SDLC (Waterfall Model)- Phases - Methods and Practices-Introduction to web- Standards and Terminologies.HTML: Introduction and versions-HTML 5-standards and tags-Head and Body-List-Labels-Tables-Forms-Videos and Audios-Figure, Figure Captions, Images CSS: Introduction-Embedded Types-CSS Selectors-Borders, Margins, Paddings-Colors and Backgrounds- Introduction to Bootstrap-Tailwind CSS **Applications:** Static website design for an organization, Report building, Color Palette design
Unit-II: Interactive Web Design using JavaScript
Introduction-Java Script adding Techniques-Variables and Operators- Conditional and Control Statements- Data Types and Functions-Events-Form Validation-Page Redirect-Java Script Exception Handling-Document Object Model (DOM) **Applications:** Dynamic website design for an organization, Picture Slideshow, Weather Forecast Report
Unit-III: Git, Git Hub and Shell Scripting
Introduction to Git and GitHub-Terminologies-Local Repository Actions- Remote Repository Actions- Advanced Repository Actions-Branching-Merging-Software Developers Communities: Google Developers Group, Google Student Developers Community, Linux Developer Community, Stack Overflow, Kaggle Shell Scripting: Processing (PS) and Listing (LS)- File Creations and Handling-Users and Groups **Applications:** Setting up local repository, Managing multiple branches, CRUD with Shell scripting
Unit-IV: Mobile Application Development with MITAI
Types of Mobile OS (Android and IOS)-Architecture- Phases of Mobile Application Development -MIT app inventor-Components-Viewer-Properties – Publishing an app **Applications:** Talk to me, Ball Bounce, Digital Doodle, Mood Ring, Translation App, To do list, Opinion Pool, Map the movement
Unit-V: Template-Driven Applications and Multimedia
Content Management System: Dynamic content-Web flow - Collection fields – Search Engine Optimization, Multimedia: Design with Canva and Blender- Image and Video Editing –Game Development with Construct 2 **Applications:** Creative blog development, My Portfolio, Simple games (Ball bouncing, Brick ball game, Model Building)
Text Books:
1. Internet & World Wide Web How to Program, 5th edition, by Paul Deitel Harvey Deitel, Abbey Deitel, Pearson Publication, 2018. 2. App Inventor 2: Create Your Own Android Apps 2nd Edition by David Wolber, Hal Abelson, Ellen Spertus, Liz Looney, 2014.
Reference Books:

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1. CS50's Web Programming with Python and JavaScript - https://cs50.harvard.edu/web/2020
2. Get Coding! Learn HTML, CSS & JavaScript & Build a Website, App & Game – by Young Rewired State, Walker Books, 2016.
3. Version Control with Git, by Jon Loeliger, Matthew McCullough, 2nd Edition, 2012.
4. Ultimate-web-design-course-https://university.webflow.com/courses/ultimate-web-design- course

Web References:

1. https://www.w3schools.com/html/html_css.asp
2. https://www.javatpoint.com/javascript-tutorial
3. https://www.freecodecamp.org/news/introduction-to-git-and-github/
4. https://appinventor.mit.edu/explore/ai2/tutorials
5. https://www.construct.net/en/tutorials/beginners-guide-construct-47
6. https://www.blender.org/support/tutorials/

MOOC/NPTEL /SWAYAM Courses:

1. https://in.coursera.org/learn/html-css-javascript-for-web-developers
2. https://amigoscode.com/p/git-github

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CS104.1	Utilize HTML5 and CSS to develop responsive web
R19CS104.2	Create Interactive web applications using JavaScript
R19CS104.3	Analyze and apply GIT and GIT HUB operations and advanced repository actions
R19CS104.4	Create mobile applications using MIT app inventor
R19CS104.5	Create simple game applications using Construct

R19CS151	Python Programming	L	T	P	C
		3	0	2	4

1.Course Description:

This course covers the fundamental concepts and practical applications of Python programming. Students will explore topics ranging from basic data types and expressions to advanced data manipulation and visualization techniques. The course will explores into programming paradigms, emphasizing Python's versatility in supporting imperative, functional, and object-oriented programming styles. Through hands-on exercises, projects and real-world examples, students will develop a strong foundation in Python programming, enabling them to write efficient, readable and maintainable code for a variety of applications.

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2.Course Objectives:

1. To make students to write efficient, readable, and well-structured code
2. To choose and use data structures such as lists, tuples, dictionaries and sets in Python programs
3. To make students to effectively organize, structure, and manage Python code using files, modules, and packages
4. To implement object-oriented programming constructs in Python
5. To use libraries for data analysis in Python and use Django framework for web application development

3.Syllabus

Unit-I: Data, Expressions, Statements

Introduction: Python Interpreter and interactive mode, comments, Identifiers and Keywords; Data types: int, float, Boolean, String; Variables and Expressions; Operators: types, precedence

Illustrative Programs: Financial application, Health care application

Unit-II: Programming Paradigms

Conditional Statements: conditional (if), alternative (if-else), chained conditional (if-elif-else); Looping Statements: while, for; Jump Statements: break, continue, pass; Fruitful Functions: return values, parameters, local and global scope, function composition, recursion; Strings: slices, immutability, functions and methods; Python-DB connectivity

Illustrative Programs: Towers of Hanoi, Kadane's Algorithm, and Chocolate Distribution Algorithm

Unit-III: Lists, Tuples and Dictionaries

Lists: operations, slices, methods, loop, mutability, aliasing, cloning, parameters, lists as arrays; Tuples: assignment, tuple as return value; Dictionaries: operations and methods; Sets: operations

Illustrative Programs: Dutch National Flag Algorithm, Count and Say Problem

Unit-IV: Files, Modules and Packages

Files: text files, reading and writing files; Format Operator; Command Line Arguments; Error and Exception Handling; Modules; Packages; Introduction to Tkinter; Introduction to Open CV

Illustrative Programs: Word count, File copying

Unit-V: Data Manipulation and Data Visualization

NumPy: Basics of NumPy Arrays; Computations: Universal Functions; Aggregations: Min-Max and Everything In Between; Pandas: Objects, Data Indexing and Selection, Data Operations, Handling Missing Data; Matplotlib: Types of plots, Simple Line Plots, Boxplots, Simple Scatter Plots

Case study: Analyze the performance of cricket players and plot a graph

3.List of Laboratory Experiments / Exercises:

1. Design a flowchart to address a real-world problem of your choice.
   Suggested Problems: Traffic signal control / Water level controller / Temperature control system / Automatic washing machine control system / Automatic Street light control system / Electricity Billing / Retail shop billing/Computing Electrical Current in Three Phase AC circuits (Minimum three problems)
2. Create a Python application that uses expressions and control flow statements to automate a common task. Ensure that your application is user-friendly and robust to different inputs.

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Suggested Problems: Swap two numbers without a temporary variable, Quadratic Equation, Valid Palindrome

3. Implement a Python program that simulates a real-world system or process using conditions and iterative loops.
   Suggested Problems: check whether an alphabet is a vowel or consonant, sum of all even numbers from 0 to n, factorial of a number
4. Implementation of real-time/technical applications using Lists and Tuples(Minimum Index Sum of Two Lists, Concatenate two lists index-wise, Tuple with the same product, Copy specific elements from one Tuple to a new tuple)
5. Implementation of real-time/technical applications using Set and Dictionaries (Magic Dictionary, Longest Word in Dictionary, Set Mismatch and Smallest Number in Finite Set)
6. Implementation of Functions in the program (Factorial, largest number in a list, area of shape)
7. Implementation of Strings in the program (Determine if string halves are alike, palindrome, character count, replacing characters)
8. Implementation of file-handling operations (copy from one file to another, word count, longest word)
9. Implementation of libraries (Pandas, NumPy, Matplotlib)
10. Implementation of applications of standard libraries (Handle scalars to work on the NumPy array, Insert values at random positions in an array, Convert the index of a series into a column of a data frame, Combine many series to form a data frame, Get frequency counts of unique items of a series, Union of two arrays, Convert a NumPy array to a data frame of a given shape, Plotting datasets)
11. Mini Project: Develop an application for any real-world problem

Text Books:

1. Al Sweigart, "Automate the Boring Stuff with Python: Practical Programming for Total Beginners," 2nd Edition, No Starch Press, 2019
2. Liang Y. Daniel, "Introduction to Programming Using Python", Pearson Education, 2017
3. Alan D. Moore, "Python GUI Programming with Tkinter: Develop responsive and powerful GUI applications with Tkinter," Packt Publishing Limited, 2018

References:

References Books:

1. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-Disciplinary Approach," Pearson India Education Services Pvt. Ltd., 2016
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist," Second edition, Updated for Python 3, Shroff O'Reilly Publishers, 2016
3. Timothy A. Budd," Exploring Python," Mc-Graw Hill Education (India) Private Ltd., 2015

Web Resources:

1. https://www.coursera.org/specializations/python
2. https://jakevdp.github.io/PythonDataScienceHandbook/02.00-introduction-to-numpy.html

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MOOC/NPTEL /SWAYAM Courses:

1. https://www.coursera.org/specializations/python
2. https://www.coursera.org/learn/python-crash-course
3. https://NPTEL.ac.in/courses/106106145

4.Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CS151.1	Apply syntax and semantics of Python programming language for developing real-world applications
R19CS151.2	Write python functions to facilitate code reuse and manipulate strings
R19CS151.3	Develop Python solutions by implementing lists, tuples, and dictionaries
R19CS151.4	Apply advanced skills in utilizing built-in functions for file system applications
R19CS151.5	Analyse data manipulation and visualization and demonstrate them in real time applications

R19CS211	DATA STRUCTURES LABORATORY	L	T	P	C
		0	0	4	2

1. Course Description:

The Data Structure Laboratory is a hands-on course designed to complement theoretical knowledge with practical implementation skills in data structures. Through a series of lab sessions, students will work on implementing code and projects focusing on lists, stacks, queues, sorting algorithms, searching techniques, hashing, trees and graph data structures. By actively engaging in coding exercises and projects, students will deepen their understanding of the course, enhance their programming skills, and gain valuable experience applicable across various computer science and engineering domains.

2. Course Objectives:

6. To build and work with linear and nonlinear data structures like arrays, linked lists, stacks, queues, trees, and graphs.
7. To discover data structures to solve real-world problems and scenarios, demonstrating an understanding of trade-offs and limitations
8. To equip students' skills in designing, implementing, and analyzing tree-based solutions to complex problems
9. To familiarize and working with algorithms, including traversal, shortest paths, and network flow, to solve complex problems
10. To implement and analyze sorting, searching, and hashing techniques to optimize data retrieval and manipulation in various contexts

3. List of Experiments:

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1. Develop a Multimedia Library Management System that organizes and manages various types of multimedia content such as audio, video, and images. Each type of content requires a different approach for efficient management. Choose a suitable linked list operation for each multimedia category's specific needs. (C01)
2. Demonstration of applications of Linked List (Reversal Problems, Segregation of Even and Odd nodes in Linked List, Palindrome checking using Linked List, Loop Detection, Sorting the biotonic using doubly linked list) (CO1)
3. Build a critical software project for a large healthcare organization that processes and manages a high volume of patient data, requiring efficient and reliable data structures for task management, resource allocation, and communication. Select appropriate data structures (stacks and queues) for specific use cases, considering their performance characteristics, flexibility, and memory usage.(C02)
4. Demonstration of applications of Stack and Queue (Evaluating Postfix Expressions, Infix to Postfix conversion, Balancing symbols and Postfix evaluation, Wild card pattern matching(CO2)
5. Develop a movie recommendation system for a popular streaming platform that recommends movies to users based on their past watching history and preferences. Use a binary tree data structure to store and search for movies based on different criteria efficiently. (CO3)
6. Build an online bookstore with a vast collection of books to manage the inventory efficiently and provide a seamless user experience with the help of a Binary Search Tree (BST) data structure.(CO3)
7. Demonstration of applications of Trees (Segment Tree and Range Minimum Query on the Constructed Segment Tree, Maximum depth of Binary tree) (CO3)
8. Design a network for any food delivery partner to understand how people are connected, and how information flows through the network and identify influential users using graph traversal algorithms. (CO4)
9. Construct a travel management system that aims to streamline the planning and organization of travel itineraries for a travel agency. The system utilizes various graph algorithms (Topological Sort, Connected Graph and Ticket Itinerary) to efficiently manage the complexities of travel planning. (CO4)
10. Design a food delivery app for a bustling city. Thousands of orders flow daily, and ensuring fast and efficient delivery is crucial for customer satisfaction. Use Dijkstra's algorithm to find the shortest paths for delivery drivers, optimizing their routes and minimizing delivery times.(CO5)
11. Design an optimized network infrastructure of an organization that connects the various departments within the organization using the minimum amount of cabling to reduce costs and enhance network efficiency. Implement Prim's and Kruskal's algorithms for finding the Minimum Spanning Tree (MST) for the network. (CO5)
12. Create a Student Grade Management System for a university that efficiently organizes and displays student grades for various courses. The system should employ different sorting algorithms to cater to diverse requirements and optimize the display of grades. Choose the suitable sorting algorithms (Bubble Sort, Insertion Sort, Quick Sort, Merge Sort) for quick grade overview, mark entry, course ranking and overall grade report. (CO5)
13. Develop a Product Inventory Management System for a retail company that handles a large number of products to implement efficient searching techniques to retrieve

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information about products in the inventory quickly. Select the appropriate searching technique (Linear Search, Binary Search) for quick product lookup, inventory sorting, and retrieval. (CO5) 14. Demonstration of applications of hashing (Single swap sorted array, Anagram Checking and Range Minimum Query Using Sparse Table, Merge two sorted arrays) (CO5)
References Books:
1. Reema Thareja, "Data Structures Using C", Second Edition, Oxford University Press, 2019 2. Narasimha Karumanchi "Data Structures and Algorithms Made Easy" Fifth Edition, Career Monk publications,2017 3. Seymour Lipschutz, "Data Structures using C", First Edition, McGraw Hill Education, 2017 **Web Resources:** 1. https://www.geeksforgeeks.org/data-structures 2. https://www.javatpoint.com/data-structure-tutorial **MOOC/NPTEL /SWAYAM Courses:** 1. https://www.udemy.com/course/datastructurescncpp/ 2. https://in.coursera.org/learn/data-structures?action=enroll

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CS211.1	Solve Problems by applying the concepts of Linked Lists
R19CS211.2	Implement Stacks and Queues with Array and LinkedList and solve problems with Stacks and Queues
R19CS211.3	Implement tree data structures and demonstrate tree operations such as insertion, deletion, traversal and balancing
R19CS211.4	Implement the graph-based algorithms to solve complex problems requiring efficient data traversal and manipulation
R19CS211.5	Apply sorting, searching and hashing algorithms to organize and retrieve data effectively

R19CY111	Chemistry Laboratory	L	T	P	C
		0	0	2	1
1. Course Description:					
Engineering students can gain practical experience and understanding of chemical principles necessary for engineering practice which will help them to get exposed to fundamental laboratory procedures, improve their comprehension of chemical topics to build their critical thinking and problem-solving abilities.					
2. Course Objectives:					

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1. To equip engineering students with precise measurement techniques, safe chemical handling, proper equipment usage, and adherence to experimental protocols.
2. Through hands-on experiments, reinforce theoretical concepts from lectures, providing practical insights into chemical phenomena, reactions, and properties.
3. To develop critical thinking through engaging in experimental design, data analysis, and problem-solving to apply scientific reasoning, identify errors, and address challenges, fostering a stronger grasp of the scientific method.
4. To cultivate teamwork by collaborating in group lab activities, enhancing communication, task delegation, and cooperation skills essential for success in engineering and beyond.
5. To prioritize safety protocols and hazard awareness to instill a safety-oriented mindset, ensuring responsible conduct and risk mitigation during experiments.

3. Syllabus:

List of Experiments:

1. Determination of total, permanent and temporary hardness of water by EDTA method.
2. Estimation of copper in brass by EDTA method.
3. Determination of alkalinity and TDS of water sample.
4. Estimation of chloride content in water by Argentometric method.
5. Determination of strength of acid by Conductometric titration (strong acid Vs strong base & strong base vs mixture of acids).
6. Determination of strength of given hydrochloric acid using pH meter.
7. Estimation of ferrous ion content of the given solution using Potentiometer.
8. Determination of do content of water sample by Winkler's method.

Text Book:

1. R.Rathinam.," Chemistry Lab Manual", Gems Publishers, 2019.

References:

1. Vogel's, "Text book of Quantitative Chemical Analysis", Pearson Publications, 2014.
2. Daniel C Harris, "Quantitative Chemical Analysis", W. H. Freeman and Company, New York, 7th Edition 2007.

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CY111.1	Analyse the role of water quality related parameters.
R19CY111.2	Design the engineering materials against corrosion.
R19CY111.3	Competent in applying the Argentometric method to precisely determine

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	the chloride content in water, as well as in data analysis, laboratory procedures, and safety protocol observation.
R19CY111.4	Execute conductometric titrations and implement your understanding about the estimation of the substance from the given sample through data interpretation.
R19CY111.5	Implement the electrochemical methods to measure the concentration and amount of unknown chemical substances by validating the data using calibration techniques essential for quantitative analysis.

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R19MC101	தமிழர் மரபு / Heritage of Tamils	L	T	P	C
		1	0	0	1

1. Course Description / பாடநெறி விளக்கம்

This course is taught to provide insight to the students into the rich culture and heritage of the state. The students should know the valued things such as historic buildings that have been passed down from previous generations and relating to things of Tamil historical and cultural value that are worthy of preservation. This course explains the growth of nationalism, the growth of the Tamil language, various religious reformers, the spread of the Dravidian movement and its possible impact on society, the role of the self-respect movement, educational development in Tamilnadu since independence and the growth of fine arts in Tamilnadu.

மாநிலத்தின் வளமான கலாச்சாரம் மற்றும் பாரம்பரியம் பற்றிய நுண்ணறிவை மாணவர்களுக்கு வழங்க இந்த பாடநெறி கற்பிக்கப்படுகிறது. முந்தைய தலைமுறையினரிடமிருந்து பெறப்பட்ட வரலாற்று கட்டிடங்கள் மற்றும் தமிழ் வரலாற்று மற்றும் கலாச்சார மதிப்புள்ள விஷயங்கள் பாதுகாக்கப்பட வேண்டிய மதிப்புமிக்க விஷயங்களை மாணவர்கள் அறிந்து கொள்ள வேண்டும். தமிழ்நாட்டின் தேசியத்தின் வளர்ச்சி, தமிழ் மொழியின் வளர்ச்சி, பல்வேறு சமய சீர்திருத்தவாதிகள், திராவிட இயக்கத்தின் பரவல் மற்றும் சமுதாயத்தில் அதன் தாக்கம், சுயமரியாதை இயக்கத்தின் பங்கு, சுதந்திரத்திற்குப் பிறகு தமிழகத்தில் கல்வி வளர்ச்சி மற்றும் தமிழகத்தில் நுண்கலைகளின் வளர்ச்சி பற்றி இந்த பாடநெறி விளக்குகிறது.

2. Course Objectives / பாடத்தின் நோக்கங்கள் :

1. To make an inference about language and traditional of the state.
   மாநிலத்தின் மொழி மற்றும் பாரம்பரியம் பற்றி அனுமானிக்க உதவுகிறது.
2. To acquire knowledge in construction of status and various musical instruments
   கட்டிடக்கலை மற்றும் பல்வேறு இசைக்கருவிகளை உருவாக்குவதற்கான அறிவைப் பெறுதல்.
3. To study the detailed information about folklore and paramilitary arts.
   நாட்டுப்புறவியல் மற்றும் ராணுவக் கலைகள் பற்றிய விரிவான தகவல்களைப் படிக்க உதவுகிறது.
4. To gain knowledge of rich culture and success history of ancient kingdoms.
   பண்டைய ராஜ்யங்களின் வளமான கலாச்சாரம் மற்றும் வெற்றி வரலாற்றைப் பற்றிய அறிவைப் பெற உதவுகிறது.
5. To acquaint the student with the knowledge of Siddha medicine and about the Indian freedom struggle.
   சித்த மருத்துவம் மற்றும் இந்திய சுதந்திரப் போராட்டம் பற்றிய அறிவை மாணவருக்கு அறிமுகப்படுத்துதல்.

3. Syllabus / பாடத்திட்டங்கள்:

Unit-I / அலகு-I: Language and Literature / மொழி மற்றும் இலக்கியம்

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Language Families in India – Dravidian Languages – Tamil as a Classical Language – Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature – Management Principles in Thirukkural – Tamil Epics and Impact of Buddhism & Jainism in Tamil Land – Bakthi Literature Azhwars and Nayanmars – Forms of minor Poetry – Development of Modern literature in Tamil – Contribution of Bharathiyar and Bharathidhasan.

இந்திய மொழி குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மைக் கருத்துகள் - தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழிலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

Unit-II / அலகு - II: Heritage–Rock Art Paintings to Modern Art –Sculpture / மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை - சிற்பக்கலை

Hero stone to modern sculpture – Bronze icons – Tribes and their handicrafts – Art of temple car making – Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments – Mridhangam, Parai, Veenai, Yazh and Nadhaswaram – Role of Temples in Social and Economic Life of Tamils.

நடுக்கல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினை பொருள்கள், பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரி முனையில் திருவள்ளுவர் சிலை – இசைக் கருவிகள் – மிருதங்கம், பறை, யாழ், வீணை, நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு

Unit-III / அலகு-III: Folk and Martial Arts / நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance – Sports and Games of Tamils.

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம் - தமிழர்களின் வீர விளையாட்டுகள்.

Unit-IV / அலகு-IV: Thinai Concept of Tamils / தமிழர்களின் திணைக்கோட்பாடுகள்

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature – Aram Concept of Tamils – Education and Literacy during Sangam Age – Ancient Cities and Ports of Sangam Age – Export and Import during Sangam Age – Overseas Conquest of Cholas.

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தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு - சங்க காலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் - சங்க கால நகரங்களும் துறை முகங்களும் - சங்க காலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல் கடந்த நாடுகளில் சோழர்களின் வெற்றி.

Unit-V/ அலகு-V: Contribution Of Tamils To Indian National Movement And Indian Culture / இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு

Contribution of Tamils to Indian Freedom Struggle – The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement – Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிற்பகுதியில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுய மரியாதை இயக்கம் - இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

Text Books:

1. தமிழக வரலாறு - மக்களும் பயன்பாடுகளும் - கே கே பிள்ளை (தமிழக பாட நூல் கழகம் மற்றும் கல்வியல் பணிகள் கழகம்).
2. கணினித் தமிழ் - முனைவர் இல .சுந்தரம் (விகடன் பிரசுரம்) .
3. கீழடி - வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளீயீடு).
4. பொருநை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு).
5. Social Life of Tamils - Dr.K.K.Pillay, A joint publication of TNTB & ESC and RMRL – (in print).
6. Social Life of the Tamils - The Classical Period - Dr.S.Singaravelu (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils - Dr. S. V. Subatamanian, Dr. K. D. Thirunavukkarasu (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture - Dr.M.Valarmathi (Published by: International Institute of Tamil Studies).
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation Tamil Nadu).
10. Studies in the History of India with Special Reference to Tamil Nadu - Dr.K.K.Pillay.

References:

1. Journey of Civilization Indus to Vaigai - R. Balakrishnan, Published by: RMRL.
2. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

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4. Course Outcomes/ பாடநெறி முடிவுகள்:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome / பாடநெறி முடிவுகள்
R19MC101.1	To know about the language families in India, the impact of the religions, and the contribution of Bharathiar and Bharathidhasan. இந்தியாவில் உள்ள மொழி குடும்பங்கள், மதங்களின் தாக்கம், பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு பற்றி தெரிந்து கொள்வது.
R19MC101.2	Observe the growth of sculpture making of musical instruments and the role of temples in socio and economic lives. தமிழர்களின் வாழ்வில் இசைக்கருவிகள், சிற்பங்களை உருவாக்கும் முறைகள், சமூக, பொருளாதார வளர்ச்சி மற்றும் கோவில்களின் பங்களிப்பு பற்றி அறிந்து கொள்வது
R19MC101.3	Understand the significance of folklore and martial arts. நாட்டுப்புறவியல் மற்றும் தற்காப்புக் கலைகளின் முக்கியத்துவத்தைப் புரிந்து கொள்வது.
R19MC101.4	Learn the Sangam literature, Sangam age and overseas conquest of Cholas. சங்க இலக்கியம், சங்க காலம் மற்றும் சோழர்களின் வெற்றிகள் ஆகியவற்றைக் கற்றுக்கொள்வது.
R19MC101.5	Understand the contribution of Tamils to the Indian freedom struggle and the role of Siddha medicines. இந்திய சுதந்திரப் போராட்டத்தில் தமிழர்களின் பங்களிப்பு, சித்த மருந்துகளின் பங்கு ஆகியவற்றைப் புரிந்து கொள்வது.

SEMESTER III

R19MA203	Discrete Mathematics	L	T	P	C
		3	1	0	4

1. Course Description:

Discrete mathematics is a foundational course that focuses on mathematical structures and techniques used in computer science, information technology, and other fields. It deals with discrete, countable structures such as integers, graphs, sets, and logic. This course covers a wide range of topics including logic and proof techniques, set theory, functions and relations, combinatorics, graph theory. It emphasis on developing problem-solving skills and mathematical reasoning.

2. Course Objectives:

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1. Familiarze the students to verify the correctness of an argument using symbolic logic and truth tables.
2. Introduce various techniques in combinatorics and solving recurrence relations.
3. Impart them with the basic concepts of graph theory.
4. Familiarize the applications of algebraic structures.
5. Inculcate effectively the concepts and results of congruence.

3. Syllabus

Unit-I: Propositional Calculus

Propositions: Logical connectives, compound propositions, tautology, contradiction; Logical equivalences and implications; Principal disjunctive and conjunctive normal forms; Predicates; Quantifiers; Rules of inference: validity of arguments.

Unit-II: Combinatorics

Permutations and combinations; Inclusion and exclusion principle; Pigeonhole principle; Mathematical induction; Recurrence relations: Solving linear recurrence relations using generating function.

Unit-III: Graph Theory

Graphs: Types of graphs, matrix representation of graphs, walk, path, circuit; Graph isomorphism using adjacency matrix and circuits; Euler graph; Hamiltonian graph.

Unit-IV: Algebraic Structures

Algebraic structures with one binary operation: Groups, properties of groups, subgroup, cosets, Lagrange's theorem, Normal subgroup; Group homomorphism and isomorphism: Cayley's theorem, fundamental theorem on homomorphism.

Unit-V: Number Theory

Division algorithm; Base-b representations; Number patterns; Linear Diophantine equations; Congruence: Simultaneous linear congruences, Chinese Remainder Theorem (statement only), Wilson's theorem, Fermat's theorem, Euler's Theorem.

Text Books:

1. Kenneth H. Rosen," Discrete Mathematics and its Applications", 7th Edition, Tata McGraw – Hill Pub. Co. Ltd, New Delhi, 2011.
2. Thomas Koshy, "Elementary Number Theory with Applications", Elsevier Publications, New Delhi, 2002.

References:

Reference Books:

1. Tremblay J.P and Manohar R, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw–Hill Pub. Co. Ltd, New Delhi, 30th Reprint, 2011.
2. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", Prentice – Hall, Engle Cliffs, N. J, 1974.

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3. San Ling and Chaoping Xing, "Coding Theory – A first Course", Cambridge Publications, Cambridge, 2004.
Journal References:
1. SIAM Journal on Discrete mathematics. https://www.siam.org/publications/siam-journals/siam-journal-on-discrete-mathematics/ 2. International journal of Discrete mathematics https://www.sciencepublishinggroup.com/journal/605/home
Web Resources:
1. https://www.youtube.com/watch?v=xlUFkMKSB3Y 2. https://nptel.ac.in/courses/106106094/32 3. www.nptel.ac.in/courses/106108054/ 4. https://nptel.ac.in/courses/106104149/2 5. https://www.youtube.com/watch?v=qPtGlrb_sXg
MOOC/NPTEL/SWAYAM Courses:
1. http://www.nptelvideos.in/2012/11/graph-theory.html 2. http://nptel.ac.in/courses/111107058/20 3. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-042j-mathematics-for-computer-science-fall-2010

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19MA203.1	Apply principles and fundamental concepts of inference theory in proving and testing the logic.
R19MA203.2	Use induction techniques, generating functions and basics of counting principle to solve mathematical statements.
R19MA203.3	Examine the types of circuits in a graph, the existence of isomorphism and sketch the Euler and Hamiltonian paths and circuits in a graph.
R19MA203.4	Apply the concept of algebraic structures with one or more binary operations.
R19MA203.5	Apply integrated approach to number theory provide a firm basis.

R19CS205	Design and Analysis of Algorithms	L	T	P	C
		3	0	0	3

1. Course Description:

This course explores the fundamental principles of algorithmic design and analysis, equipping students with the essential tools to tackle complex computational problems efficiently. Through a comprehensive exploration of various algorithmic techniques, including Brute Force, Divide-and-Conquer, Dynamic Programming, Greedy Approach, Backtracking, and Branch and Bound, students will gain a profound understanding of how to formulate, analyze and optimize algorithms for diverse applications. Through hands-on exercises, projects and theoretical discussions, students will develop the skills necessary to

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design algorithms, assess their efficiency, and make informed decisions regarding algorithm selection for real-world problems.
2. Course Objectives:
1. To familiarize the student with analysis of algorithmic efficiency, including time and space complexity, to evaluate and compare algorithm performance. 2. To make students to work on efficient solutions to complex problems using brute force and divide-and-conquer techniques 3. To acquaint students with dynamic programming techniques to solve complex optimization problems. 4. To enable students to understand and apply the greedy approach to solve optimization problems. 5. To Equip students with the problem-solving strategies of backtracking and branch and bound problems.
3.Syllabus
Unit-I: Algorithm Analysis Techniques
Notion of an algorithm , Importance & role of algorithms in computing , Important problem types ; Analysis of algorithmic efficiency , Time and Space Complexity , Asymptotic notations and their properties ; Analysis framework: Mathematical analysis for recursive and non-recursive algorithms; String Algorithms: Naïve algorithm , Rabin Karp Algorithm , KMP Algorithm , Manachers algorithm
Unit-II: Brute Force and Divide-And-Conquer
Brute force: Selection sort , String matching , Exhaustive search , Boyer Moore algorithm , Travelling salesman problem , Knapsack problem , Assignment problem , Huffman codes and data compression; Divide and Conquer: Binary search , Quick sort , Heap sort , Multiplication of large integer
Unit-III: Dynamic Programming
Ugly numbers ; Coin changing problem ; Friends pairing problem ; Golomb sequence ; Warshall's algorithm , Floyd's algorithm , Multi stage graph , Optimal binary search trees , Fractional Knapsack Problem , K Knight's tour on chess board
Unit-IV: Greedy Approach
Definition , Activity selection problem , Longest common subsequence , Sieve of Sundaram , Assign mice to holes; Huffman trees , Sparse matrix , Bloom filter
Unit-V: Backtracking and Branch and Bound
Backtracking, Rat in maze , Permutation and Combination , N Queen problem , Hamiltonian circuit problem , Knight's tour problem , Subset sum problem , Graph Coloring ; Branch and Bound: Assignment problem , Knapsack problem , Travelling salesman problem

Text Book:
1. Anany Levitin — Introduction to the Design and Analysis of Algorithms, Third Edition, Pearson Education, 2017
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Reference Books:

1. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, —Introduction to Algorithms, Third Edition, PHI Learning Private Limited, 2022
2. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, Computer Algorithms/ C++, Second Edition, Universities Press, 2008

Web Resources:

1. https://www.javatpoint.com/daa-tutorial
2. https://www.geeksforgeeks.org/design-and-analysis-of-algorithms/

MOOC/NPTEL /SWAYAM Courses:

1. https://onlinecourses.nptel.ac.in/noc24_cs23/preview
2. https://www.udemy.com/course/design-and-analysis-of-algorithm

4.Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CS205.1	Understand the importance of designing strategies, time and space complexity
R19CS205.2	Apply brute force and divide and conquer strategies in solving problems
R19CS205.3	Apply dynamic programming in solving complex problems
R19CS205.4	Apply greedy algorithms in solving optimization problems
R19CS205.5	Compare the time and space complexities of different types of algorithms

R19CS202	Database Management Systems	L	T	P	C
		3	0	0	3

1. Course Description:

This course offers a comprehensive exploration of Database Management Systems (DBMS) theory, focusing on essential concepts and principles underlying the design, implementation and optimization of databases. Students will explore into various topics, including an Introduction to Databases, Structured Query Language (SQL) & Procedural Language/SQL (PL/SQL), Transaction and Concurrency Control, Storage & Indexing, and NoSQL databases. The students will gain a deep understanding of database architectures, data modelling techniques, query languages, transaction management strategies, storage mechanisms, indexing methods and the role of NoSQL databases in modern data management.

2. Course Objectives:

1. To enable students to understand the fundamental concepts and principles of database management.
2. To teach students to master the database querying and programming using SQL and PL/SQL

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3. To foster students to learn the principles and mechanisms of transaction processing and concurrency control 4. To familiarize students to design and implement efficient database storage and indexing solutions 5. To acquaint students to effectively use NoSQL databases to build scalable, high-performance applications
3.Syllabus:
Unit-I: Introduction to Databases
Purpose of Database , Types and examples of Databases (RDBMS, NOSQL, In-memory Databases & Distributed SQL databases) , Relational Database System Architecture ; Views of Data , Schema architecture , Data Independence , Schema and instance ; Data Models , Benefits and Phases of Data Model ; ER Diagram: Symbols , Components , Relationships , Weak entities , Attributes , Cardinality , Extended ER Diagram , Examples ; Relational Data Model ; Keys ; Relational Algebra ; Normalization: 1NF, 2NF, 3NF, BCNF,4NF,5NF; **Case Study:** ER Diagram on Online Streaming, Movie Ticket Recommendation, Bike Tracking
Unit-II: SQL & PL/SQL
SQL Fundamentals : DDL Commands , Create, Drop, Alter, Truncate, Rename ; Keys : Primary Key, Candidate Key, Super Key, Foreign Key ;DML Commands , DQL Commands : Select, Insert, Update, Delete, Any, All, In, Exists, Non-Exists, Union, Intersection ; Advanced SQL Features , Aggregate Functions : SUM, COUNT, AVG, MIN, MAX, EXPLAIN, COALESCE ; Clauses , Order By , Group By, Having, CASE, LIMIT,WITH Clause, Date Functions, String Functions ; Subqueries , Nested, Correlated, Joins : Inner, Outer, and Equi-Joins ; Order of Execution, Embedded SQL , Dynamic SQL ; Creation and Dropping of Views, Types of Views , Creation and Execution of Stored Procedures , Cursors : Opening, Fetching, and Closing ; Triggers : Creation, Insertion, Deletion, and Updating Database ; Exception Handling ; MySQL JDBC Connectivity **Case Study:** Online Streaming, Movie Ticket Recommendation, Bike Tracking, Import/Export Random records from CSV file to MYSQL
Unit-III: Transaction and Concurrency Control
Transaction processing: ACID Properties , Failure and Recovery , Schedules , Serializability , Concurrency Control , Lock-based protocol , Isolation levels ; SQL Facilities for concurrency and recovery , Database Integrity, Security and Authorization **Case Study:** ACID Properties in Online Streaming Database
Unit-IV: Storage & Indexing
Overview of Storage Techniques : File organization , RAID ; Indexing : Types of ordered indices , B & B+ tree ; Hashing : Static & Dynamic Hashing , Query Processing & Optimization , SQL Performance Tuning **Case Study:** Indexing in Online Streaming Database to optimize the retrieval of data
Unit-V: NOSQL
Need for NO SQL , Characteristics of NOSQL , Key-value database , Columnar Databases , Apache Cassandra , Click House , Document Databases , MongoDB : CRUD operations

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with MongoDB , MongoDB JDBC Connectivity , MongoDB Testing , Graph Databases , Metabase **Case study:** Conversion of Online Streaming Database (RDBMS) to MongoDB
Text Books:
1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, — "Database System Concepts", Seventh Edition, Tata McGraw Hill, 2019 2. RamezElmasri, Shamkant B. Navathe, —"Fundamentals of Database Systems", Sixth Edition, Pearson Education, 2014
References:
References Books: 1. C.J.Date, A.Kannan, S.Swamynathan, —"An Introduction to Database Systems", Eighth Edition, Pearson Education, 2013 2. KrisitnaChodorow, "MongoDB – The Definitive Guide", O' Reilly, 2013 **Web References:** 1. https://www.youtube.com/playlist?list=PLsjUcU8CQXGFFAhJI6qTA8owv3z9jBbpd 2. https://www.youtube.com/watch?v=c5HAwKX-suM 3. https://youtu.be/FNYdBLwZ6cE 4. https://youtu.be/qEhNHOEa5sE **MOOC/NPTEL /SWAYAM Courses:** 1. https://onlinecourses.NPTEL.ac.in/noc23_cs41/preview 2. https://codewithmosh.com/p/complete-sql-mastery 3. https://www.udemy.com/course/nosql-databases-for-beginners/

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CS202.1	Use data models and depict a database system
R19CS202.2	Design relations for various business requirements
R19CS202.3	Understand the properties of the database and recovery process
R19CS202.4	Understand the optimization techniques in database storage
R19CS202.5	Design non-structured database systems in application development

R19CS203	Object Oriented Programming using Java	L	T	P	C
		3	0	0	3
1.Course Description:					
This course provides students with a comprehensive understanding of the principles,					

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mechanisms and advanced features of the Java programming language. Starting with the Foundations of Java, students will build a solid understanding of basic syntax, data types, control structures, and object-oriented concepts. They will explore into Object-Oriented Mechanisms, mastering topics such as classes, objects, inheritance, polymorphism and encapsulation. The course also covers essential Java libraries and features, including Strings, Collections, Java 8 Features, Exception Handling, and Multithreading. Additionally, students will explore JavaFX for graphical user interface (GUI) development and JDBC for database connectivity, enhancing their proficiency in Java application development.

2.Course Objectives:

1. To understand object-oriented programming concepts and the basics of java programming language
2. To know the principles of packages, inheritance and interfaces
3. To understand strings & collections with java 8 features
4. To develop a Java application with exception handling and threads
5. To develop windows-based applications with jdbc

3.Syllabus:

Unit-I: Foundations of Java

Overview of OOP – Object oriented programming paradigms – Features of Object-Oriented Programming – Java Buzzwords – Overview of Java – JVM - JDK – Programming Structures in Java – Classes & its types in Java - Data Types, Variables – Operators – Keywords - Control Statements – Wrapper Classes – Constructors - Methods - Access specifiers - Arrays & its types – java.util. Arrays - Java Doc comments - I/O classes

Unit-II: Object Oriented Mechanisms

Association – Aggregation – Composition - Polymorphism – Overloading Vs Overriding – Static and Dynamic Binding - Inheritance - Basics – Types of Inheritance – Super, static & final keywords with inheritance and polymorphism – Abstraction - Abstract Classes and Interfaces - Encapsulation - Packages – Access modifiers

Unit-III: Strings, Collections & Java 8 Features

Strings, creation, declaration of a string, storage structure of a string and its methods, StringBuilder, String Buffer, regex - Collection Interface – Generics - List, Set, Map interfaces and classes, Comparable - Comparator – Java lambda expressions – Date & time Object in java 1.8 and its functions – Streams

Unit-IV: Exception Handling and Multithreading

Exception handling - Hierarchy, Types of exception, Mechanisms - try, catch, throw, throws and finally, Exception Propagation - Exception in Inheritance - Introduction to Multiprocessing - threads vs process – threads - Creation of thread - Thread states - Thread Lifecycle and its methods, Executor Framework, Concurrency API, Synchronization Blocks

Unit-V: JAVAFX & JDBC

JAVAFX Events and Controls: Event Basics – Handling Key and Mouse Events. Controls: Checkbox, ToggleButton – RadioButtons – ListView – ComboBox – ChoiceBox – Text

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Controls – ScrollPane. Layouts – Flow Pane – HBox and VBox – Border Pane – Stack Pane – Grid Pane. Menus – Basics – Menu bars – Menu Item - JDBC – drivers, Steps to create a JDBC application- DB Connection Pool
Text Books:
1. Herbert Schildt, "Java: The Complete Reference", 12th Edition, McGraw Hill Education, New Delhi, 2019 2. Cay S.Horstmann., "Core Java Fundamentals", Volume 1, 11th Edition, Prentice Hall, 2018
References:
References Books: 1. Deitel P and Deitel H, "Java: How to Program", 11th Edition, Prentice Hall, 2018 2. James Gosling, Bill Joy, Guy Steele, Gilad Bracha, Alex Buckley and Daniel Smith, "The Java Language Specification – Java SE", 13th Edition, Oracle America Inc., USA, 2019 3. Matt Weisfeld, "The Object-Oriented Thought Process", 5th Edition, Addison-Wesley Professional, US, 2019 **Video References:** 1. https://www.youtube.com/@abdul_bari/videos 2. https://www.youtube.com/@JennyslecturesCSIT 3. https://caveofprogramming.teachable.com/p/java-multithreading **MOOC/SWAYAM/NPTEL Courses:** 1. https://www.udemy.com/course/java-se-programming/ 2. https://cse.iitkgp.ac.in/~dsamanta/java/index.htm 3. https://caveofprogramming.teachable.com/p/java-for-complete-beginners

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CS203.1	Understand the core concepts of Java programming
R19CS203.2	Understand the principles of object-oriented programming
R19CS203.3	Understand the concepts of strings and collections
R19CS203.4	Apply exception-handling & multithreading concepts in applications
R19CS203.5	Apply JavaFX & JDBC in application development

R19AD251	Data Science	L	T	P	C
		3	0	2	4
1. Course Description:					
The course aims to provide students with a comprehensive understanding of data science, covering key concepts, methodologies, and tools essential for data analysis, interpretation, and decision-making. Students will learn to collect, preprocess, and analyze data from					

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various sources using statistical techniques and machine learning algorithms. Students will gain practical experience in applying data science methods to real-world problems. By the end of the course, students will be equipped with the knowledge and proficiency needed to extract valuable insights from data, make informed decisions, and contribute effectively to the rapidly evolving field of data science.
2. Course Objectives:
1. Gain a foundational understanding of data science concepts and methods. 2. Develop the ability to collect, clean, and manage data. 3. Learn how to analyse data using statistical and machine learning techniques. 4. Develop the ability to solve real-world problems using data science. 5. Develop an understanding of the ethical implications of data science
3. Syllabus
Unit-I: Basics of Data Science
Data science: need for data science, various data science disciplines, connecting to data science disciplines, reason behind these disciplines, popular data science techniques, data science related to other fields; computational thinking; Data science life cycle. different/popular tools available for data science, data exploration, feature engineering, applications.
Unit-II: Data Acquisition and Exploration
Data collection and management: Introduction, sources of data, data collection and APIs, data pre-processing techniques: data analysis and data analytics: descriptive analysis, diagnostic analytics, predictive analytics, prescriptive analytics. Exploratory analysis, data pre-processing, handling missing values, dealing with outliers, categorical to numerical conversion
Unit-III: Statistics
Statistics: role to statistics, probability concepts, axioms of probability; probability distributions: Poisson, Normal, Binomial, Uniform; distribution properties, measures of central tendency, mean and variance of a Discrete and continuous random variable, covariance and correlation, Central limit theorem.
Unit-IV: Roles – Data Science
Introduction to Python, Installing Python and Jupyter, variables and data types, Operators, Conditional Statement, Python Functions, Sequence, Iteration, Modules and Packages;Data Engineering: Cloud (GCP) and ETL tools. Introduction to Data Engineering ,Extract (GCP Console, Cloud SDK, client libraries) Loading (Cloud Storage, PUB/Sub) Transformation (Cloud Functions, Cloud Dataflow, Cloud Dataproc); Data Analyst: Tableau, SQL Connect to data and edit a data source, Sort, filter, and group data, Use the Tableau workspace to create visualizations, Build a range of essential chart types for analysis, Create basic calculations, including quick table calculations; Build interactive dashboards to reveal data insights, Describe how to share and publish visualizations.
Unit-V: Data Modelling with Machine Learning Algorithms
Introduction to ML: Types of machine Learning Models, Supervised learning: Linear regression, Logistic regression, Naive Bayes, Support vector machines, Model selection and feature selection, Ensemble methods: Bagging, boosting. Unsupervised learning: Hierarchical clustering, K-means clustering, Evaluating and debugging learning algorithms.
List of Experiments: 1. Data Acquisition using REST API, requests module and beautiful soup package. 2. Plot and generate different types of probability distributions. 3. Plotting normal distribution and perform normality test using Q-Q plot. 4. Exploratory Data Analysis (EDA) 5. House Price prediction using linear regression.

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6. Medical diagnosis for disease spread pattern using logistic regression.
7. Customer segmentation in business model based on their demographic, psychographic and behavioural data.
8. Customer churn classification using decision tree and random forest on telecom data.
9. Behavioural analysis of online shoppers' intention for online purchase model using KNN Model.
10. Creating an interactive dashboard using Tableau.

Text Books:

1. Avrim Blum, John Hop croft, and Ravindran Kannan," Foundations of Data Science", Springer-2018.
2. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.
3. Cathy O'Neil, Rachel Schutt, "Doing Data Science, Straight Talk from The Frontline", O'Reilly, 2013.

References:

Reference Books:

1. Dean J, "Big Data, Data Mining and Machine learning", Wiley Publications, 2014.
2. Provost F and Fawcett T, "Data Science for Business", O'Reilly Media Inc, 2013.

Web Resources:

1. https://www.ibm.com/topics/data-science
2. https://ischoolonline.berkeley.edu/data-science/what-is-data-science/
3. https://www.coursera.org/browse/data-science

MOOC/SWAYAM/NPTEL Courses:

1. https://onlinecourses.nptel.ac.in/noc21_cs69/preview
2. https://onlinecourses.nptel.ac.in/noc22_cs32/preview

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19AD251.1	Apply the fundamentals of data science for effective contribution to real-world applications.
R19AD251.2	Apply the various data collection and exploration techniques to analyze the data.
R19AD251.3	Analyze the distribution of data using various statistical measures.
R19AD251.4	Design interactive dashboards using suitable data science tools to reveal the insights of data.
R19AD251.5	Implement different machine learning algorithms for real time applications.

R19CS215	Design and Analysis of Algorithms Laboratory	L	T	P	C
		0	0	4	2

1. Course Description:

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In this practical course students will immerse themselves in the application of foundational algorithm techniques to real-world problems. Through hands-on exercises, coding assignments and project work, students will gain practical experience in Algorithm Analysis Techniques, including Brute Force, Divide-and-Conquer, Dynamic Programming, Greedy Approach, Backtracking and Branch and Bound. By implementing these algorithms in various programming languages, students will develop a deep understanding of their operation, efficiency and applicability across different problem domains. Through iterative refinement and experimentation, students will hone their algorithmic design skills, learning to optimize solutions for performance and scalability.

2. Course Objectives:

1. Instruct students on analyzing algorithmic efficiency, including time and space complexity, to evaluate and compare algorithm performance.
2. Guide students in developing efficient solutions to complex problems using brute force and divide-and-conquer techniques.
3. Teach students dynamic programming techniques for solving complex optimization problems.
4. Enable students to understand and apply the greedy approach for solving optimization problems.
5. Equip students with problem-solving strategies using backtracking and branch-and-bound techniques.

3. List of Experiments:

1. Implementation of string algorithms (CO1)
2. Demonstration of applications of string algorithms (Naïve algorithm, Rabin Karp Algorithm, KMP Algorithm and Manachers algorithm) (CO1)
3. Implementation of brute force and divide-and-conquer techniques (CO1)
4. Demonstration of applications of brute force and divide and conquer techniques (Boyer Moore algorithm, Travelling salesman problem, Knapsack problem, Assignment problem, Jump game, Maximum subarray, Merge Intervals, Tiling problem, Karatsuba algorithm) (CO2)
5. Implementation of dynamic programming (CO3)
6. Demonstration of applications of dynamic programming (Warshall's algorithm, Floyd's algorithm, Knapsack Problem, Longest Common Subsequence, Levenshtein distance (Edit distance) problem, Longest palindrome, Longest common substring, Longest happy string, Palindrome partitioning, Minimum coin change, Equal subset sum partition, Wildcard matching, longest repeated subsequence)(CO4)
7. Implementation of Greedy approach(CO4)
8. Demonstration of applications of Greedy approach (Activity Selection Problem, Graph Colouring Problem, Huffman coding compression algorithm, shortest superstring problem, Flip the world, Dials algorithm, Minimum spanning tree, Sieve of sundaram, Remove invalid parenthesis, Maximum ribbon cut) (CO4)
9. Implementation of backtracking and branch & bound(C05)
10. Demonstration of applications of backtracking and branch & bound (Queen problem, Hamiltonian circuit problem, Knight's tour problem, Subset sum problem, Sudoku Solver, Letter combinations of a phone number, Combinatorial optimization

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problems, Zigzag conversion, Valid Sudoku, People holding hands, Reverse pairs) (CO3 , CO4, CO5)

Mini project: Create a simple gaming application

References:

Reference Books:

1. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, Computer Algorithms/ C++, Second Edition, Universities Press, 2008

Web Resources:

3. https://www.javatpoint.com/daa-tutorial
4. https://www.geeksforgeeks.org/design-and-analysis-of-algorithms/
5. https://www.udemy.com/course/design-and-analysis-of-algorithm

MOOC/NPTEL /SWAYAM Course:

1. https://onlinecourses.nptel.ac.in/noc24_cs23/preview

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcomes
R19CS215.1	Implement various algorithm design strategies in a programming environment and analyze their time and space complexities
R19CS215.2	Apply brute force, divide and conquer strategies for sorting and searching tasks
R19CS215.3	Implement dynamic programming solutions for complex optimization and pathfinding problems
R19CS215.4	Apply greedy algorithms to solve optimization problems
R19CS215.5	Analyze the time and space complexities of different algorithms

R19CS212	Database Management Systems Laboratory	L	T	P	C
		0	0	2	1

1. Course Description:

This practical course offers hands-on experience in essential database concepts and technologies. Students will explore into Introduction to Databases, mastering the fundamentals of data modelling and relational database design. They will then explore Structured Query Language (SQL) and Procedural Language/SQL (PL/SQL), acquiring skills in querying and manipulating data. Through practical exercises, students will learn Transaction and Concurrency Control techniques, ensuring data integrity and consistency in multi-user environments. Additionally, they will gain proficiency in Storage & Indexing, optimizing database performance through efficient data storage and retrieval strategies. Finally, students will explore NoSQL databases, understanding their unique characteristics and applications in modern data management scenarios

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2. Course Objectives:

1. To enable students to understand the fundamental concepts and principles of database management.
2. To teach students to master the database querying and programming using SQL and PL/SQL
3. To foster students to learn the principles and mechanisms of transaction processing and concurrency control
4. To familiarize students to design and implement efficient database storage and indexing solutions
5. To acquaint students to effectively use NoSQL databases to build scalable, high-performance applications

3.List of Laboratory Experiments

1 ER Diagrams (CO1)

Create an Entity Relationship model for the above applications

2 SQL Queries (CO2)

Develop the SQL Queries using the following commands for the database

a. DDL commands - Create, alter (Add, Modify, Rename), Truncate, Drop commands

b. DML commands - Insert, Update, and Delete commands

c. DQL commands - Select and its basic operations

d. DCL commands - Commit, Rollback, and Savepoint operations

e. TCL commands - Grant and Revoke operations for the different users

3 Implementation of Key constraints(CO2)

a. Build the Integrity Constraints - Unique, NOT NULL, Auto Increment, Primary Key, Foreign Key, Check, Default constraints for the given databases

4 Advanced SQL Queries(CO2)

Implementation of Aggregate Functions

a. Find the total count of all the records in the table

b. Find the average value of a specific column in the table

c. Find the maximum/min/sum value of a specific column in the table

d. Find the count of all distinct values in a specific column in the table

5 Implementation of Group By Clause(CO2)

a. Find the average/max/min/sum of all values of a specific column for each group records in the table

b. Find the count/average/max/min of all records in the table grouped by multiple columns

6 Implementation of OrderBy Clause(CO2)

a. Sort the list of all records in the table by multiple columns/specific columns

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in ascending or descending order

b. Find the top/ bottom 10 records in the table sorted by a specific column/multiple columns

c. Find the list of all records in the table sorted by a specific column/multiple columns and limited to a certain range

7 Implementation of String Functions(CO2)

a. Find the length of characters in a specific string

b. Find the leftmost/rightmost portion of a specific string up to a certain character or length

c. Find the specific portion of a string extracted using a regular expression pattern

d. Find the specific string with all occurrences of a certain character or pattern replaced with another character or string

e. Find the specific string converted to uppercase or lowercase

f. Find the specific string with leading or trailing whitespace characters removed

g. Find the specific string with a certain character or substring removed or replaced

h. Find the specific string with a certain character or substring added at a certain position

i. Find the specific string with all occurrences of a certain substring concatenated with another substring

8 Implementation of Date function(CO2)

a. Find the current date and time in MySQL

b. Find the day of the week for a specific date in MySQL

c. Find the month/year for a specific date in MySQL

d. Find the difference between two specific dates in MySQL

e. Find the date in MySQL after adding/subtracting a specific number of days to a specific date.

f. Find the number of days/average time between two specific dates in MySQL

g. Find the earliest or latest date in a specific column of the table in MySQL

9 Implementation of Nested queries(CO3)

a. Find the maximum/min/count/sum/average/distinct count value of a specific column in the table for a specific subset of records selected using a nested query

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b. Find the average/max/sum/count/min value of a specific column in the table where the value of another column is equal to a specific value selected using a nested query

c. Find the maximum value of a specific column in the table for a specific subset of records selected using a nested query within another nested query

10 Implementation of Joins(CO3)

a. Find the result of an inner/left/right/full outer/cross joins between two/multiple tables on a specific column in MySQL

11 Construction of Index(CO3)

a. Create an index for the database and show the comparative analysis of Query execution time with and without using an index for the given scenario

12 Implementation of views(CO3)

a. Perform the DDL, DML, and DQL operations on the views and check the consistency of the relations

b. Create different types of views and their categories of the REFRESH command.

c. Implement the materialized views with Aggregate and Join queries

13 PLSQL(CO4)

Develop a program in PLSQL using Before/After trigger, row, and statement trigger and instead of trigger

a. Develop a program in PLSQL using Before/After trigger, row, and statement trigger and instead of trigger.

b. Create a trigger and check for the before/after insertion, update, and deletion operations in the table.

14 NOSQL(CO5)

Implementation of MongoDB application and run through CRUD operations

a. Command to create a collection and a document in MongoDB

b. Command to insert/update/delete a document in a MongoDB collection

c. Command to query a MongoDB collection to retrieve documents that meet certain criteria

d. Command to use aggregation pipelines to perform more complex queries in MongoDB

e. Command to create an index in MongoDB to improve query performance

15 Create tables and execute the queries using Click House(CO5)

a. Command to create a table, view, and functions

b. Command to insert the data in a table from compressed files, Infiles, and

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multiple files

c. Command to query the data using the SELECT, WHERE, JOIN, GROUPBY, HAVING clauses

d. Command to query the data using the Regular, Aggregate, and Table functions

Design a project for the following application using JDBC Connectivity

- Online Food Ordering System
- Online Movie Ticket Booking System
- Online Parking System
- Online Hotel Room Booking System

References:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, —"Database System Concepts", Sixth Edition, Tata McGraw Hill, 2013
2. Ramez Elmasri, Shamkant B. Navathe, —"Fundamentals of Database Systems", Sixth Edition,Pearson Education, 2014
3. NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence – "Sadalage, P. & Fowler, Pearson Education, 2013

References:

References Books:

1. C.J.Date, A.Kannan, S.Swamynathan, —"An Introduction to Database Systems", Eighth Edition, Pearson Education, 2013
2. KrisitnaChodorow, "MongoDB – The Definitive Guide", O' Reilly, 2013

Web References:

1. https://www.youtube.com/playlist?list=PLsjUcU8CQXGFFAhJI6qTA8owv3z9jBbpd
2. https://www.youtube.com/watch?v=c5HAwKX-suM
3. https://youtu.be/FNYdBLwZ6cE
4. https://youtu.be/qEhNHOEa5sE

MOOC/NPTEL /SWAYAM Courses:

1. https://onlinecourses.NPTEL.ac.in/noc23_cs41/preview
2. https://codewithmosh.com/p/complete-sql-mastery
3. https://www.udemy.com/course/nosql-databases-for-beginners/

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CS212.1	Demonstrate the ability to identify, define, and analyze complex problems using ER diagram
R19CS212.2	Write queries for different business requirements

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R19CS212.3	Implement Joins, Nested queries and built in functions for different database applications
R19CS212.4	Design and implement reusable PL/SQL procedures, functions and triggers that encapsulate business logic and perform complex data manipulations efficiently
R19CS212.5	Analyze data storage design and implement the operations of a NoSQL database

R19CS213	Object-Oriented Programming using Java Laboratory	L	T	P	C
		0	0	2	1

1.Course Description:

This laboratory course offers hands-on experience in applying Java concepts and techniques to real-world programming scenarios. Students will engage in practical exercises and projects covering key topics such as Foundations of Java, Object-Oriented Mechanisms, Strings, Collections & Java 8 Features, Exception Handling, Multithreading, JavaFX, and JDBC. Through guided lab sessions, students will develop proficiency in writing Java code, designing object-oriented solutions, implementing error handling strategies, and building graphical user interfaces and database-driven applications using JavaFX and JDBC.

2.Course Objectives:

1. To understand object-oriented programming concepts and the basics of java programming language
2. To know the principles of packages, inheritance and interfaces
3. To understand strings & collections with java 8 features
4. To develop a Java application with exception handling and threads
5. To build windows-based applications with JDBC

3.List of Laboratory Experiments:

1. **Foundations of Java**
   - Implement class, objects, data types, operators, control statements, wrapper classes and scanner classes using java
   - Implement command line arguments with i/o packages using java
   - Implement sequential search, binary search and quadratic sorting algorithms using java
2. **Object-Oriented Mechanisms**
   - Implement encapsulation, abstraction, polymorphism and inheritance using java
   - Implement interface by accessing super class constructors and methods using java
3. **Strings, Collections & Java 8 Features**
   - Implement string, string functions, string builder, string buffer and regex using java

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- Implement lambda expression & for each() method using java
- Implement generics-wildcard expression using java
- Implement stack and queue data structures using java
- Implement list, map, set, date and time using java

4. **Exception Handling And Multithreading**
   - Implement exception handling by creating user-defined exceptions using java
   - Implement multithreading and inter-thread communication using java
5. **JAVAFX & JDBC**
   - Develop applications using javafx controls, layouts and menus
6. **Project**
   - Develop an application using jdbc-oops-collections-javafx in eclipse IDE

References:

References Books:

1. Deitel P and Deitel H, "Java: How to Program", 11th Edition, Prentice Hall, 2018
2. James Gosling, Bill Joy, Guy Steele, Gilad Bracha, Alex Buckley and Daniel Smith, "The Java Language Specification – Java SE", 13th Edition, Oracle America Inc., USA, 2019
3. Matt Weisfeld, "The Object-Oriented Thought Process", 5th Edition, Addison-Wesley Professional, US, 2019

Video References:

1. https://www.youtube.com/@abdul_bari/videos
2. https://www.youtube.com/@JennyslecturesCSIT
3. https://caveofprogramming.teachable.com/p/java-multithreading

MOOC/SWAYAM/NPTEL Courses:

1. https://www.udemy.com/course/java-se-programming/
2. https://cse.iitkgp.ac.in/~dsamanta/java/index.htm
3. https://caveofprogramming.teachable.com/p/java-for-complete-beginners

4. **Course Outcomes:**

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CS213.1	Demonstrate the ability to identify, define, and analyze complex problems using appropriate algorithms, data structures, methodologies and
R19CS213.2	Design effective visual representations (UML diagrams/Flowchart) to solve the identified problems
R19CS213.3	Create solutions and implement them using suitable programming platforms

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R19CS213.4	Develop effective presentation skills to present and defend the designs and solution
R19CS213.5	Understand issues related to privacy, security and accessibility and adhere to coding standards

R19MC102	Tamils and Technology / தமிழரும் தொழில்நுட்பமும்	L	T	P	C
		1	0	0	1

1. Course Description:

The intersection of Tamils and technology refers to the field of agricultural technology, focusing on the use of modern tools and techniques to enhance farming practices and increase agricultural productivity.

2. Course Objectives:

1. To increase agricultural productivity and profitability by implementing innovative solutions that optimize resource usage, minimize losses, and enhance crop yields.
2. To automate the irrigation systems to adjust water usage based on real-time data on soil moisture levels, weather forecasts, and crop water requirements.

3. Syllabus:

Unit-I: Weaving and Ceramic Technology / நெசவு மற்றும் பானைத் தொழில்நுட்பம் (3)

Weaving Industry during Sangam Age – Ceramic Technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

சங்க காலத்தில் நெசவுத் தொழில் - பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் - பாண்டங்களில் கீறல் குறியீடுகள்.

Unit-II: Design and Construction Technology / வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்

Designing and Structural construction of Houses & Designs in household materials during the Sangam Age - Building materials and Hero stones of Sangam Age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் &சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு- சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் - சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் - நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாட்டு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ- சாரோசெனிக் கட்டிடக் கலை

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Unit-III: Manufacturing Technology / உற்பத்தித் தொழில் நுட்பம்
Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold- Coins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram. கப்பல் கட்டும் கலை - உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பை உருக்குதல், எஃகு - வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத்துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.
Unit-IV: Agriculture and Irrigation Technology / வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்
Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society. அணை, ஏரி, குளங்கள், மதகு - சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு- மீன்வளம் முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்.
Unit-V: Scientific Tamil and Tamil Computing /அறிவியல் தமிழ் மற்றும் கணித்தமிழ்
Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project. அறிவியல் தமிழின் வளர்ச்சி -கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம்- தமிழ் இணையக் கல்விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்.
Text Books:
1. தமிழக வரலாறு மக்களும் பண்பாடும் கே.கே.பிள்ளை (வெளியீடு - தமிழ்நாடு பாடநூல் மற்றும்கல்வியியல் பணிகள் கழகம்). 2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்). 3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு). 4. பொருநை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு).

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5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by: RMRL) – Reference Book.

References:

Reference Books:

1. Journey of Civilization Indus to Vaigai - R. Balakrishnan, Published by: RMRL.
2. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).

4. Course Outcomes/ பாடநெறி முடிவுகள்:

CO. No.	Course Outcome / பாடநெறி முடிவுகள்
R19MC102.1	Describe about the weaving industry in sangam age and ceramic technology. சங்க காலத்தில் நெசவுத் தொழில் மற்றும் பீங்கான் தொழில்நுட்பம் பற்றி விரிவாக அறிந்து கொள்ளுதல்.
R19MC102.2	Observe the design of houses, sculptures and construction of temples. வீடுகளின் வடிவமைப்பு, சிற்பங்கள் மற்றும் கோவில்களின் கட்டுமானத்தைப் பற்றி தெரிந்து கொள்ளுதல்.
R19MC102.3	Relate the various manufacturing materials and stone types in Silappathikaram. சிலப்பதிகாரத்தில் உள்ள பல்வேறு உற்பத்திப் பொருட்கள் மற்றும் கல் வகைகளைப் பற்றி புரிந்து கொள்ளுதல்.
R19MC102.4	Understand the significance of agriculture and irrigation technology in the ancient period. பண்டைய காலத்தில் விவசாயம் மற்றும் நீர்ப்பாசன தொழில்நுட்பத்தின் முக்கியத்துவத்தை புரிந்து கொள்ளுதல்.

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SEMESTER IV

R19MA206	Probability and Statistics	L	T	P	C
		3	1	0	4

1. Course Description:

This course provides a foundational understanding of probability theory and statistical methods, essential for making informed decisions in diverse fields such as science, engineering, business, and social sciences. It will encompasses both theoretical principles and practical applications, enabling students to analyze data, draw meaningful inferences, and make informed decisions in uncertain situations.

2. Course Objectives:

1. Familiarize the students with the outcomes of random occurrences.
2. Enhance the knowledge of various distributions and its applications.
3. Impart the knowledge in the relationship between multiple variables.
4. To make an inference about the population on the basis of a random sample taken from that population.
5. Inculcate techniques approximate the value of a population parameter on the basis of sample statistics.

3. Syllabus

Unit-I: Probability

Probability axioms; Conditional probability; Baye's theorem statement only; Discrete and continuous random variables; Moments, moment generating functions.

Unit-II: Standard Distributions

Discrete distributions: Binomial, poisson, geometric; Continuous distributions: Uniform, exponential and Gaussian.

Unit-III: Pair of Random Variables

Joint distributions; marginal and conditional distributions; covariance; linear correlation; regression lines.

Unit-IV: Testing of Hypothesis

Sampling distributions: Statistical hypothesis; Large sample test: Single mean, difference of means, proportion; Small sample test: t-test, F-test; Chi-square test: Goodness of fit, independence of attributes.

Unit-V: Estimation Theory

Unbiased estimators; method of moments; maximum likelihood estimation; curve fitting by principle of least squares.

Text Books:

1. Johnson R. A., Miller and Freund's, "Probability and Statistics for Engineers", 8th Edition, Pearson Education, Delhi, 2015.
2. Walpole R. E., Myers S.L. and Keying Ye, "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education Inc, 2012.

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References:
Reference Books:
1. Devore. J. L., "Probability and Statistics for Engineering and the Sciences", 8th Edition, Cengage Learning, New Delhi, 2014. 2. Gupta S. P, "Statistical Methods", Sultan Chand & Sons Publishers, 2014. 3. Veerarajan. T, "Probability, Statistics and Random Processes", 3rd Edition, Tata McGraw Hill, 2009.
Journal References:
1. International journal of probability and statistics: http://www.sapub.org/Journal/articles.aspx?journalid=1119 2. International journal of experimental design and process optimisation: https://www.inderscience.com/jhome.php?jcode=ijedpo
Web Resources:
1. www.nptelvideos.in/2012/12/probability-random-variables.html 2. www.freevideolectures.com › Mathematics › IIT Kharagpur 3. www.freevideolectures.com › Computer Science › IIT Madras 4. https://www.youtube.com/watch?v=32CuxWdOlow 5. https://www.youtube.com/watch?v=I_dhPETvll8
MOOC/NPTEL/SWAYAM Courses:
1. nptel.ac.in/courses/111104079/ 2. https://nptel.ac.in/noc/courses/noc22/SEM1/noc22-ma30/ 3. https://onlinecourses.nptel.ac.in/noc22_mg31/

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19MA206.1	Apply fundamental probability concepts to explore random experiments.
R19MA206.2	Apply the concepts of standard distributions to solve real-world problems and make decisions.
R19MA206.3	Apply the functions of two-dimensional random variables through its probability values.
R19MA206.4	Analyze the concept of various test statistics used in hypothesis testing for mean and variances of large and small samples.
R19MA206.5	Evaluate the values of parameters based on measured empirical data.

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R19AM301	Machine Learning	L	T	P	C
		3	0	0	3

1. Course Description:

This course provides an in-depth introduction to the fundamental concepts and techniques of machine learning, a field at the intersection of computer science and statistics that focuses on the development of algorithms capable of learning from data. Students will gain a comprehensive understanding of the principles and applications of machine learning, along with hands-on experience in implementing and evaluating machine learning models.

2. Course Objectives:

1. To explain the different types of Machine learning techniques and mathematical concepts
2. To use natural language processing technique using large language models
3. To apply the different machine learning tools to solve the real time problems
4. To make decisions using reinforcement learning and Markov Decision process.

3. Syllabus

Unit-I: INTRODUCTION

Review of Linear Algebra for Machine Learning. Introduction and motivation for machine learning: Types of Machine Learning: Supervised Learning, Unsupervised Learning and Reinforcement learning.Statistical Decision theory: Classification and Regression, Bias and Variance.Case Study: Stock Price Prediction

Unit-II: CLASSIFICATION AND REGRESSION

Linear Regression, Multivariate Regression, Subset Selection, Shrinkage methods, Principal Components Regression, Partial Least Squares. Ridge and LASSO Regression. Logistic Regression. Linear Discriminant Analysis. Decision Tree, K Nearest Neighbor, Separating hyperplane – Perceptron learning Support Vector Machines and kernels. Artificial Neural Networks: Backpropagation Algorithm, Maximum Likelihood estimate.

Case Study: House Price Prediction using Linear Regression and spam email classification usingsupport vector machine algorithm.

Unit-III: EVALUATION MEASURES AND ENSEMBLE TECHNIQUES

Evaluation Measures: Bootstrapping and cross validation ROC Curve, Minimum Description length and exploratory analysis. Ensemble Methods: Bagging, Committee machines, Stacking, Boosting, Gradient Boosting, Random ForestCase Study: Random Forest for Credit Scoring and Stacking for Image Classification

Unit-IV: BAYESIAN NETWORKS AND CLUSTERING

Naïve Bayes, Bayesian Networks, Undirected Graphical models, Hidden Markov models, Varaible Elimination, Belief Propagation; Partitional Clustering, Hierarchical Clustering, BIRCH and CURE algorithms, Density based Clustering, Spectral Clustering.

Case Study: Analyze customer reviews to determine the sentiment (positive, negative, or neutral) associated with a product or service.

Unit-V: REINFORCEMENT LEARNING

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Introduction to Reinforcement learning, Framework, Elements of Reinforcement learning, MarkovDecision Process, Q – Learning in Python, Deep Q- learning. Case Study: Game Playing
Text Books: 1. Ethem Alpaydin, "Introduction to Machine Learning", Third Edition, Prentice Hall of India, 2015. 2. Tom Mitchell, "Machine Learning", McGraw-Hill, 2017. 3. Christopher Bishop, "Pattern Recognition and Machine Learning", Springer, 2006. 4. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012. 5. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", Second Edition, CRC Press,2014.
References:
Reference Books: 1. Fabio Nelli, "Python Data Analytics with Pandas, Numpy, and Matplotlib", Second Edition, Apress,2018. Educational Publishers Inc., 2015. 2. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", FirstEdition, Cambridge University Press, 2012. **Video References:** 1. https://www.ysoutube.com/c/3blue1brown 2. https://www.youtube.com/channel/UCfzlCWGWYyIQ0aLC5w48gBQ **Web References:** 1. https://www.youtube.com/channel/UCWN3xxRkmTPmbKwht9FuE5A 2. Machine Learning by Andrew Ng on Coursera **MOOC/SWAYAM/NPTEL Courses:** 1. Introduction to Deep Learning - MIT OpenCourseWare 2. Essential Mathematics for Artificial Intelligence on edX

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19AM301.1	Apply the mathematical concepts of machinelearning to solve the real-time problems.
R19AM301.2	Apply the different types of machine learning and graphical modelling for data analysis andvisualization.
R19AM301.3	Implement boosting algorithms using appropriate libraries and tune hyperparametersfor optimal performance.
R19AM301.4	Interpret and communicate the results obtained from Bayesian network analysis and clusteringalgorithms in the context of specific applications.
R19AM301.5	Examine the Markov Decision Process and Reinforcement learning algorithms in simulatedenvironment.

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R19AD201	Artificial Intelligence	L	T	P	C
		3	0	0	3

1. Course Description:

This course offers a comprehensive exploration of the foundational principles and core concepts in Artificial Intelligence (AI). Beginning with an introduction to the history and applications of AI, the course progressively delves into intelligent agents, problem-solving, search algorithms, and extends to encompass knowledge representation and planning. Machine learning is a branch of artificial intelligence that enables systems to learn from data and improve their performance over time without being explicitly programmed. Students will gain a solid understanding of various machine learning algorithms, their theoretical underpinnings, and how to apply them both artificial intelligence and machine learning to real-world problems.

2. Course Objectives:

1. To study the structure of agents and the nature of environments
2. To learn the search algorithms of AI in different environments
3. To Learn and apply adversarial search techniques to solve problems in dynamic environments.
4. To understand the basic concepts of machine learning.
5. To understand and build supervised and unsupervised learning models.

3. Syllabus:

Unit-I: INTELLIGENT AGENTS

Introduction to artificial intelligence; Intelligent agents: agents & environment, concept of rationality, nature of environments, structure of agents.

Case Study: Autonomous Delivery Robots which interact with their surroundings and navigate through dynamic environments to deliver packages.

Unit-II: PROBLEM SOLVING AGENTS

Uninformed search strategies, Heuristic search strategies, heuristic functions; Local search and optimization problems, local search in continuous space, search with nondeterministic actions, search in partially observable environments, online search agents and unknown environments.

Case Study: Autonomous vehicle Navigation in Unknown Environments

Unit-III: GAME PLAYING AND CSP

Adversarial search: Games, optimal decisions in games, alpha - beta pruning, stochastic games, partially observable games; Constraint satisfaction problems; constraint propagation, backtracking search for CSP, local search for CSP, structure of CSP Case Study: Artificial intelligence system plays chess to make optimal moves in a partially observable and dynamic environment.

Unit-IV: SUPERVISED LEARNING

Machine Learning; Types of Machine Learning: Supervised Learning, Unsupervised Learning; Basic Concepts in Machine Learning ; Machine Learning Process; Weight Space; Testing Machine Learning Algorithms; A Brief Review of Probability Theory : Turning

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Data into Probabilities , The Bias-Variance Trade off. Linear Models for Regression; Linear Basis Function Models; The Bias-Variance Decomposition; Bayesian Linear Regression; Common Regression Algorithms: Simple Linear Regression, Multiple Linear Regression; Linear Models for Classification: Common Classification Algorithms: k-Nearest Neighbours, Decision Trees, Random Forest model, Support Vector Machines.

Unit-V: UNSUPERVISED LEARNING

Mixture Models and EM; K-Means Clustering; Dirichlet Process Mixture Models; Spectral Clustering; Hierarchical Clustering; The Curse of Dimensionality; Dimensionality Reduction: Principal Component Analysis; Latent Variable Models(LVM): Latent Dirichlet Allocation (LDA). Reinforcement Learning, Representation Learning – Neural Networks – Active Learning – Ensemble Learning – Bootstrap Aggregation – Boosting – Gradient Boosting Machines.

Text Books:

1. Stuart Russel and Peter Norvig, "Artificial Intelligence: A Modern Approach", Fourth Edition, Pearson Education, 2020.
2. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth Edition, 2020.
3. Tom Mitchell, "Machine Learning", McGraw-Hill, 2017.

References:

Reference Books:

1. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw Hill Education, New Delhi, 2017
2. Christopher Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
3. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.

Video References:

1. https://www.youtube.com/watch?v=JxgmHe2NyeY
2. https://www.youtube.com/watch?v=z18nw4adsx4

Web References:

1. https://alex.smola.org/drafts/thebook.pdf

2. https://www.cin.ufpe.br/~cavmj/Machine%20-0Learning%20%20Tom%20Mitchell.pdf

MOOC/SWAYAM/NPTEL Courses:

1. Introduction to Machine learning- MIT OpenCourseWare

Essential Mathematics for Artificial Intelligence on edX

4. **Course Outcomes:**

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19AD201.1	Implement a study of agents' structures and diverse environments in AI.

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R19AD201.2	Apply various AI search algorithms for different environmental scenarios using the knowledge and skills acquired.
R19AD201.3	Implement a comprehensive study of adversarial search techniques and resolving constraint satisfaction problems in AI.
R19AD201.4	Apply logical and probabilistic inference mechanisms to improve decision-making in AI systems.
R19AD201.5	Analyze knowledge representation techniques and planning algorithms vital for Artificial Intelligence

R19CS204	Operating Systems	L	T	P	C
		3	0	0	3

1. Course Description:

This course introduces students to the fundamental principles and concepts underlying modern operating systems. Through lectures, practical exercises, and assignments, students will gain a deep understanding of the design, implementation, and management of operating systems. Topics covered include process management, memory management, file systems, device management, security, and virtualization. Emphasis will be placed on both theoretical concepts and practical applications, with hands-on experience in working with various operating systems.

2. Course Objectives:

1. To understand the core principles and architecture of operating systems, including kernel types and process management.
2. To implement CPU scheduling and synchronization techniques to manage concurrent processes.
3. To analyse and identify appropriate strategies for handling deadlock situations, and to apply advanced memory management techniques effectively.
4. To manage virtual memory and file systems for optimal resource allocation and storage efficiency.
5. To gain expertise in real-time operating systems (RTOS) and virtualization technologies to address modern system challenges.

3.Syllabus

Unit – I: Kernel and Process Management

Operating System Overview: Objective and Functions-Types of Operating System-Services- Boot Block- Kernel- Microkernel-Monolithic Kernel-Macro Kernel-System Calls Processes: States of Process-Process Control Block (PCB)-Context Switch-Creation and Termination-Inter-process Communication Threads: Introduction-Multithreading Models-Thread Libraries-Threading issues Case Study: Zombie Process and their Prevention-Lottery Process Scheduling

Unit – II: CPU Scheduling and Process Synchronization

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CPU Scheduling: Scheduling – Scheduling Criteria-Scheduling Algorithms: Preemptive and Non-Preemptive Scheduling (FCFS, SJF, LRTF, Round-Robin, Priority)-Process Synchronization: The Critical Section Problem-Peterson's Solution-Synchronization Hardware-Mutex Locks-Semaphores-Classical Problems of Synchronization-Producer Consumer Problem-Dining Philosophers Problem Case Study: Sleeping Barber Problem-Dekker's Algorithm-Bakery Algorithm

Unit– III: Deadlock and Memory Management

Deadlocks: Necessary Conditions -Resource Allocation Graph- Deadlock Prevention, Deadlock Avoidance-Banker's Algorithm-Deadlock Detection-Recovery from Deadlock Main Memory Management: Swapping-Contiguous Memory Allocation-Paging-Segmentation-Segmentation with paging Case Study: Snow Cone: Android Memory Management.

Unit- IV: Virtual Memory Management and Secondary Storage

Virtual Memory Management: Demand Paging-Page Replacement (FIFO, LRU, Optimal)-Allocation of Frames-Thrashing File Management: Overview-Organization-Access-File Directories-File Structures-File Sharing and Protection-Allocation Methods-Free Space Management Mass Storage Structure: Mass Storage System-Disk Structure-Disk Scheduling and Management-Swap Space management-I/O Management and Disk Scheduling Case Study: Buddy Memory Allocation Scheme in Operating Systems

Unit – V: RTOS and Virtualization

RTOS: Introduction to real-time systems and OS- RTOS services, real-time tasks- RTOS memory management- Free RTOS Virtualization: Process and System VMs-Taxonomy of VMs -Hardware Emulation-Full Virtualization with binary translation-Hardware assisted - Operating System-Virtualization- Case Study: RTOS for fault Tolerant Applications-Container /Docker

Text Books:

1. Abraham Silberschatz, Peter Bear Galvin and Greg Gagne, "Operating System Concepts", John Willey & Sons (Asia)Pvt ltd, Tenth Edition,2018.
2. Remzi H.Arpaci - Dusseau, Andrea C.Arpaci - dussea, "Operating Systems :Three Easy Pieces", Amazon Digital Services, First Edition,2018.
3. Dhanajay M. Dhamdgere, "Operating systems-A Concept Based Approach", Third Edition, Tata McGraw Hill Edition 2019.
4. Smith, Nair, "Virtual Machines:Versatile Platforms for Systems and Processes", Morgan Kaufman Publishers (2005).

References:

Reference Books:

1. Andrew S. Tanenbaum, "Modern Operating Systems", Pearson Education, Third Edition, 2015.
2. William Stallings, "Operating Systems: Internals and Design Principles", Pearson Education, Ninth Edition, 2018
3. Charles Crowley, "Operating systems: A Design-Oriented approach", Tata McGraw Hill Education,2017.

MOOC/SWAYAM/NPTEL Course:

1. https://onlinecourses.nptel.ac.in/noc21_cs88/preview.

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4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CS204.1	Analyse the states of a process and explain the role of the Process Control Block.
R19CS204.2	Evaluate CPU Scheduling Algorithms and Implement Synchronization Mechanisms.
R19CS204.3	Design Solutions for Deadlocks and Implement Memory Management Strategies.
R19CS204.4	Apply their understanding of file management concepts, including file directories, structures, and sharing, to real-world scenarios.
R19CS204.5	Apply their understanding of Real-Time Operating Systems and virtualization to real-world scenarios.

R19EC253	Computer Networks	L	T	P	C
		3	0	2	4

1. Course Description:

This course delves into the world of computer networks, equipping the students with a deep understanding of their architecture, communication protocols, and security practices. Students will explore the fundamental OSI and TCP/IP architectures, gaining insights into how data flows seamlessly across networks. Student will gain vital knowledge about common vulnerabilities and learn powerful security mechanisms to safeguard your systems. By the end, a solid foundation in network architectures, communication protocols, and cyber security, empowering the students to navigate the digital world with confidence.

2. Course Objectives:

1. To Teach Core Networking and Layering Structures
2. To Instruct in Depth on Physical and Data Link Layer Services, Standards, and Access Controls
3. To Guide Students Through Network Layer Protocols and Routing Services
4. To Explain Transport Layer Protocols and Socket Programming Services
5. To Support the Development of Networked Applications with Security Features

3. Syllabus:

Unit-I: Network Model

Network Structures: Point-point, Multipoint; Types: LAN, WAN; Transmission Modes: Simplex, Half-duplex, Full-duplex; Network Topology: Star, Ring, Bus, Mesh; Basic Network commands; Network Devices: Hub, Switch, Router; Switching Techniques: Circuit switching, Packet switching, Layering in Networks: TCP/IP Architecture, OSI Architecture.

Unit-II: Physical and Data Link Layer

Physical Layer: Performance parameters: Bandwidth, Latency, Throughput; Transmission Media: Twisted pair, Co-axial cable, Optical fibre.

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Data Link Layer: Link Layer addressing, ARP, Error Detection: CRC, LRC, VRC; Flow control: Stop and Wait, Sliding window, Multiple access protocols: ALOHA, CSMA, CSMA/CD, CSMA/CA.

Unit-III: Network Layer

Network Layer Services; IPV4 Addressing: structure, Classful, Classless; Subnetting; IPV6 Addressing: structure, Transition from IPV4 to IPV6; Routing: Overview of Unicasting and multicasting, Distance vector, link state, Path vector.

Unit-IV: Transport Layer

Transport Layer Services; TCP: Structure, Three-way Handshake, SCTP, Congestion control; UDP: Structures, Services, Applications; Socket Programming.

Unit-V: Application Layer and Security

Application Layer protocols: FTP, HTTP, Email: SMTP, POP3, MIME, IMAP; DNS; **Security:** Goals, CIA Triad, OSI Security architecture, Firewalls, VPN

List of Experiments:

1. Build network using cisco packet tracer. Evaluate the communication between different topologies and analyze the cost between different networks.
2. Develop client server applications using socket programming/software tool and examine its connections over Transmission control and User-datagram Protocol.
3. Establish a communication from Client to Server scenario using NS2/NS3 and measure its network resource rudiments. Plot their characteristics.
4. Analyze a website in realtime. Identify and capture the different files available and inspect the files to verify the presence of Malware using Wireshark
5. By using Cisco Packet Tracer build a Multiserver with various nodes to perform the communication using the protocols HTTP, FTP, SMTP and DNS
6. Build a network for smart home/industrial automation/environmental monitoring with different sensors, actuators, smart devices using CISCO Packet Tracer.

Text Books:

1. Behrouz A Forouzan, "Data Communications and Networking", McGraw Hill Education, 5th edition, 2017.
2. Andrew S. Tanenbaum "Computer Networks", Prentice Hall, 5th Edition, 2011.

Reference Books:

1. James F. Kurose, Keith W. Ross, "Computer Networking, A Top-Down Approach Featuring the Internet", Pearson Education, Sixth Edition, 2013
2. Ethical hacking and countermeasures v11 – Professional Series - CEH Handbook,2021
3. Richard Fox, Wei Hao, "Internet Infrastructure Networking, Web Services, and Cloud Computing", T& F, CRC Press, 2018.
4. Larry Peterson, Bruce Davie, Computer Network A systems Approachl- Morgan Kauffmann publishers, Fifth edition, 2011

Web Resources:

1. https://www.nesoacademy.org/cs/06-computer-networks/03-logical-addressing-and-subnetting/14-subnetting

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2. https://www.youtube.com/watch?v=qZLPq5mebFM1
3. https://www.cisco.com/c/en_in/products/security/vpn-endpoint-security-clients/what-is-vpn.html#~how-a-vpn-works
4. https://www.checkpoint.com/cyber-hub/network-security/what-is-firewall/

MOOC/SWAYAM/NPTEL Courses:

1. https://onlinecourses.nptel.ac.in/noc22_cs19/preview
2. https://onlinecourses.nptel.ac.in/noc19_cs75/preview

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19EC253.1	Analyze the fundamental network needs addressed by OSI and TCP/IP models, and evaluate their layering strategies.
R19EC253.2	Analyze and interpret the services, standards, and access control mechanisms that shape the physical and data link layers.
R19EC253.3	Apply addressing schemes and routing protocols to ensure precise delivery of information to their destinations
R19EC253.4	Evaluate the impact of Transport layer protocols on network performance and user experience through their provision of essential services
R19EC253.5	Examine the effectiveness of network authentication for protecting sensitive information from unauthorized access.

R19AM311	Machine Learning Laboratory	L	T	P	C
		0	0	2	1

1. Course Description:

The Machine Learning Laboratory is a hands-on course designed to provide students with practical experience in applying machine learning techniques to real-world problems. Through a series of guidedexercises, projects, and case studies, students will develop the skills and knowledge necessary to workwith machine learning algorithms, preprocess data, and make informed decisions based on model evaluations.

2. Course Objectives:

1. To develop practical programming skills for implementing machine learning algorithms.
2. To enable students to choose appropriate models and evaluate their performance effectively.
3. To familiarize students with feature engineering techniques to enhance model performance.
4. To ensure proficiency in using popular machine learning tools and libraries.

List of Laboratory Experiments:

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1. Introduction to Machine Learning Tools

Objective: Familiarize students with essential tools and libraries for machine learning. Activities:

- Set up Python environment with libraries like NumPy, Pandas, and Matplotlib.
- Introduce Jupyter Notebooks for interactive coding.
- Perform basic operations and data manipulations using NumPy and Pandas.
- Visualize data distributions and relationships with Matplotlib.

2. Data Preprocessing

Objective: Teach students how to prepare and clean datasets for machine learning tasks. Activities:

- Handle missing data using imputation techniques.
- Remove outliers and understand their impact on models.
- Standardize or normalize numerical features.
- Encode categorical variables using techniques like one-hot encoding.

3. Feature Engineering and Model Selection

Objective: Explore the impact of feature engineering and model selection. Activities:

- Experiment with different feature engineering techniques.
- Compare the performance of different machine learning models (e.g., Decision Trees, Support Vector Machines).
- Use cross-validation to assess model performance.

4. Simple Linear Regression

Objective: Implement and understand the basics of a linear regression model. Activities:

- Generate synthetic data for a simple linear regression problem.
- Implement the linear regression algorithm from scratch.
- Use scikit-learn to fit a linear regression model.
- Visualize the regression line and predictions.

5. Classification with Decision Trees

Objective: Introduce classification problems and decision tree algorithms. Activities:

- Create a synthetic dataset for a binary classification problem.
- Train a decision tree classifier using scikit-learn.
- Visualize the decision boundaries of the classifier.
- Evaluate the model's performance using metrics like accuracy and confusion matrix.

6. Neural Network for Image Classification

Objective: Introduce neural networks for image classification tasks. Activities:

- Use a pre-trained neural network (e.g., TensorFlow/Keras) for image classification.
- Fine-tune the model for a specific image dataset.
- Visualize learned features and filters in the neural network.

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7. Sentiment Analysis

Objective: Apply machine learning to text data for sentiment analysis. Activities:

- Preprocess text data, including tokenization and removing stop words.
- Train a sentiment analysis model using techniques like Bag-of-Words or Word Embeddings.
- Evaluate the model on a dataset of customer reviews.

8. Model Deployment

Objective: Explore the deployment of machine learning models. Activities:

- Convert a trained model to a format suitable for deployment.
- Deploy a simple model using cloud services or containers.
- Create a basic web interface for interacting with the deployed model.

9. **Fake News Detection:** Develop a machine learning model that can identify and classify fake or misleading news articles, helping users distinguish reliable information from misinformation.

10. Project Work

Objective: Apply all learned concepts to a comprehensive machine learning project. Activities:

- Select a real-world problem or dataset.
- Define the problem, clean and preprocess the data.
- Choose and implement appropriate machine learning models.
- Evaluate the model's performance and present findings.

Projects:

1. Object detection and tracking: Build a model that can detect and track objects in real-time video streams, enabling applications like surveillance systems or autonomous vehicles.
2. Spam Email Classification: Build a model that can classify emails as spam or non-spam. This could be applied to filtering out unwanted emails and improving overall email security.
3. Chatbot Creation: Develop an interactive chatbot using NLP techniques to provide assistance or answer questions on a specific topic or domain. Incorporate natural language understanding and generation to create a smooth conversational experience.
4. Named Entity Recognition (NER): Design and train a model that can identify and classify named entities in text, such as names of people, organizations, locations, dates, etc. Evaluate the model's performance using standard benchmark datasets.
5. Price comparison tool: Develop a web scraper that extracts product prices from multiple e-commercewebsites and displays them on a single webpage, allowing users to compare prices and find the best deals.
6. Product review aggregator: Build a web scraper that extracts product reviews from multiple reviewwebsites and presents them in a consolidated format. This can help consumers make informedpurchasing decisions by providing them with a comprehensive overview of a product's pros and cons. 7. Stock market analysis: Develop a web scraper that extracts stock market data, such as historical prices, trading volumes, and financial ratios, for

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different companies. Use this information to perform technical analysis and generate trading signals.
References:
1. https://onlinecourses.nptel.ac.in/noc24_cs51/course?user_email=sumathi.s@sece.ac.in 2. https://www.youtube.com/c/3blue1brown 3. https://www.youtube.com/channel/UCfzlCWGWYyIQ0aLC5w48gBQ 4. https://www.youtube.com/channel/UCWN3xxRkmTPmbKwht9FuE5A 5. Machine Learning by Andrew Ng on Coursera 6. Introduction to Deep Learning - MIT OpenCourseWare 7. Essential Mathematics for Artificial Intelligence on edX

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19AM311.1	Understand and implement basic AI tasks using PROLOG.
R19AM311.2	Demonstrate the ability to solve problems using searching and backtracking algorithms.
R19AM311.3	Develop programs to implement simulated annealing and genetic algorithms.
R19AM311.4	Implement simple reasoning systems using backward and forward inference mechanisms.
R19AM311.5	Implement basic machine learning programs for AI.

R19AD211	ARTIFICIAL INTELLIGENCE LABORATORY	L	T	P	C
		0	0	2	1

1. Course Description:

This course delves into practical applications in Artificial Intelligence (AI), emphasizing hands-on experience and implementation. The course covers a range of topics, including logic programming with PROLOG, problem-solving with searching and backtracking algorithms, heuristic optimization with simulated annealing and genetic algorithms, reasoning systems with backward and forward inference, and basic machine learning implementations.

2. Course Objectives:

1. To understand and apply PROLOG in various AI tasks
2. To learn and implement the searching algorithms in AI
3. Apply advanced search algorithms to solve complex AI problems with optimal efficiency
4. Deploy evolutionary algorithms to solve optimization problems in AI
5. To implement the first order inference rule mechanism for simple reasoning system

List of Laboratory Experiments:

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1. Identify and discuss the distinctive features that set PROLOG apart as a declarative programming language. Break down the essential elements, delving into the role of facts, rules, and queries. Examine how these components work together to facilitate logical reasoning.
2. Imagine you are working on an AI system for an automated chessboard configuration. One of the challenges is placing four queens on a 4x4 chessboard in such a way that no two queens threaten each other. Provide the Prolog code and demonstrate the solution by showing the positions of the queens on the 4x4 grid.
3. Imagine a scenario in a computer game where a character needs to navigate through various cities to complete a quest. The goal is to design a Prolog program that solves the Traveling Salesman Problem for the character, finding the optimal route to visit each city exactly once and return to the starting point while minimizing the total distance traveled. The cities in the game are connected by different types of paths, each with its own associated cost.
4. Assume you are playing the Pac-Man game where the maze is represented as a grid with Pac-Man, ghosts, walls, and empty spaces. Implement Breadth-First Search (BFS) for Pac-Man navigation, considering the presence of ghosts as obstacles in the exploration process.
5. Imagine a Real-Time Strategy game (Age of Empires) where you command a battalion of futuristic units navigating a dynamic battlefield. The terrain is diverse, including open fields, mountains, and urban areas. Your mission is to implement the A* search algorithm for unit path finding, considering the real-time movements of enemy units and dynamically changing obstacles. Describe how you would model the game environment as a grid, incorporating varying traversal costs for different terrains. Discuss the heuristic function you would employ to guide unit movements, considering factors such as the proximity of enemies, defensive structures, and the goal of reaching specific objectives on the map.
6. Implement the Alpha-Beta Pruning algorithm to determine the best move for a player in a Tic-Tac-Toe game tree. The game tree must represent all possible moves and countermoves, creating an extensive search space.
7. Consider a scenario where you are developing an AI-driven robotic system for package delivery in a city. The challenge is to evolve the optimal set of parameters that enable the robotic fleet to navigate efficiently through urban environments, considering factors such as traffic, pedestrian density, and delivery deadlines. Design a genetic algorithm to evolve the optimal parameters for route planning and execution in the robotic package delivery system. Describe the genetic operators (crossover and mutation) you would implement in your genetic algorithm. How do these operators enable the exploration and exploitation of the solution space, and how are they tailored to the specific challenges of route planning in urban environments?
8. In a telecommunications company, the network infrastructure team is faced with the challenge of optimizing the design of their communication network. The team has decided to apply Simulated Annealing to address this complex optimization problem. The goal is to create an efficient layout of network nodes and connections that minimizes latency, maximizes data throughput, and ensures resource utilization is optimized.
9. Imagine a smart home automation system that utilizes sensors and actuators to control various devices in a household. The system is equipped with motion sensors, door/window sensors, and temperature sensors. Implement propositional logic inferences to make decisions and take actions based on the information gathered by these sensors. The system need to adapt for handling dynamic situations like sudden drop in temperature, changes in occupancy patterns, or the introduction of new devices.

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10. Design a knowledge base for the medical diagnosis system, including predicates representing symptoms, diseases, and treatments. Create classes or functions to represent predicates, clauses, and resolution-based inference operations. Formulate resolution-based inference rules for diagnosing diseases based on reported symptoms and recommending treatments for diagnosed diseases.

References:

Reference Books:

1. Stuart Russel and Peter Norvig, "Artificial Intelligence: A Modern Approach", Fourth Edition, Pearson Education, 2020.
2. Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw Hill Publishing Company, New Delhi, 2014.

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19AD211.1	Understand and implement basic AI tasks using PROLOG.
R19AD211.2	Demonstrate the ability to solve problems using searching and backtracking algorithms.
R19AD211.3	Develop programs to implement simulated annealing and genetic algorithms.
R19AD211.4	Implement simple reasoning systems using backward and forward inference mechanisms.
R19AD211.5	Implement basic machine learning programs for AI.

R19CS214	Operating Systems Laboratory	L	T	P	C
		0	0	2	1

1. Course Description:

The Operating Systems Laboratory complements the theoretical concepts learned in the Operating Systems course by providing hands-on experience with operating system principles and practices. Through a series of guided exercises and projects, students will gain practical skills in operating system design, implementation, and management. This laboratory course focuses on reinforcing key concepts through experimentation, troubleshooting, and real-world application.

2. Course Objectives:

1. To understand and implement Linux Commands.
2. To develop Shell Scripts for System Tasks.
3. To implement and analyse System Calls and Deadlock avoidance algorithm.
4. To design and solve Synchronization and Scheduling Problems.
5. To build and test components of an OS Kernel.

3. List of Laboratory Experiments:

1. LINUX Commands:

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man, touch, cat, mkdir, rm, rmdir, ls, cd, cp, mv, pwd, bc, head, tail, wc, rev, who, echo, finger, find, awk, more, paste, bg, fg

2. Shell Programming:

Operators and decision-making statements for pattern generation, simulating arithmetic calculator, and printing number series

3. System Calls:

a) Process Management: fork, exec, getpid, exit, wait, close, stat, system

b) Interprocess Communication: pipe, mkfifo, creat, write, read, open, seek, close

4. Demonstrate the Creation of Zombie and Orphan Processes

5. Implementation of Threading & Synchronization Applications

6. CPU Scheduling:

First Come First Serve, Shortest Job First, Priority and Round-Robin Scheduling Algorithm

7. Process Synchronization:

a) Dining Philosophers' Problem using Semaphore

b) Producer Consumer Problem using Semaphore

8. Deadlock Avoidance:

a) Banker's Algorithm

9. Linux Kernel:

Configuration, compilation, and rebooting from the newly compiled kernel

10. File Allocation Strategies

a) Sequential

b) Indexed

c) Linked

11. Project:

Build the parts of an OS kernel by using teaching packages such as Nachos and Pintos

References:

Reference Books:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", John Wiley & Sons (Asia) Pvt. Ltd, Ninth Edition, 2018.

2. Andrew S. Tanenbaum, "Modern Operating Systems", Pearson Education, Third Edition, 2015.

3. William Stallings, "Operating Systems: Internals and Design Principles", Pearson Education, Ninth Edition, 2018.

4.Achyut S. Godbole, Atul Kahate - "Operating Systems", McGraw Hill Education, 2016.

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CS214.1	Demonstrate the ability to identify, define, and analyze complex problems using appropriate commands, System calls and programming
R19CS214.2	Create solutions and execute them utilizing appropriate programming platforms.
R19CS214.3	Choosing appropriate operating systems in virtualized environments to execute various applications

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R19CS214.4	Evaluate the advantages and disadvantages of different design options and consider the associated issues when designing operating systems.
R19CS214.5	Acquire practical understanding of the interaction between programming languages, operating systems, architecture, and effectively utilize them.

R19AD281	Project with Design Thinking (Product/Software Development Life Cycle)	L	T	P	C
		0	0	2	1

1.Course Description:

This course is designed to provide students with an opportunity to apply their knowledge and skills acquired to a real-world project. Students will work to define, plan, execute, and present a project under the guidance of a faculty supervisor. Students will collaborate in teams to tackle real-world challenges, emphasizing creativity, critical thinking, and project management skills, thus reflecting the relevant TRL and SDG levels.

2.Course Objectives:

- Understand and apply the five stages of design thinking to various contexts.
- Empathize with users to uncover needs that drive innovative solutions.
- Ideate practical and original solutions to complex challenges.
- Develop prototypes and iterate based on user feedback.
- Work in diverse teams to manage projects from conception to completion.
- Present design concepts and prototypes clearly and persuasively.

3. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19AD281.1	Articulate the principles and processes of design thinking.
R19AD281.2	Demonstrate the ability to conduct comprehensive user research and synthesize findings into actionable project insights.
R19AD281.3	Apply ideation techniques to generate innovative and practical solutions.
R19AD281.4	Design and develop prototypes using appropriate tools and technologies.
R19AD281.5	Evaluate prototypes and iterate based on user feedback and testing results.

R19EM201	Logical Thinking	L	T	P	C
		0	0	2	1

1. Course Description:

This course aims to help students build strong skills in logical thinking, reasoning and problem-solving. They will learn to analyze and evaluate arguments, spot logical fallacies and create clear and convincing arguments. Through lectures and practical exercises, students will develop the critical thinking needed to tackle engineering problems

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methodically and precisely. They will also understand the importance of logical thinking in designing and implementing engineering solutions, making them more effective engineers.
2. Course Objectives:
1. Apply logical algorithms to tackle complex problem-solving scenarios. 2. Develop analytical skills for optimizing costs in logical operations. 3. Master time and resource management through logical approaches. 4. Strengthen quantitative reasoning for data-driven decision-making. 5. Enhance logical and visual reasoning to solve intricate problems effectively.
3. Syllabus
Unit-I: Fundamental Skills for Problem Solving
Application of Problem Solving in real life, Different algorithms in problem solving: Brute force approach, Pattern finding method and Deep Learning Approach. Numbers System: Primes and factors, factors and factorials, divisibility rule, unit digit calculation and power cycle method, remainder concepts, HCF and LCM.
Unit-II: Critical Analysis of Cost Management
Fundamentals of Finance: Percentages, Fluctuations in percentage, Profit and Loss, Pricing Logics, Retail Pricing Strategy; Interest calculation: Cash Flow and Taxes; Simple and Compound interest calculation, Puzzle related to interest changes and Case Studies.
Unit-III: Time and Work Management
Fundamentals of Human Resources and Operations: Resources allocation, Time and Work, Puzzle involving backtracking, All possible routes, Pipes and Cisterns.
Unit-IV: Quantitative Reasoning and Data Interpretation
Fundamentals of statistics: Mean, Median and Mode, Real life application of statistics, Application of Ratios and Proportions in business problems, Partnerships; Geometry: 2D, 3D Visualizations.
Unit-V: Logical and Visual Reasoning
Paradigm shift and its application: Syllogism, Cube 3D visualization problems, Blood Relation, Coding decoding: Basics and Advanced. Visual reasoning: Patterns, Paper folding, Case Studies and Puzzles.
References:
Reference Books: 1. Dr. R S Aggarwal, Quantitative Aptitude, Revised Edition, S.Chand Publishing Company Ltd(s), 2022 2. Arun Sharma, How to prepare for Quantitative Aptitude for the CAT, 10th Edition, Tata McGraw-Hill Publishing Company Ltd, 2022
Online References: 1. https://www.hackerearth.com/ 2. https://www.geeksforgeeks.org/ 3. https://www.indiabix.com/

4. Course Outcomes:

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After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19EM201.1	Apply logical algorithms and mathematical methods to solve real-world problems.
R19EM201.2	Analyze and evaluate cost management strategies in various contexts.
R19EM201.3	Apply principles of time management and work efficiency in practical situations.
R19EM201.4	Use quantitative methods and interpret data to make informed decisions.
R19EM201.5	Create solutions to complex logical and visual reasoning problems by applying advanced reasoning techniques

R19EM203	Summer Internship	L	T	P	C
		-	-	-	NC

1. Course Description:

"Summer Internship" provides students with the opportunity to gain practical work experience in a professional setting during the summer months. Through supervised placements in various industries, students will apply theoretical knowledge acquired in their academic studies to real-world scenarios. The internship aims to enhance students' professional skills, expand their networks, and foster personal and career development. Under the guidance of experienced mentors, interns will engage in hands-on projects, tasks, and responsibilities tailored to their academic background and career interests. Through reflection, feedback, and evaluation, interns will refine their skills, gain valuable insights into industry practices, and make meaningful contributions to their host organizations.

2. Course Objectives:

1. Exposure in an Industrial/professional work environment relevant to the student's field of study.
2. Develop the ability to apply practical skills and knowledge learned in academic coursework to real-world projects and tasks.
3. Network with professionals in the industry to explore career opportunities and build professional relationships.
4. Create awareness of current industrial technological developments relevant to the program domain.
5. Provide opportunities to understand the social, economic, and administrative considerations in organizations.

3. Guidelines:

The Summer Internship/Industrial Training program offers students valuable opportunities to engage with real-world industrial environments aligned with their academic curriculum. Following completion of the IV Semester, students are required to obtain prior approval from the Head of the Department (HoD) to participate in these immersive learning

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experiences. The duration of the training spans two weeks during the summer vacation, providing students with focused insights into industry practices and technological advancements relevant to their field of study. Proof of participation, accompanied by a satisfactory completion certificate from the hosting organization, is mandatory to validate the learning experience.

Evaluation Process and Final Assessment

Upon completion of their internship or training, students are required to deliver a seminar based on their training report. This seminar is conducted before an expert committee formed by the concerned department in accordance with institutional norms. The evaluation process focuses on several key criteria to assess the student's performance comprehensively as per AICTE guidelines:

1. Quality of Content Presented
2. Proper Planning for Presentation
3. Effectiveness of Presentation
4. Depth of Knowledge and Skills
5. **Additional Factors such as** Attendance records, daily diaries, and departmental reports

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19EM203.1	Demonstrate an understanding of industry-specific practices, procedures, and terminology through immersion in a professional work environment
R19EM203.2	Interpret and explain the relevance of theoretical concepts learned in academic coursework to practical tasks and projects encountered during the internship
R19EM203.3	Apply acquired knowledge and skills to solve real-world problems, contribute to projects, and complete assigned tasks effectively within the internship setting
R19EM203.4	Analyze and evaluate their internship experiences, reflecting on challenges faced, solutions implemented, and lessons learned to assess their own growth and development.
R19EM203.5	Synthesize their internship experiences, integrating knowledge gained from various sources, including academic coursework, mentorship, and practical application, to formulate strategies for future career development and success.

R19MC202	Indian Constitution and Tradition	L	T	P	C
		1	0	0	NC

1. Course Description

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This course provides a comprehensive exploration of the Indian Constitution and Tradition, with a primary focus on understanding its historical evolution, guiding principles, organizational framework, and contemporary relevance. Students will delve into the intricate layers of India's constitutional legacy, examining the multifaceted influences of democratic governance.

2. Course Objectives:

1. Understand the foundational principles and historical context of the Indian Constitution and tradition.
2. Explore the role of tradition in shaping contemporary Indian constitutional law and governance.
3. Assess the interplay between constitutional amendments and traditional values in Indian society.
4. Critically reflect on the relevance and adaptability of Indian constitutional principles in a modern context.
5. Examine the evolution of constitutional rights and duties within the framework of Indian tradition.

3. Syllabus:

Unit-I: History of Indian Constitution

Meaning of the constitution law and constitutionalism - Historical perspective of the Constitution of India, Salient features and characteristics of the Constitution of India

Unit-II: Fundamental Rights and Duties

Scheme of the fundamental rights - Fundamental Duties and its legal status - Directive Principles of State Policy, Its importance and implementation

Unit-III: Federal Structure and Distribution of Powers

Federal structure and distribution of legislative and financial powers between the Union and the States - Parliamentary Form of Government in India - The constitution powers and status of the President of India - Amendment of the Constitutional Powers and Procedure

Unit-IV: Constitutional Amendments And Emergency Provisions

The historical perspectives of the constitutional amendments in India - Emergency Provisions: National Emergency, President Rule, Financial Emergency - Local Self Government - Constitutional Scheme in India

Unit-V: Right To Equality, Freedom, And Personal Liberty

Scheme of the Fundamental Right to Equality - Scheme of the Fundamental Right to certain Freedom under Article 19 - Scope of the Right to Life and Personal Liberty under Article 21

Text Books:

1. Sunil Khilnani, "The Idea of India", Penguin India Ltd., New Delhi.
2. Madhav Khosla, "The Indian Constitution", Oxford University Press. New Delhi, 2012.

References:

Reference Books:

1. Brij Kishore Sharma, "Introduction to the Indian Constitution", PHI, New Delhi
2. Sumantra Bose, "Transforming India: Challenges to the World's Largest Democracy", Picador India, 2013.
3. Atul Kohli, "Democracy and Discontent: India's Growing Crisis of Governability", Cambridge University Press, Cambridge, U. K., 1991.

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4. M. P. Singh and Rekha Saxena, "Indian Politics: Contemporary Issues and Concerns", PHI, New Delhi, 2008, latest edition.
5. Rajni Kothari, "Rethinking Democracy", Orient Longman, New Delhi, 2005.

Video References:

1. https://www.youtube.com/watch?v=JrqpQvRQft0
2. https://www.youtube.com/watch?v=XrKEtEzqZ7g
3. https://www.youtube.com/watch?v=9yaf5TFp-DE

Web References:

1. https://en.wikipedia.org/wiki/Constitution_of_India
2. https://www.india.gov.in/my-government/constitution-india
3. https://byjus.com/free-ias-prep/sources-of-indian-constitution/
4. https://academic.oup.com/past/advance-article/doi/10.1093/pastj/gtad009/7147824
5. https://www.vifindia.org/article/2017/august/03/indian-civilisation-and-the-constitution
6. https://search.worldcat.org/title/constitution-of-india-a-contextual-analysis/oclc/1002722580
7. https://main.sci.gov.in/constitution

MOOC/SWAYAM/NPTEL Courses:

1. https://archive.nptel.ac.in/noc/courses/noc20/SEM2/noc20-lw03/
2. https://archive.nptel.ac.in/courses/129106002/

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19MC202.1	Understand the characteristics of the Constitution of India.
R19MC202.2	Understand the fundamental rights and duties.
R19MC202.3	Understand the federal structure and distribution of legislative and financial powers.
R19MC202.4	Understand the constitutional amendments and emergency provisions.
R19MC202.5	Understand the fundamental right to equality, freedom, life and personal freedom.

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SEMESTER V

R19AM302	Deep Learning for Computer Vision	L	T	P	C
		3	0	0	3

1. Course Description:

This course focuses on teaching advanced techniques that combine deep learning algorithms with computer vision tasks. Students will learn to apply these methods to analyse and interpret visual data effectively. Through lectures and practical exercises, they will develop skills in image processing, featureextraction, and building Convolutional Neural Networks (CNNs) for tasks like image classification andobject detection. By the end of the course, students will be proficient in using deep learning models to solve real-world computer vision problems.

2. Course Objectives:

1. To understand fundamentals of image and video processing.
2. To apply the methods for visual feature extraction.
3. To understand the principles of convolutional neural networks (CNNs).
4. To apply CNN for various computer vision applications.
5. To apply Recurrent Neural network and Generative models for computer vision applications.

3. Syllabus

Unit-I: Fundamentals of Image and Video Processing

Introduction to Image Formation, capture, and representation; Image transformation and enhancement Correlation, Histogram, connectivity, threshold, morphology, Convolution filters: Convolution kernels, Mean, Median and Sobel filters, pooling methods; Video processing: Serial, parallel, pipeline, file splitting and time profiling architectures.

Unit-II: Visual Features

Visual Features and Representations: Edge features: Canny, Blobs, Corner Detection; SIFT, SURF; HoG.Matching Techniques and Transformations; Visual Matching: Bag-of-Words, VLAD; RANSAC, HoughTransform, Pyramid Matching.

Unit-III: Deep Learning Fundamentals and CNNs

Fundamentals of deep Learning: Feed forward fully connected layer, Backpropagation, feature maps; Deep learning methods: Convolutional Neural Network (CNN), Recurrent Neural Network (RNN) and Long Short Term Memory (LSTM). CNN Architectures: Alex Net, ZFNet, VGG, Inception Nets, Res Nets, Dense Nets.

Unit-IV: Advanced CNNs and its applications

CNNs for classification; CNNs for object detection: Background of Object Detection, YOLO family, R-CNN family: Fast R-CNN, Faster R-CNN; SSD, RetinaNet; CNNs for Segmentation: FCN, SegNet, U-Net, Mask-RCNN, Object tracking: CNN with LSTM.

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Unit-V: RNN and Generative Models
Recurrent Neural Networks (RNNs) Review, CNN + RNN Models for Video Understanding; Attention Models in Vision; Vision and Language Integration: Image Captioning, activity annotation; Vision transformers; Deep Generative Models: GANs, VAEs, Pix2Pix.
Text Books:
1. Goodfellow, Ian, Yoshua Bengio, and Aaron Courville. Deep Learning. MIT Press, 2016. 2. Nielsen, Michael. Neural Networks and Deep Learning. Determination Press, 2016. 3. Prince, Simon J. D. Computer Vision: Models, Learning, and Inference. Cambridge UniversityPress, 2012. 4. Forsyth, David, and Jean Ponce. Computer Vision: A Modern Approach. Prentice Hall, 2002.
References:
Reference Books: 1. Bishop, Christopher. Neural Networks for Pattern Recognition. New York, NY: OxfordUniversity Press, 1995. 2. Bishop, Christopher M. Pattern Recognition and Machine Learning. Springer, 2006. 3. Duda, Richard, Peter Hart, and David Stork. Pattern Classification. 2nd ed. New York, NY: Wiley-Interscience, 2000. 4. Mitchell, Tom. Machine Learning. New York, NY: McGraw-Hill, 1997. 5. Richard Hartley, Andrew Zisserman, Multiple View Geometry in Computer Vision, 2004. 6. David Marr, Vision, 1982.
Journal References: 1. Yoshua Bengio (2009), "Learning Deep Architectures for AI", Foundations and Trends® inMachine Learning: Vol. 2: No. 1, pp 1-127. http://dx.doi.org/10.1561/2200000006 2. Szeliski, Richard. Computer Vision: Algorithms and Applications. Springer Science &Business Media, 2010.
MOOC/SWAYAM/NPTEL Courses: 1. https://onlinecourses.nptel.ac.in/noc20_cs88/preview 2. https://onlinecourses.nptel.ac.in/noc20_cs62/preview 3. https://onlinecourses.nptel.ac.in/noc19_cs58/preview

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19AM302.1	Understand the fundamentals of image and videoprocessing
R19AM302.2	Apply various techniques for feature extraction inimages.
R19AM302.3	Understand the working principles of ConvolutionalNeural Network and Recurrent Neural Network.

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R19AM302.4	Apply CNNs for object detection, tracking andsegmentation tasks.
R19AM302.5	Apply the RNNs, vision transformer and Generativemodels for various computer vision applications.

R19CS206	Full Stack Development	L	T	P	C
		3	0	0	3

1. Course Description:

This is a comprehensive course designed to equip students with the knowledge and skills required to become proficient full stack developers. The course covers essential front-end and back-end technologies, including HTML5, CSS3, JavaScript, React.js, Node.js with Express.js, Spring Boot backend framework, and fundamentals of MongoDB. Through a combination of theoretical lectures, hands-on coding exercises, and real-world examples, students will gain a deep understanding of each technology's role in the development process and how they work together to build modern web applications

2. Course Objectives:

1. To empower students to design, develop, and deploy dynamic web applications using HTML5, CSS3, and JavaScript
2. To introduce students to build fast, scalable, and maintainable front-end applications using ReactJS
3. To familiarize students with the skills to effectively use MongoDB to build robust, scalable, and data-driven applications
4. To acquaint students to build scalable and efficient web applications using Node.js and Express.js
5. To equip students with the skills to master Spring Boot's core features

3. Syllabus

Unit-I: HTML5, CSS3 and JavaScript

Full Stack Application: component; HTML5: tags, attributes, properties, importance of semantic HTML, classes; CSS3: CSS3 syntax, properties, borders, text, image, grid layout, media queries, animations; Types of CSS frameworks- Tailwind CSS; Overview of JavaScript: advanced working with functions; JavaScript namespaces; Prototypes; Error handling; Modules in JavaScript; Chaining JavaScript methods; Promises.

Case Study: Website design for an automobile industry

Unit-II: Reactjs

ReactJS: library, directory; React components: types of Components, component composition, component styling, adding styles, component intercommunication, data sharing, routing; Hooks: states, hooks vs states, types of Hooks; Redux: state container for react apps; React bootstrap: props, router.

Case Study: Portfolio development with authentication.

Unit-III: MongoDB

MongoDB: features, environment; Data modelling: Schema creation using mongoose(ODM), create database, data types, drop database; Collection: insert, query, update and delete; Projection: limiting records, sorting records, indexing and aggregation.

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Case Study: Design of a simple search engine.
Unit-IV: Nodejs and Expressjs
Tech Stack Comparison; NodeJS: node module system, Node Package Manager (NPM); ExpressJs: building RESTful API's; Advanced topics: asynchronous JavaScript, CRUD operations using mongoose, mongo data validation, mongoose modeling relationships between connected data, authentication, authorization, and deployment.
Case Study: QR Code Generator application
Unit-V: Spring Boot
Spring Boot: configuration, spring data JPA, create spring data repositories for JPA, web application with Spring Boot, RESTful controllers, message converters, WAR / JAR deployment, creating a RESTful application, HTTP GET, PUT, POST, DELETE.
Case Study: real time message transfer application.
Text Books:
1. Vasan Subramanian, 'Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node', Second Edition, Apress, 2019 2. Brad Dayley, Brendan Dayley, Caleb Dayley, 'Node.js, MongoDB and Angular Web Development', Addison-Wesley, Second Edition, 2018
References:
1. Chris Northwood, 'The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer', Apress; 1st edition, 2018. 2. Kirupa Chinnathambi, 'Learning React: A Hands-On Guide to Building Web Applications Using React and Redux', Addison-Wesley Professional, 2nd edition, 2018.
Web Resources:
1. https://www.tutorialspoint.com/the-full-stack-web-development/index.asp 2. https://www.youtube.com/playlist?list=PL9ooVrP1hQOGTHk2auXsk3cyqRBbbsQ6l 3. https://www.freecodecamp.org/news/learn-web-development-free-full-stack-developer-courses-for-beginners/
MOOC/NPTEL /SWAYAM Courses:
1. https://www.udemy.com/course/ultimate-web/?couponCode=SKILLS4SALEB 2. https://www.coursera.org/professional-certificates/ibm-full-stack-cloud-developer

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CS206.1	Build dynamically enriched web pages with HTML5, CSS3, and JavaScript
R19CS206.2	Implement data handling and fetching in React applications using state management libraries
R19CS206.3	Develop a web application with MongoDB as the backend
R19CS206.4	Develop ExpressJS applications that define routes and handle HTTP requests and responses

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R19CS206.5	Develop RESTful APIs with Spring Boot for resource representation, HTTP methods and error handling

R19AD252	Data Exploration And Visualization	L	T	P	C
		2	0	2	3

1. Course Description:

This course covers principles and tools for creating impactful visualizations, using software like Tableau, Power BI, and Python libraries. Students learn to analyze and communicate data effectively, developing interactive dashboards and compelling visual narratives for decision-making across industries.

2. Course Objectives:

1. To learn the essential exploratory techniques for analyzing and visualizing data.
2. To gain hands-on experience of using software tools for data preparation, analytics, and visualization.
3. To utilize visualization for exploratory data analysis, identifying patterns and trends.
4. To apply visualization techniques to practical, real-world datasets.
5. To develop compelling visual narratives to communicate insights effectively.

. Syllabus

Unit-I: Data Exploration

Data: Aesthetics, Types of Data, Coordinate systems and axes, Colour Scales; Data Cleanup Basics: Normalizing and standardizing the data; Exploring the data: Importing the data, exploring table functions, identifying correlation and outliers; Introduction to Single variable: Distribution Variables, Numerical Summaries of Level and Spread, Scaling and Standardizing, Inequality, Smoothing Time Series.

Unit-II: Data Analysis

Data collection and management: Introduction, Sources of data, Data collection, APIs; Data Pre- processing Techniques; Data Analysis and Data Analytics: Descriptive Analysis, Diagnostic Analytics, Predictive Analytics, Prescriptive Analytics, Exploratory Analysis, Mechanistic Analysis; Analysis Method: Quantitative Methods, Qualitative Methods; Evaluation: Comparing Models, Cross Validation; Data storage and management, using multiple data sources.

Unit-III: Data Visualization

The Seven Stages of Visualizing Data, Univariate Plots: Histogram, Single and multiple distributions, Probability Distribution plots, Run Sequence Plots; Bivariate Plots: Bar graphs, Heat maps; Density Plots, Pair plots, Contour plots; Empirical cumulative distribution functions and q-q plots; Time series Data: Individual time series, Multiple time series and dose–response curves; Geo-spatial Data: Cartograms.

Unit-IV: Introduction to Tableau

Overview of Tableau and its applications, Installation and setup, connecting to data sources (Excel, CSV, databases), Understanding Tableau's interface; Data Preparation in Tableau, Maps and geographical data visualization, Intermediate Visualization Techniques, Storytelling with Tableau, Real-time data connections and live dashboards.

Unit-V: Power BI for Data Visualization And Analysis

Data Preparation and Transformation, Basic Visualization Techniques, Advanced DAX functions and calculations, Power BI Data Modelling; Case Study: Wildfire Activity in the Western United States, Single Family Residential Home and Rental Values.

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List of Laboratory Experiments:	
1.	You are a data analyst working for an insurance company and you have been tasked with generating a comprehensive data quality report for the company's customer data. The data is intended to be used for risk assessment and policy pricing. The dataset contains information about policyholders, their coverage details, and claim history. Your goal is to identify and report on missing values, irregular cardinality, and outliers in the dataset.
2.	You are a data analyst working for a winery, and your team has provided you with a dataset containing information about various attributes related to wine quality. The dataset includes features such as acidity levels, residual sugar, alcohol content, and the quality rating assigned by experts. Your task is to perform Exploratory Data Analysis (EDA) to gain insights into the characteristics of the wines and understand the factors influencing wine quality.
3.	You are a data scientist working for an e-commerce company, and your team has provided you with a dataset containing information about customer purchases. The dataset includes features such as purchase amount, product category, customer age, and the time of purchase. Your goal is to prepare the data for exploratory analysis, employing normalization, binning, and sampling methods.
4.	You are a data scientist working for a telecommunications company, and your team is interested in predicting customer churn. The dataset includes various features such as customer tenure, monthly charges, usage patterns, and customer satisfaction scores. Your task is to identify a descriptive feature that shows a clear relationship with the target feature, which is whether a customer churns or not. You will use visualization techniques to explore these relationships effectively.
5.	You are a data scientist working for a retail company, and your team has provided you with a time series dataset containing daily sales data for various products over the past few years. Your task is to perform time series analysis to understand sales patterns, trends, and seasonality. Additionally, you need to forecast future sales using appropriate visualization techniques.
6.	You work for a travel and tourism company, and your team has tasked you with analyzing and visualizing data related to popular tourist destinations. The dataset includes information such as location coordinates, tourist attractions, and ratings. Your goal is to perform data analysis and represent the information on a map with interactive features, including mouse rollover effects and user interaction.
7.	You work for a global non-profit organization that focuses on socio-economic development, and your team has tasked you with creating cartographic visualizations for multiple datasets involving various countries worldwide and specific states and districts within India. The datasets cover diverse indicators such as education, health, and economic factors. Your goal is to create insightful visualizations that allow stakeholders to compare socio-economic conditions across different regions.
8.	Assume you have a sample COVID-19 dataset named covid_data with variables like Date, Country, Confirmed_Cases, Deaths, and Recovered. How can you filter rows and variables in Tableau? Use the ggplot2 package for data visualization to understand the trend of confirmed cases, deaths, and recoveries over time. Consider a real- time problem: "Visualizing the spike in confirmed cases for a specific country, e.g., USA."
9.	Case Study 1: Retail Sales Analysis Objective: You are a data analyst for a retail company, and the management wants you to analyze the sales data to identify trends, customer preferences, and potential areas for improvement. Dataset: The dataset includes the following columns: Order_ID: Unique identifier for each order.

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Order_Date: Date of the order placement. Product_ID: Unique identifier for each product. Product_Name: Name of the product.
Category: Product category (e.g., Electronics, Clothing, Home Appliances). Unit_Price: Price of one unit of the product.
Quantity: Number of units ordered.
Total_Sales: Total sales amount for the order.
Insights and Recommendations:
a. Monthly Sales Trend: Sales have been consistently increasing, with a noticeable spike in [specific month]. Management could investigate the factors contributing to this increase for potential replication in other months.
b. Product Category Analysis: [Category A] is the highest-selling category, indicating a strong demand. The company might consider expanding or promoting products within this category.
c. Top Selling Products: [Top Product 1] and [Top Product 2] are the highest-selling products. Marketing efforts can be focused on these products to capitalize on their popularity.
d. Customer Segmentation: Further analysis is needed to understand customer segments based on demographics. Targeted marketing strategies can be developed for each segment.
e. Correlation Analysis: Positive correlations between [Variable X] and [Variable Y] suggest that changes in [Variable X] may impact [Variable Y]. Further investigation is recommended.

Case Study 2: Ridesharing Platform Analysis
Objective: You are a data analyst for a ridesharing company, and the management wants you to analyze the rides data to gain insights into user behavior, trip patterns, and areas for service improvement.
Dataset: The dataset includes the following columns:
Ride_ID: Unique identifier for each ride. User_ID: Unique identifier for each user. Timestamp: Date and time of the ride. Pickup_Location: Pickup location of the ride. Dropoff_Location: Dropoff location of the ride. Distance: Distance of the ride in miles.
Duration: Duration of the ride in minutes. Fare: Fare amount for the ride.
Rider_Rating: Rating given by the rider to the driver (out of 5). Insights and Recommendations:
a. User Activity Over Time:
There is a noticeable increase in rides during peak hours, suggesting high demand during specific times. Consider adjusting service capacity or introducing dynamic pricing during peak hours.
b. Trip Duration Distribution:
Most trips have a duration of between 10-30 minutes. Investigate and optimize routes for shorter trips to enhance efficiency.
c. User Ratings Analysis:
The median rider rating is high, indicating overall satisfaction. Identify factors contributing to low ratings and address them to maintain service quality.
d. Geographical Analysis:
Analyze popular pickup and dropoff locations to optimize driver allocation and potentially identify areas for promotional campaigns.
Further Analysis:
a. User Segmentation:
Explore user segments based on frequency, distance traveled, and rider ratings. Tailor marketing strategies for each segment.
b. Price Sensitivity Analysis:

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	Investigate the relationship between fare amounts and rider ratings. Understand if there is a correlation and adjust pricing strategies accordingly. e. Weather Impact: If available, incorporate weather data to analyze how weather conditions influence ride demand and duration.
10.	Mini project: Scenario 1: E-commerce Sales Analysis Objective: You are working for an e-commerce company, and the management wants to understand the sales performance of their products over the past year. They have provided you with a dataset containing information about the sales transactions. Dataset: The dataset includes the following columns: Transaction_ID: Unique identifier for each transaction. Product_ID: Unique identifier for each product. Product_Name: Name of the product. Transaction_Date: Date of the transaction. Transaction_Amount: The amount of money spent on the transaction. Perform the following tasks and subtasks: 1. Data Exploration a. Load the data b. Explore the data c. Check for missing values 2. Data Visualization a. Time series analysis b. Product sales distribution c. Transaction amount distribution d. Monthly sales trend Scenario 2: Fitness App User Engagement Analysis Objective: You are working for a fitness app company, and the management wants to understand the user engagement patterns and activity levels of their users. They have provided you with a dataset containing information about user activities. Dataset: The dataset includes the following columns: User_ID: Unique identifier for each user. Date: Date of the activity. Steps: Number of steps taken by the user on that day. Calories_Burned: Calories burned by the user on that day. Active_Minutes: The total number of active minutes (e.g., exercise, workout) by the user. Perform the following tasks and subtasks: 1. Data Exploration a. Load the data b. Explore the data c. Check for missing values 2. Data Visualization a. Daily Steps Trend b. Calories Burned vs. Active Minutes c. Weekly Aggregation of Steps d. Histogram of Active Minutes e. User Engagement by Day of the Week

Text Books:

1. Claus O Wilke, "Fundamentals of Data Visualization A Primer on Making Informative and Compelling Figures", O"Reilly Media, Inc., First Edition, 2019.
2. David Baldwin," Mastering Tableau: Smart Business Intelligence techniques to get maximum insights from your data", Packt, First Edition, 2016.

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References:

Reference Books:

1. Catherine Marsh, Jane Elliott, Exploring Data: An Introduction to Data Analysis for Social Scientists, Wiley Publications, 2nd Edition, 2008.
2. Alberto Cairo, "The Functional Art: An Introduction to Information Graphics and Visualization", New Riders, 2012.
3. Nathan Yau. "Visualize This: The Flowing Data Guide to Design, Visualization and Statistics", John Wiley & Sons, 3rd Edition, 2011.
4. Ben Fry, "Visualizing Data", O"Reilly Media, Inc., 2007.

Journals:

1. Deepmala Srivastava, "An Introduction to Data Visualization Tools and Techniques in Various Domains," International Journal of Computer Trends and Technology, vol. 71, no. 4, pp. 125-130, 2023. Crossref, https://doi.org/10.14445/22312803/IJCTT-V71I4P116
2. Diamond, Michael and Angela Mattia. "Data Visualization: An Exploratory Study into the Software Tools Used by Businesses." Journal of Instructional Pedagogies 17 (2015).

Video References:

1. https://www.youtube.com/watch?v=TPMlZxRRaBQ
2. https://youtu.be/64-cK-tdTPc

MOOC/SWAYAM/NPTEL Courses:

1. https://www.udemy.com/course/data-exploration-data-analysis-data-visualization/
2. https://www.coursera.org/courses?query=data%20visualization

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19AD252.1	Apply the key techniques and theory behind Data Exploration.
R19AD252.2	Apply the statistical techniques and methods for Data visualization
R19AD252.3	Apply various data visualization techniques for a variety of tasks
R19AD252.4	Implement data visualization techniques using Tableau and Power BI
R19AD252.5	Create story telling Dashboards using Tableau and Power BI

R19EC252	Digital Principles And Computer Organization	L	T	P	C
		3	0	2	4

1. Course Description:

This course introduces you to the fundamental concepts of digital circuits and computer architecture. By combining these two areas, you'll gain a foundational understanding of how computers work at a hardware level.

2. Course Objectives:

1. To facilitate understanding of logic gates and minimization techniques
2. To guide design of simple combinational logic circuits

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3. To instruct on operation of sequential logic circuits
4. To teach basic computer organization
5. To explain principles of parallel processing and memory hierarchy

3. Syllabus:

Unit-I: Logic Gates and Minimization Techniques

Basic Theorems and properties of Boolean algebra – canonical form and standard forms – digital logic gates – Minimization Techniques: K-Map (upto 4 variables) – Don't care condition - NAND & NOR Implementation.

Unit-II: Combinational Logic Circuits

Combinatorial Logic Circuits: Design Procedure – Half adder and Full adder – Half Subtractor and Full Subtractor – Magnitude comparator – Encoder and Decoder - Multiplexer and Demultiplexer – code converter (binary to gray, BCD to excess-3 and vice versa).

Unit-III: Sequential Logic Circuits

Sequential Circuits: Flip-flops-Triggering of Flip-flops- Registers – Shift Registers – Ripple Counters -Synchronous counters (up and down counter) – Random Access Memory (RAM).

Unit-IV: Basic Computer Organization

Data Representation: Fixed and Floating Point – Micro operations: Arithmetic, Logic, shift – Arithmetic Logic Shift Unit – Instruction Codes – Computer registers – Computer Instructions – Timing and control – Instruction Cycle – Design of Basic computer.

Unit-V: Performance Enhancement Techniques

Parallel processing - Pipelining – Arithmetic and Instruction pipeline – RISC pipeline - Memory hierarchy Main memory - Cache memory – Characteristics and Multiprocessors – Interconnection Structures.

List of Experiments:

1. Verification of Boolean theorems using logic gates.
2. Implementation of half adder and full adder using logic gates
3. Implementation of Multiplexer and De-multiplexer using logic gates.
4. Verification of JK and D Flip-flops.
5. Implementation of SISO and PIPO 4-bit shift register using Flip- flops.
6. Construction and verification of 4-bit ripple counter.

Text Books:

1. M. Morris Mano, Michael D Ciletti, "Digital Design", Pearson Edu, 6/e, 2018 (Unit I, II, III)
2. M. Morris Mano, "Computer System Architecture", Pearson Edu, 3/e, 2017 (Unit IV & V)

Reference Books:

1. Donald P. Leach and Albert Paul Malvino, "Digital Principles and Applications", MGH, 8/e, 2014
2. Thomas L. Floyd, "Digital Fundamentals", Pearson, 11/e, 2017
3. John L. Hennessy, David A. Patterson, "Computer Architecture A Quantitative Approach", Morgan Kaufmann Press, 5/e, 2012

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4. William Stallings, "Computer Organization and Architecture: Designing for Performance", Pearson, 10/e, 2016

Web Resources:

1. https://www.youtube.com/watch?v=lumpHzyakVs&t=1s
2. https://www.youtube.com/watch?v=Ol8D69VKX2k&t=4s/
3. https://www.youtube.com/watch?v=Ol8D69VKX2k&t=4s

MOOC / NPTEL / SWAYAM Course:

1. https://onlinecourses.nptel.ac.in/noc20_ee42/preview

4. Course Outcomes:

CO. No.	Course Outcome
R19EC252.1	Understand the working of logic gates and Apply minimization techniques
R19EC252.2	Design and analyze combinational logic circuits
R19EC252.3	Design and analyze sequential logic circuits
R19EC252.4	Understand the basic computer organization and apply in complex digital system design
R19EC252.5	Understand the various performance enhancement techniques in processors and memories.

R19AM313	Deep Learning for Computer Vision Laboratory	L	T	P	C
		0	0	2	1

1. Course Description:

This laboratory course focuses on practical applications of deep learning techniques in computer vision. Students will work with tools like TensorFlow or PyTorch or Keras to implement CNNs for image classification, and fine-tuning on pre-trained models, explore object detection with YOLO and Faster R-CNN, delve into semantic segmentation using CNNs, experiment with GANs for image generation, conduct image-to-image translation with Pix2Pix, study attention mechanisms in CNNs, and analyse adversarial attacks and defences in computer vision models. The course emphasizes hands-on learning through lab exercises and projects to develop skills in applying deep learning to real-world vision tasks.

2. Course Objectives:

1. To implement and fine-tune convolutional neural networks (CNNs) for image classification tasks in a practical setting.
2. To develop and deploy object detection models using deep learning frameworks.
3. To experiment with semantic segmentation techniques to understand pixel-level image analysis.
4. To implement activity detection and language captioning models using CNN, RNN and LSTM.
5. To design and train generative adversarial networks (GANs) for image generation and styletransfer applications.

3. List of Laboratory Experiments:

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1. Implementing frame processing methods: Serial, parallel, pipeline
2. Implementing CNN model for classification in images.
3. Object detection and localization with YOLO or Faster R-CNN
4. Semantic Segmentation using CNN.
5. Object detection and tracking in videos using CNN.
6. Human activity detection using CNN with LSTM.
7. Language captioning using CNN, RNN and LSTM.
8. Image-to-Image Translation with Pix2Pix.
9. Implementing image classification using vision transformer.
10. Generative Adversarial Networks (GANs) for Image Generation

References:

Reference Books:

1. Goodfellow, Ian, Yoshua Bengio, and Aaron Courville. Deep Learning. MIT Press, 2016.
2. Nielsen, Michael. Neural Networks and Deep Learning. Determination Press, 2016.
3. Prince, Simon J. D. Computer Vision: Models, Learning, and Inference. Cambridge UniversityPress, 2012.
4. Forsyth, David, and Jean Ponce. Computer Vision: A Modern Approach. Prentice Hall, 2002.

Web References:

1. Bishop, Christopher. Neural Networks for Pattern Recognition. New York, NY: OxfordUniversity Press, 1995.
2. Bishop, Christopher M. Pattern Recognition and Machine Learning. Springer, 2006.
3. Duda, Richard, Peter Hart, and David Stork. Pattern Classification. 2nd ed. New York, NY:Wiley-Inderscience, 2000.
4. Mitchell, Tom. Machine Learning. New York, NY: McGraw-Hill, 1997.
5. 5Richard Hartley, Andrew Zisserman, Multiple View Geometry in Computer Vision, 2004.
6. David Marr, Vision, 1982.
7. Yoshua Bengio (2009), "Learning Deep Architectures for AI", Foundations and Trends® inMachine Learning: Vol. 2: No. 1, pp 1-127. http://dx.doi.org/10.1561/2200000006
8. Szeliski, Richard. Computer Vision: Algorithms and Applications. Springer Science & Business Media, 2010.

4.Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19AM313.1	Apply Convolutional Neural Network for classification tasks.
R19AM313.2	Apply the principles behind object detection,semantic segmentation, and image generation usingdeep learning techniques.
R19AM313.3	Evaluate the performance of object detection algorithms like YOLO and Faster R-CNN through quantitative metrics and qualitative analysis.
R19AM313.4	Apply RNN for language integration in images.

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R19AM313.5	Design and develop advanced computer visionmodels vision transformers and Generative models.

R19CS216	Full Stack Development Laboratory	L	T	P	C
		0	0	2	1

1. Course Description:

The comprehensive laboratory course is designed to provide hands-on experience with essential technologies and frameworks in Full Stack development. Students will gain proficiency in HTML5, CSS3, JavaScript, ReactJS, Node.js with Express.js, and the fundamentals of MongoDB. The course is structured to cover both front-end and back-end development, emphasizing a holistic approach to creating robust and scalable web applications

2. Course Objectives:

1. To empower students to design, develop, and deploy dynamic web applications using HTML5, CSS3, and JavaScript
2. To introduce students to build fast, scalable, and maintainable front-end applications using ReactJS
3. To familiarize students with the skills to effectively use MongoDB to build robust, scalable, and data-driven applications
4. To acquaint students to build scalable and efficient web applications using Node.js and Express.js
5. To equip students with the skills to master Spring Boot's core features

3. List of Laboratory Experiments:

1. Develop a music streaming web application to provide users with a seamless and interactive music listening experience. Users should be able to discover, play, and share their favourite music in real-time. The application should support multiple features such as user authentication, personalized playlists, real-time updates on trending tracks, and social sharing capabilities
2. Build a video conferencing web application that facilitates seamless communication between individuals or groups through high-quality video and audio interactions and supports real-time features, user authentication, screen sharing to enhance the overall video conferencing experience
3. Develop a dynamic and engaging social media platform web application that connects users globally. The platform aims to provide a seamless and real-time social experience, allowing users to connect, share content, and interact with each other and should incorporate features such as user profiles, real-time feed updates, multimedia content sharing, instant messaging, and community building
4. Create a web application that constitutes a dynamic Content Management System (CMS) tailored for blogging that allows users to effortlessly create, manage, and share blog content and provides an intuitive interface, support multimedia content, and facilitate collaboration among multiple authors
5. Build a web application designed to serve as a real-time Project Management Dashboard to streamline project management processes, enhance collaboration, and provide stakeholders with a dynamic and comprehensive view of project progress. The

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application should offer real-time updates, intuitive navigation, and advanced project tracking features.

6. Design a web application to perform real-time analytics for data-driven decision-making. This web application aims to empower users to analyze, visualize, and derive insights from streaming data that will be suitable for industries requiring instantaneous data processing, such as finance, e-commerce environments
7. Develop a web application designed to revolutionize the job search process to provide job seekers with real-time access to a diverse range of job opportunities, personalized recommendations, and interactive tools to streamline the entire job searching experience
8. To develop an online crowdfunding web application to facilitate real-time creative financing for innovative projects. which acts as a catalyst for novel ideas by providing a dynamic platform where creators can present their visions, attract support, and turn aspirations into tangible achievements
9. Build a To-Do List web application elevates the task management experience through real-time collaboration and user authentication. This application provides users with an intuitive platform for creating, organizing, and collaborating on to-do lists in real-time, ensuring secure access and personalized task management
10. Develop a chat web application to facilitate real-time communication and collaboration. The web application aims to provide users with a seamless and interactive platform for one-on-one and group chats, ensuring instant messaging, multimedia sharing, and a user-friendly experience
11. Develop a comprehensive web application to empower users with a real-time expense tracking system for efficient money management that constitutes users with a user-friendly interface, real-time financial insights, and personalized budgeting features to help them make informed financial decisions and achieve their financial goals
12. Design a gaming web application that offers a real-time multiplayer gaming experience to provide users with a diverse range of games, interactive features, and a social gaming environment, allowing players to connect, compete, and collaborate in real-time

Text Books:

1. Vasan Subramanian, 'Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node', Second Edition, Apress, 2019
2. Brad Dayley, Brendan Dayley, Caleb Dayley, 'Node.js, MongoDB and Angular Web Development', Addison-Wesley, Second Edition, 2018

References:

1. Chris Northwood, 'The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer', Apress; 1st edition, 2018.
2. Kirupa Chinnathambi, 'Learning React: A Hands-On Guide to Building Web Applications Using React and Redux', Addison-Wesley Professional, 2nd edition, 2018.

Web Resources:

1. https://www.tutorialspoint.com/the-full-stack-web-development/index.asp
2. https://www.youtube.com/playlist?list=PL9ooVrP1hQOGTHk2auXsk3cyqRBbbsQ6l
3. https://www.freecodecamp.org/news/learn-web-development-free-full-stack-developer-courses-for-beginners/

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1. https://www.udemy.com/course/ultimate-web/?couponCode=SKILLS4SALEB
2. https://www.coursera.org/professional-certificates/ibm-full-stack-cloud-developer

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CS216.1	Demonstrate the ability to identify, define, and analyze complex problems using appropriate algorithms, data structures, methodologies and tools
R19CS216.2	Design effective visual representations (UML diagrams/Flowchart) to solve the identified problems
R19CS216.3	Create Fullstack solutions and implement them using suitable programming platforms
R19CS216.4	Develop effective presentation skills to present and defend the designs and solutions
R19CS216.5	Understand issues related to privacy, security and accessibility and adhere to coding standards

R19EM202	Advanced Logical Thinking	L	T	P	C
		0	0	2	1

1. Course Description:

This course aims to develop student's logical thinking skills to an advanced level. Students will explore various techniques and strategies to analyse, evaluate, and synthesize information effectively. Analyzing a situation or problem using a logical approach involves gathering all available information, assessing the facts and efficiently deciding the best course of action. Students strive to understand various topics deeply, enhance their memory skills and build greater understanding. They also apply their ideas effectively and thoroughly analyze any arising issues.

2. Course Objectives:

1. Enhance Critical thinking skills by solving programming logic problems involving permutations and combinations.
2. Enhance the Decision making skills using different Possibilities through Probability
3. To develop the skills to analyze complex problems in Simple Solutions through Time Speed Distance Concept
4. Enhance the strategic thinking for Solving Real life problems using Mathematical Concepts
5. Reinforce the Logical skills through Reasoning Puzzles

3. Syllabus:

Unit-I: Inductive Reasoning through Permutations & Combination

Fundamental Principles of Counting: Permutations & Combination, Number Generation Fundamentals; Digit repeater concepts: All possible ways; Recursion and Backtracking: N step Problems, Chess oriented problems and Case Studies.

Unit-II: Decision Making based on Probability

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Introduction to Probabilities, Application of Probability; Power of Compounding: Case Studies.
Unit-III: Strategical techniques in Time, Speed and Distance
Definition and Basics of Time, Speed and Distance; Relative speed: Problems based on Trains; Effective Speed: Problems based on Boats and Streams; Problems based on Races, Escalator problems; Case Studies.
Unit-IV: The Logical Approach to Mixture and Allegation
Introduction to Mixtures: Multi variable mixing, Profit and Loss concept based on mixing; Liquid mixing concepts: Replacement problems and Repetitive iteration problems.
Unit-V: Logical Reasoning
Introduction to design of clocks; Formula creation: Speed clock and Slow clock problems; Angle calculation; Calendars design: Concept of odd days, Day of a date and Calendar repetition logic; Data Arrangements; Data Sufficiency; Directions; Number series and Puzzles.
References:
Reference Books: 1. Dr. R S Aggarwal, Quantitative Aptitude, Revised Edition, S.Chand Publishing Company Ltd(s), 2022 2. Arun Sharma, How to prepare for Quantitative Aptitude for the CAT, 10th Edition, Tata McGraw-Hill Publishing Company Ltd, 2022 **Online References:** 1. https://www.hackerearth.com/ 2. https://www.geeksforgeeks.org/ 3. https://www.indiabix.com/

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19EM202.1	Develop the ability to use inductive reasoning to solve complex problems involving permutations and combinations.
R19EM202.2	Understand probability theory to make informed decisions under uncertainty.
R19EM202.3	Utilize strategic techniques to solve problems related to time, speed, and distance.
R19EM202.4	Apply logical reasoning to solve problems involving mixtures and allegations.
R19EM202.5	Enhance logical reasoning skills to tackle a variety of analytical problems.

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SEMESTER VI

R19IT303	Cryptography And Cyber Security	L	T	P	C
		3	0	0	3

1. Course Description:

This course provides a comprehensive introduction to the field of cryptography and cyber security. Cryptography is the cornerstone of modern information security, enabling secure communication, data integrity, authentication, and non-repudiation. Cyber security covering essential concepts, and principles. Students will develop into the fundamental principles of cryptography, understanding various cryptographic algorithms, cyber security landscape and vulnerabilities.

2. Course Objectives:

1. Learn to analyze the security of in-built cryptosystems.
2. Develop cryptographic algorithms for information security.
3. Comprehend the various types of data integrity and authentication schemes.
4. To understand Email & Transport level security.
5. To acquire knowledge in common Web Security Vulnerabilities.

3. Syllabus:

Unit – I:Introduction to Cryptography

Computer Security Concepts: The OSI Security Architecture, Security Attacks, Security Services, Mechanisms and attacks, A Model for Network Security; Classical encryption techniques: Substitution techniques, Transposition techniques, Steganography; Foundations of modern cryptography: Perfect security , Information Theory, Product Cryptosystem, Cryptanalysis.

Unit-II: Encryption Algorithms in Cryptography

Symmetric Key Encryption: Block ciphers and Stream Ciphers, Block Cipher Design Principles, Modes of operation, Data Encryption Standard, Advanced Encryption Standard (AES), Multiple Encryption, Triple DES. Asymmetric Key Encryption: Principles of public key cryptosystems, The RSA algorithm-Key management, Diffie Hellman Key exchange, Elliptic curve arithmetic, Elliptic curve cryptography.

Unit – III: Authentication Algorithms

Authentication requirement: Authentication function, MAC, Hash function, Security of hash function: HMAC, CMAC, SHA; Digital signature and authentication protocols: DSS, Schnorr Digital Signature Scheme, ElGamal cryptosystem; Entity Authentication: Biometrics, Passwords, Challenge Response protocols, Authentication applications ,Kerberos

Unit – IV: Introduction to Cyber Security

Email Security: Security Services for email, Attacks possible through email, Establishing keys privacy, authentication of the source, Message Integrity, Non-repudiation, Pretty Good Privacy, S/MIME.IP Security: Overview of IPSec, IPv4 and IPv6, Authentication Header, Encapsulation Security Payload (ESP), Internet Key Exchange. Transport Level Security: SSL/TLS Basic Protocol, computing the keys, client authentication, PKI as deployed by SSL, Attacks fixed in v3, Exportability, Encoding, Secure Electronic Transaction (SET).

Unit – V:Web Security Vulnerabilities

Vulnerabilities: SQL injection, Broken authentication, Sensitive data exposure, XML External Entities (XXE), Broken access control, Security misconfiguration, Cross-Site

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Scripting (XSS), Insecure deserialization, Using components with known vulnerabilities, Insufficient logging & monitoring, Cross-site request forgery (CSRF).

Text Books:

1. William Stallings, "Cryptography and Network Security - Principles and Practice", Seventh Edition, Pearson Education, 2017.
2. Behrouz A. Forouzan, "Introduction to Cryptography and Network Security", TataMcGraw-Hill Publishing 2nd Edition (2011).
3. Nina Godbole, Sunit Belapure, "Cyber Security: Understanding Cyber crimes, Computer Forensics and Legal Perspectives", First Edition, Wiley India, 2011.

References:

Book References:

1. Charlie Kaufman, Radia Perlman and Mike Speciner, "Network Security", Prentice Hall of India, 2002.
2. Manuel Mogollon, "Cryptography and Security Services – Mechanisms and Applications", Cyber tech Publishing, 2008.
3. William R. Cheswick, Steven M. Bellovin, Aviel D. Rubin, "Firewalls and Internet Security" Addison- Wesley, 2003.

Journals:

1. IEEE Security and Privacy
2. IEEE Transactions on Information Forensics and Security
3. ACM Transactions on Information and System Security

Video References:

1. https://www.youtube.com/watch?v=C7vmouDOJYM
2. https://www.youtube.com/watch?v=5jpgMXt1Z9Y
3. https://www.youtube.com/watch?v=HPM17_aZB3g
4. https://www.youtube.com/watch?v=hXSFdwIOfnE

MOOC/SWAYAM/NPTEL Courses:

1. https://onlinecourses.nptel.ac.in/noc22_cs03/preview
2. https://onlinecourses.nptel.ac.in/noc22_cs90/preview
3. https://onlinecourses.swayam2.ac.in/nou19_cs08/preview
4. https://www.udemy.com/course/certified-secure-netizen/

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19IT303.1	Apply the fundamentals of networks security, security architecture, threats and vulnerabilities.
R19IT303.2	Make use of Symmetric and Asymmetric encryption techniques to solve cryptographic problems.
R19IT303.3	Apply the different cryptographic operations of public key cryptography.
R19IT303.4	Analyze security services in Application, Transport and Network layers.
R19IT303.5	Examine common web application security vulnerabilities and various prevention mechanisms.

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R19EC352	Embedded Systems And Iot	L	T	P	C
		3	0	2	4

1. Course Description:

This course empowers you to unlock the potential of the Internet of Things (IoT) by diving into the core technologies driving smart devices. Gain a solid understanding of embedded system architecture and development processes, learn how to design and connect embedded hardware within the IoT landscape, and explore the powerful integration with cloud computing and GSM interfaces. By the end, you'll be equipped to develop and build your own simple IoT applications.

2. Course Objectives:

1. To facilitate Understanding of Embedded System Architecture
2. To guide Students Through the Embedded Systems Development Process and AI Integration
3. To instruct on IoT Architecture and Embedded Hardware Design
4. To explain Cloud Computing Concepts and GSM Interface
5. To guide the Development of Products for Simple IoT Applications

3. Syllabus:

Unit-I: Embedded System Architecture

Introduction to Embedded systems; application areas; categories; overview; specialities; recent trends; hardware architecture; software architecture; application software; communication software; Embedded System Lifecycle; process of generating executable image; developing and testing tools; Market available freeware for Embedded Systems development.

Unit-II: Embedded System Development

Development process: requirements engineering, design, implementation, integration and testing; Architecture of Kernel; Tasks and task scheduler; Interrupt service routines; semaphores; mailboxes; timers; memory management; valgrind for memory analysis priority inversion problem; Debugging Tools for Embedded Systems; Introduction to Embedded AI, Edge AI and role of Tiny ML in embedded systems.

Unit-III: IOT Architecture and Embedded Hardware

IoT Evolution and Applications; IoT Application development stages; Microcontrollers used in IoT; Arduino IDE and exploration; Basics of Arduino Programming; PWM signalling in Arduino; Interfacing Sensors: IR sensor; Potentiometer with Arduino; Interfacing Servo motor with Arduino; Introduction to Bluetooth Technology; Interfacing HC-05 and Arduino; Introduction to Arduino Mega, Due; Interfacing of Accelerometer and Colour Sensor; Interfacing Gyroscope with Arduino Uno.

Unit-IV: GSM, Cloud Computing and IoT

Introduction to GSM; Interfacing GSM with Arduino Uno; Calling; Messaging using GSM; Controlling an LED using GSM; Introduction to Cloud Computing; Challenges in Cloud Computing; Data protocols in IoT; Cloud types; Cloud architecture: Infrastructure, platforms, communication protocols and applications; Cloud Services: IaaS, PaaS, SaaS; Understanding Adafruit; Communicating with Cloud.

Unit-V: Product Building and Miniaturization

NodeMCU in a nutshell; ESP32 in a nutshell; Attiny85 in a Nutshell; Programming Attiny85 with Arduino Uno; Interfacing Gyro; Bluetooth with Attiny85; General Voltage Regulation

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Techniques for IoT; Raspberry Pi in a NutShell; Headless Setup of Raspberry Pi; Video Surveillance using Raspberry Pi; Realtime projects with IoT; Accident Impact Detection; Driver Drowsiness Detection System; Advanced Driver Assist System.

List of Experiments:

Prelims:

a. Interfacing Arduino with - Pot, Servo motor, IR Sensor, Stepper Motor, and other Analog/Digital sensors.

Core projects:

1. Displaying Text/Images using OLED
2. Controlling an LED using WebPage - With NodeMCU
3. Fire Accident Detection Project using MQ135 & LM35. Generating Alert using GSM
4. Logistics tracker using NodeMCU and GPS
5. Interfacing Gyro, Bluetooth with Attiny85
6. Interfacing Ultrasonic sensor and other sensors with Raspberry Pi

Text Books:

1. Embedded Systems- Architecture, Programming And Design | Third Edition - Rajkamal McGraw-Hill 2015 (Unit–I, II)
2. https://www.routledge.com/Lets-Get-IoT-fied-30-IoT-Projects-for-All-Levels/Juluru-Vasudevan-Murugesh/p/book/9780367706074 (Unit III, IV (Half))
3. Internet of Things, 2ed, Shriram K Vasudevan, Abhishek S Nagarajan, RMD Sundaram.
   ISBN: 9789388991018, Wiley India. (Unit IV, V)

Reference Books:

1. Shibu K.V., "Introduction To Embedded Systems", MGH, 2nd edition, 2017
2. Perry Xiao, "Designing Embedded Systems and the Internet of Things (IoT) with the ARM Mbed", Wiley, 2018

Journals:

1. IEEE Transactions on Embedded Systems
2. Journal of Embedded Computing

Magazines:

1. https://www.embedded.com/
2. https://www.iotworldtoday.com/

Web Resources:

1. https://www.arduino.cc/
2. https://www.raspberrypi.org/

MOOC / NPTEL / SWAYAM Courses:

1. https://onlinecourses.nptel.ac.in/noc20_ee98/preview
2. https://onlinecourses.nptel.ac.in/noc22_cs53/preview

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome

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R19EC352.1	Analyze and synthesize the architecture of Embedded Systems, delineating its constituent components.
R19EC352.2	Utilize conceptual understanding to apply the design process of Embedded Systems
R19EC352.3	Apply advanced cognitive skills to conceptualize the architecture of IoT systems and develop basic applications employing embedded hardware.
R19EC352.4	Apply higher-order cognitive abilities to implement Cloud services in IoT applications
R19EC352.5	Generate innovative solutions by integrating NodeMCU and Raspberry Pi boards to design IoT applications

R19AM351	Natural Language Processing	L	T	P	C
		2	0	2	3

1. Course Description:

This course offers a deep dive into the world of Natural Language Processing (NLP), providing learnerswith a structured and systematic approach to understanding the intricacies of human language and its computational processing. Through this multifaceted course, students will develop the ability to analyze and interpret human language using computational methods, and apply logical reasoning to address linguistic challenges and optimize NLP tasks.

2. Course Objectives:

1. To develop a solid understanding of the foundational concepts and principles of Natural Language Processing, including language structures, syntax, semantics, and pragmatics.
2. To gain hands-on experience with essential NLP techniques and tools, such as part-of-speech tagging, syntactic parsing, and semantic analysis, to effectively process and analyze textual data.
3. To apply NLP methodologies to real-world problems and applications, including text classification, sentiment analysis, machine translation, and information extraction.
4. To use industry-standard NLP tools, libraries, and resources, enhancing the ability to work withstemmers, taggers, lexicons, corpora, and other essential components of NLP.
5. To enhance analytical and problem-solving abilities by applying computational methods and logical reasoning to address linguistic challenges, optimize NLP tasks, and improve overall system performance.

3. Syllabus

Unit-I: Introduction

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Introduction to NLP; Various stages of NLP; The Ambiguity of Language: Why NLP Is Difficult; Partsof Speech: Nouns and Pronouns, Words: Determiners and adjectives, verbs, Phrase Structure; Statistics Essential Information Theory : Entropy, perplexity; Text Normalization: Basic pre-processing, Word and sentence segmentation, Lemmatization, Stemming, Introduction to Corpora: Corpora Analysis; Inflectional and Derivation Morphology, Morphological analysis and generation using Finite State Automata and Finite State transducer; Detecting and Correcting Spelling Errors; Minimum Edit Distance
Unit-II: Word Level Analysis
Smoothed N-grams; Evaluating N-grams; Smoothing; Interpolation and Backoff ; Word Classes, Part- of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models.
Unit-III: Syntactic Analysis
Context-Free Grammar, Grammar rules for English, Treebanks, Normal Forms for grammar, Dependency Grammar, Syntactic Parsing, Dynamic Programming parsing, Shallow parsing, Probabilistic CFG, Probabilistic CYK; Probabilistic Lexicalized CFGs: Feature structures, Unification of feature structures.
Unit-IV: Semantics and Pragmatics
Requirements for representation: First-Order Logic; Description Logics: Syntax-Driven Semantic analysis; Semantic attachments: Word Senses, Relations between Senses, Thematic Roles; Selection restrictions: Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus: Bootstrapping methods: Word Similarity using Thesaurus and Distributional methods.
Unit-V: Discourse Analysis and Lexical Resources
Discourse segmentation: Coherence, Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm; Coreference Resolution Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC).

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List of Laboratory Experiments:

Imagine you are working on a project to develop a new NLP tool that can analyze and enhance textual data. Below are some scenario-based questions based on the given experiments:

1. Imagine you are given a dataset containing unstructured text data from various sources. Your task is to preprocess this data to prepare it for Natural Language Processing tasks. Utilize Python libraries to perform text normalization techniques such as tokenization, stemming, and lemmatization. Provide a step-by-step approach to handle this preprocessing task.
2. You're developing a text analysis tool for a linguistics project. Use finite state automata to analyze and generate morphological forms of words in different languages.
3. Consider you're given a dataset of text documents containing numerous spelling errors. Describe your approach to detecting and correcting these errors using the Minimum EditDistance algorithm.
4. Assume you're analyzing the frequency of word sequences in a large text corpus. Implement and compare unsmoothed and smoothed N-grams to understand the languagepatterns better
5. Imagine you're tasked with developing a PoS tagging system for a specific domain like medical or legal texts. Implement and evaluate rule-based, stochastic, and transformation-based PoS tagging methods tailored to this domain.
6. You need to analyze the syntactic structure of sentences from a linguistic perspective. Describe your approach to performing syntactic parsing using Dependency Grammar and how you would visualize the parse trees.
7. ssume you're developing an NLP application that requires understanding the roles andmeanings of words in sentences. Implement Semantic Role Labeling using First-Order Logic and perform Word Sense Disambiguation using Supervised and Dictionary-basedmethods.
8. You're analyzing a collection of texts to understand discourse structures and resolve references. Explain your strategy to segment discourse, maintain coherence, and resolveanaphoric references using Hobbs and Centering Algorithm.
9. Imgaine you want to enrich your NLP tool with additional lexical resources. Explore andintegrate resources like WordNet, Penn Treebank, and Brill's Tagger to improve text processing capabilities.
10. You're aiming to enhance the parsing accuracy of your NLP tool by incorporating advanced techniques. Implement Probabilistic CFG, Probabilistic CYK, and Probabilistic Lexicalized CFGs, and what metrics would you use to evaluate their performance.

Text Books:

1. Daniel Jurafsky, James H. Martin, "Speech and Language Processing: An Introduction to NaturalLanguage Processing", Computational Linguistics and Speech, Pearson Publication, 2014.
2. Steven Bird, Ewan Klein and Edward Loper, —Natural Language Processing with Python‖, FirstEdition, O_Reilly Media, 2009.

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References:
Reference Books: 1. Breck Baldwin, —Language Processing with Java and Ling Pipe Cookbook, Atlantic Publisher,2015 2. Richard M Reese, —Natural Language Processing with Javall, Reilly Media, 2015. 3. Nitin Indurkhya and Fred J. Damerau, —Handbook of Natural Language Processing, SecondEdition, Chapman and Hall/CRC Press, 2010. 4. Tanveer Siddiqui, U.S. Tiwary, —Natural Language Processing and Information Retrievall,Oxford University Press, 2008
MOOC/SWAYAM/NPTEL Courses: 1. https://onlinecourses.nptel.ac.in/noc19_cs56/preview 2. https://onlinecourses.nptel.ac.in/noc20_cs87/preview

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19AM351.1	Apply the understanding of NLP fundamentals, including language ambiguity, parts of speech, and text normalizationtechniques, in practical NLP tasks and applications.
R19AM351.2	Demonstrate the ability to analyze and generate morphological structures using finite state automata and other NLP techniques
R19AM351.3	Implement algorithms for detecting and correcting spelling errors using techniques like Minimum Edit Distance.
R19AM351.4	Apply and evaluate unsmoothed and smoothed N-grams to analyze language patterns and sequences in text corpora.
R19AM351.5	Implement and assess rule-based, stochastic, and transformation-based PoS tagging methods on various text datasets.

R191T312	Cryptography and Cyber Security Laboratory	L	T	P	C
		0	0	2	1

1. Course Description:

This laboratory course provides hands-on experience in cryptography and cyber security, covering fundamental principles and practical techniques essential for securing digital information. Through a combination of theoretical lectures, practical exercises, and real-world case studies, students will gain an understanding of cryptographic algorithms, protocols, and tools used to protect data integrity, confidentiality, and authenticity in various computing environments.

2. Course Objectives:

- Implement the various symmetric and asymmetric cryptographic algorithms
- To configure virtual networks using network simulator.
- Exploit the various security tools for protecting a network.

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- Analyze the behaviour of packets in network using Wireshark.
- To perform the web penetration testing using Burp suite.

3. Syllabus:

List of Laboratory Experiments / Exercises:

1. Write a program to implement the following cipher techniques to perform encryption and decryption.
   (a) Caesar Cipher
   (b)Playfair Cipher
   (c) Hill Cipher
2. Write a program to implement the following transposition techniques
   (a) Rail fence technique –Row major transformation
   (b) Rail fence technique - Column major transformation
3. Write a program to implement DES algorithm.
4. Write a program to implement AES algorithm.
5. Write a program to implement RSA Encryption algorithm
6. Write a program to implement the Diffie-Hellman Key Exchangemechanism. Consider one of the parties as Alice and the other party asbob.
7. Write a program to calculate the message digest of a text using the SHA-1algorithm.
8. Write a program to calculate the message digest of a text using the MD-5algorithm.
9. To configure virtual networks using network simulator.
10. To install and exploit security tools for protecting a network.
11. To analyze the network packet using Wireshark.
12. To perform the web penetration testing using Burp suite.

References:

Book References:

1. Behrouz A. Forouzan, "Introduction to Cryptography and Network Security", Tata McGraw-Hill Publishing 2nd Edition (2011).
2. Nina Godbole, SunitBelapure, "Cyber Security: Understanding Cyber crimes, Computer Forensics and Legal Perspectives", First Edition, Wiley India,2011.

MOOC/SWAYAM/NPTEL Courses:

1. https://www.simplilearn.com/tutorials/cryptography-tutorial
2. https://www.mygreatlearning.com/blog/cryptography-tutorial/
3. https://www.tutorialspoint.com/cryptography/index.htm
4. https://www.simplilearn.com/tutorials/cyber-security-tutorial
5. https://www.geeksforgeeks.org/cyber-security-tutorial/

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19IT312.1	Develop a code for classical encryption techniques.
R19IT312.2	Build symmetric and asymmetric algorithms to secure the data
R19IT312.3	Construct a code for various Authentication schemes.

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R19IT312.4	Apply the various principles, schemes, methods of digital signature in Public Key Cryptosystems
R19IT312.5	Implementation of various network exploits and their mitigation techniques using simulators and real devices.

R19AM384	Project on Robotics using AI	L	T	P	C
		0	0	6	3

1.Course Description:

This course is designed to provide students with an opportunity to apply their knowledge and skills acquired to a real-world project. Students will work to define, plan, execute, and present a project under the guidance of a faculty supervisor. Students will collaborate in teams to tackle real-world challenges, emphasizing creativity, critical thinking, and project management skills, thus reflecting the relevant TRL and SDG levels.

2.Course Objectives:

- Understand and apply the five stages of design thinking to various contexts.
- Empathize with users to uncover needs that drive innovative solutions.
- Ideate practical and original solutions to complex challenges.
- Develop prototypes and iterate based on user feedback.
- Work in diverse teams to manage projects from conception to completion.
- Present design concepts and prototypes clearly and persuasively.

3. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19AM384.1	Articulate the principles and processes of design thinking.
R19AM384.2	Demonstrate the ability to conduct comprehensive user research and synthesize findings into actionable project insights.
R19AM384.3	Apply ideation techniques to generate innovative and practical solutions.
R19AM384.4	Design and develop prototypes using appropriate tools and technologies.
R19AM385.5	Evaluate prototypes and iterate based on user feedback and testing results.

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8.1 Professional Elective Syllabus

R19AM511	Time Series Analysis and Forecasting	L	T	P	C
		3	0	0	3

1. Course Description:

Proficiency in various forecasting methods such as moving averages, exponential smoothing, ARIMA (Autoregressive Integrated Moving Average), and machine learning techniques like neural networks can be applied by the students. Moreover budgeting, inventory management, resource allocation, and sales forecasting can be done.

2. Course Objectives:

1. To study about decomposition and smoothing.
2. To study the forecast accuracy and error statistics.
3. To study trend in time series analysis and forecasting implications.
4. To study the ARIMA Models and Dynamic linear models.

3. Syllabus

Unit-I: Time Series Decomposition and Smoothing

Decomposition – Steps in decomposition – Decomposition in R – Smoothing – Exponential smoothing –Single exponential smoothing – Double exponential smoothing – Seasonal exponential smoothing – Forecasting with Exponential Smoothing.

Unit-II: Forecast Accuracy

Regression method – Line of Best Fit – Forecast Accuracy - Mean Squared Error (MSE) – Mean Absolute Deviation (MAD) - Cumulated Forecast Error (CFE) - Symmetrical Mean Absolute Percentage Error (sMAPE)- Forecast Error Statistics and Evaluation.

Unit-III: Time Series Analysis I

Covariance Stationarity – Definition for Random Vectors – White noise – Auto regressive process –Weakly Vs strictly stationary - Trend in Time Series – Deterministic Trends – Stochastic trends – Forecasting implications - Unit Root Problem: Estimation and Testing.

Unit-IV: Time Series Analysis II: Arima Models

Identification- Estimation and Diagnostic Checking - Introduction to Forecasting - ARMA Analysis of Regression Residuals.

Unit-V: Time Series Analysis III: Advanced Topics

ARCH and GARCH Model Estimation - Multi-Equation Time Series Models - Dynamic Linear Models – Case study.

Text Books:

1. Paul S.P. Cowpertwait and Andrew V. Metcalfe, Introductory Time Series with R, Springer-Verlag, New York, 2009.
2. Rob J. Hyndman and George Athanasopoulos, Forecasting: Principles and Practice, Oneline, Open Access Textbooks.

References:

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Reference Books:
1. Walter Zucchini, Oleg Nenadic, Time Series Analysis with R. 2. Avril Coghlan, A Little Book of R for Time Series.
Journals (Reference):
1. Time Series Analysis and Forecasting 2. Theory and Applications of Time Series Analysis 3. Journal of Time Series Analysis
MOOC/NPTEL/SWAYAM Course:
1. Applied Time Series Analysis

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19AM511.1	Understand the concepts of time series decomposition and smoothing.
R19AM511.2	Apply the design and characteristics Forecast accuracy and error evaluation.
R19AM511.3	Apply the design and characteristics of random
R19AM511.4	Analyze the estimation and diagnostic checking in ARMA Analysis.
R19AM511.5	Analyze the advanced time series ARCH and GARCH Model Estimation.

R19AM512	Video Analytics	L	T	P	C
		3	0	0	3

1. Course Description:
Video analytics is an interdisciplinary field that combines computer vision, machine learning, and data analytics techniques to extract meaningful insights from video data. This course is designed to provide students with a comprehensive understanding of video analytics, covering its fundamental concepts, applications, and practical implementations.
2. Course Objectives:
1. To understand the need for video Analytics 2. To understand the basic configuration of video analytics 3. To understand the functional blocks of a video analytic system 4. To understand the various security related applications in video analytics 5. To get exposed to the various applications of video analytics.
3. Syllabus
Unit-I: Video Analytic Components
Need for Video Analytics-Overview of Video Analytics- Foreground extraction- Feature extraction- classifier - Pre-processing- edge detection- smoothening- Feature space-PCA-FLD-SIFT features.
Unit-II: Foreground Extraction
Background estimation- Averaging- Gaussian Mixture Model- Optical Flow-based- Image Segmentation- Region growing- Region splitting-Morphological operations- erosion-Dilation- Tracking in a multiple camera environment.

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Unit-III: Classifiers
Neural networks (backpropagation) - Deep learning networks- Fuzzy Classifier- Bayesian classifier-HMM based classifier.
Unit-IV: Video Analytics for Security
Abandoned object detection- human behavioral analysis -human action recognition- perimeter security- Crowd Behavior and Social Group Analysis Techniques in Smart Surveillance- Person Re-identification
Unit-V: Video Analytics for Business Intelligence & Traffic Monitoring and Assistance
Intelligent Traffic Video Analytics- Automated Behavior Understanding in Learning Environments: A Review of Opportunities, Emerging Methods, and Challenges-Residual-driven Fuzzy C-Means Clustering for Image Segmentation.
Text Books: 1. El-Sayed M. El-Alfy, George Bebis, Mengchu Zhou, "Intelligent Image and Video Analytics", 1st Edition, CRC Press, 2023 2. Nilanjan Dey (Editor), Amira Ashour (Editor) and Suvojit Acharjee (Editor), "Applied Video Processing in Surveillance and Monitoring Systems", (IGI global) 2016.
References:
Reference Books: 1. Maheshkumar H Kolekar, Intelligent Video Surveillance Systems and Algorithmic Approach An Algorithmic Approach, 1st Edition, CRC Press, 2023. 2. Caifeng Shan (Editor), Fatih Porikli (Editor), Tao Xiang (Editor), Shaogang Gong (Editor) Video Analytics for Business Intelligence, Springer, 2012.
Journals (Reference): 1. Multimodal Deep Learning Methods for Video Analytics 2. Video Analytics
MOOC/NPTEL/SWAYAM Courses: 1. https://onlinecourses.nptel.ac.in/noc23_ee53/preview 2. https://onlinecourses.nptel.ac.in/noc23_cs56/preview

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19AM512.1	Explain the requirement for Video analytics
R19AM512.2	Differentiate between estimation, extraction, segmentation and tracking models with case study
R19AM512.3	Apply the suitable classifiers for a given problem
R19AM512.4	Apply an appropriate human behavioral technique and improve the performance for a given problem
R19AM512.5	Design custom made video analytics system for the given target application

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R19AM513	Text and Speech Analytics	L	T	P	C
		3	0	0	3

1. Course Description:

This course comprehensively introduces the core concepts and practical applications of text and speech Technologies. Students will gain foundational knowledge and hands-on experience in developing systems that understand, interpret, and generate human language in both text and speech formats. The curriculum is structured to provide a progressive learning experience, starting from the basics and advancing to complex system development.

2. Course Objectives:

1. Understand natural language processing basics
2. Apply classification algorithms to text documents
3. Build question-answering and dialogue systems
4. Develop a speech recognition system
5. Develop a speech synthesizer

3. Syllabus

Unit-I: Natural Language Basics

Foundations of natural language processing – Language Syntax and Structure- Text Preprocessing and Wrangling – Text tokenization – Stemming – Lemmatization – Removing stopwords – Feature Engineering for Text representation – Bag of Words model- Bag of N-Grams model – TF-IDF model

Unit-II: Text Classification

Vector Semantics and Embeddings -Word Embeddings - Word2Vec model – Glove model – FastText model – Overview of Deep Learning models – RNN – Transformers – Overview of Text summarization and Topic Models

Unit-III: Question Answering and Dialogue Systems

Information retrieval – IR-based question answering – knowledge-based question answering – language models for QA – classic QA models – chatbots – Design of dialogue systems -– evaluating dialogue systems.

Unit-IV: Text-To-Speech Synthesis

Overview. Text normalization. Letter-to-sound. Prosody, Evaluation. Signal processing - Concatenative and parametric approaches, WaveNet and other deep learning-based TTS systems.

Unit-V: Automatic Speech Recognition

Speech recognition: Acoustic modelling – Feature Extraction - HMM, HMM-DNN systems.

Text Books:

1. Daniel Jurafsky and James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Third Edition, 2022.

References:

Reference Books:

1. Dipanjan Sarkar, "Text Analytics with Python: A Practical Real-World approach to Gaining Actionable insights from your data", APress,2018.
2. Tanveer Siddiqui, Tiwary U S, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.

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3. Lawrence Rabiner, Biing-Hwang Juang, B. Yegnanarayana, "Fundamentals of Speech Recognition" 1st Edition, Pearson, 2009.
4. Steven Bird, Ewan Klein, and Edward Loper, "Natural language processing with Python", O'REILLY.

Journals (Reference):

1. https://link.springer.com/journal/10772
2. https://uk.sagepub.com/en-gb/cur/textual-analysis/book237784

MOOC/NPTEL/SWAYAM Courses:

1. https://onlinecourses.nptel.ac.in/noc19_mg47/preview
2. https://nptel.ac.in/courses/106101224
3. https://onlinecourses.nptel.ac.in/noc19_cs56/preview

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19AM513.1	Explain existing and emerging deep learning architectures for text and speech processing
R19AM513.2	Apply deep learning techniques for NLP tasks, language modelling and machine translation
R19AM513.3	Explain coreference and coherence for text processing
R19AM513.4	Build question-answering systems, chatbots and dialogue systems
R19AM513.5	Apply deep learning models for building speech recognition and text-to-speech systems

R19AM514	Statistical Analysis and Computing	L	T	P	C
		3	0	0	3

1. Course Description:

This course introduces fundamental concepts in probability theory, hypothesis testing, and statistical inference. Students will learn to analyze data using parametric and non-parametric tests, explore sampling distributions, and apply correlation and regression analysis techniques. Through hands-on exercises and real-world examples, students develop the skills needed to make informed decisions and draw meaningful insights from data.

2. Course Objectives:

1. To learn a basic introduction to statistics.
2. To study sampling distribution by using various techniques.
3. To enhance knowledge on testing on parametric hypothesis.
4. To learn about the Non-parametric tests for data analysis
5. To study correlation and regression concepts.

3. Syllabus

UNIT-I: Introduction

Basic definitions and rules for probability, Baye's theorem and random variables, Probability distributions: Binomial, Poisson, Uniform and Normal distributions.

UNIT-II: Sampling Distribution and Estimation

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Introduction to sampling distributions, Central limit theorem and applications, sampling techniques, Point and Interval estimates of population parameters.
UNIT-III: Testing of Hypothesis - Parametric Tests
Hypothesis testing: one sample and two sample tests for means of large samples (z-test), one sample and two sample tests for means of small samples (t-test), ANOVA one way.
UNIT-IV: Non-Parametric Tests
Chi-square tests for independence of attributes and goodness of fit, Kolmogorov-Smirnov – test for goodness of fit, Mann – Whitney U test and Kruskal Wallis test.
UNIT-V: Correlation and Regression
Correlation –Rank Correlation – Regression – Estimation of Regression line – Method of Least Squares – Standard Error of estimate.
Text Books: 1. Richard I. Levin, David S. Rubin, Masood H.Siddiqui, Sanjay Rastogi, Statistics for Management, Pearson Education, 8th Edition, 2017. 2. T N Srivastava and Shailaja Rego, Statistics for Management, Tata McGraw Hill, 3rd Edition 2017.
References:
Reference Books: 1. David R. Anderson, Dennis J. Sweeney, Thomas A.Williams, Jeffrey D.Camm, James J.Cochran, Statistics for business and economics, 13th edition, Thomson (South – Western) Asia, Singapore, 2016. 2. N. D. Vohra, Business Statistics, Tata McGraw Hill, 2017. 3. Dr.Debashis Dutta, Statistics and Operation Research-A Unified Approach, Second Edition, Laxmi Publications,2006.
Journals (Reference): 1. Journal of Statistical Software - https://www.jstatsoft.org/index 2. Computational Statistics & Data Analysis - https://www.sciencedirect.com/journal/computational-statistics-and-data-analysis 3. Statistics and Computing - https://link.springer.com/journal/11222 4. Journal of Computational and Graphical Statistics - https://www.tandfonline.com/toc/ucgs20/current
MOOC/NPTEL/SWAYAM Courses: 1. https://onlinecourses.nptel.ac.in/noc22_cs120/preview 2. https://onlinecourses.nptel.ac.in/noc21_ma74/preview

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19AM514.1	To apply objective solutions in business decision-making.
R19AM514.2	To apply the knowledge and understand the real-world business problems
R19AM514.3	To apply statistical techniques to data sets, and correctly interpret the
R19AM514.4	To develop skill-set that is in demand in both the research and business environments

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R19AM514.5	To enable the students to apply the statistical techniques in a work setting.

R19AM515	Data Warehousing and Mining	L	T	P	C
		3	0	0	3

1. Course Description:

Data Warehousing and Mining is a comprehensive course designed to provide students with a solid understanding of the concepts, techniques, and tools involved in managing and analyzing large volumes of data. The course encompasses both theoretical principles and practical applications, focusing on the creation, maintenance, and utilization of data warehouses for decision support and business intelligence.

2. Course Objectives:

1. To study data warehouse concepts, architecture, business analysis and tools
2. To understand data mining and data pre-processing techniques
3. To study algorithms for finding hidden and interesting patterns in data
4. To understand and apply various classification and clustering techniques
5. Understand various applications on data mining, data types and tools

3. Syllabus

Unit-I: Data Warehousing and Online Analytical Processing

Data Warehouse: Basic Concepts-Components –Database Architectures for Parallel Processing. Multidimensional Data Modelling – Data Warehouse Schemas, Concept Hierarchies -Characteristics of OLAP Systems – Typical OLAP Operations, OLAP and OLTP.

Unit-II: Data Mining and Data Preprocessing

Data Mining- Functionalities-Classification of Data Mining Systems-Data Preprocessing: Needs Preprocessing the Data - Data Cleaning- Data Integration and Transformation-Data Reduction.

Unit-III: Association Rule Mining and Classification

Mining Frequent Patterns, Associations and Correlations – Mining Methods – Mining various Kinds of Association Rules – Correlation Analysis – Constraint Based Association Mining- Classification: Advanced Methods

Unit-IV: Cluster Analysis

Cluster Analysis: Basic Concepts and Methods-Advanced Cluster Analysis-Deep Learning-Outlier Detection

Unit-V: Data Mining Trends and Tools

Mining Complex Data Types: Mining Sequence Data-Mining Graphs and Networks-Visual and Audio Data Mining-Data Mining Applications-Data Mining and Society-Data Mining Trends. Data Mining Tools: Weka Tools-Orange Data Mining

Text Books:

1. Jiawei Han & Micheline kamber, "Data Mining-Concepts and Techniques" Morgan Kaufmann Publishers, Fourth Edition, 2022.

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2. Alex Berson and Stephen J.Smith, —Data Warehousing, Data Mining & OLAP‖, Tata McGraw – Hill Edition, 35th Reprint 2016.

Reference

Reference Books:

1. Arun K Pujari, "Data Mining Techniques" Universities Press India Ltd., Third Edition, 2012.
2. Ian H.Witten and Eibe Frank, —Data Mining: Practical Machine Learning Tools and Techniques‖, Elsevier, Second Edition.
3. George M. Marakas, "Modern Data Warehousing, Mining, & Visualization Core concepts", Pearson Education, 2003.

Journals (Reference):

1.https://www.sciencedirect.com/book/9780128206010/artificial-intelligence-in-data-mining
2. https://orangedatamining.com/

MOOC/NPTEL/SWAYAM Courses:

1. https://nptel.ac.in/courses/106105174
2. https://www.udemy.com/course/data-warehousing

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19AM515.1	Understand the concepts of Data Warehouse and Online Analytical Processing (OLAP)
R19AM515.2	Understand the Multidimensional Data Modeling Concepts
R19AM515.3	Apply preprocessing and cleaning techniques for data analysis.
R19AM515.4	Implement ETL Processes and data transformation techniques.
R19AM515.5	Analyze frequent pattern and association rule mining techniques for data analysis

R19AM516	Generative AI	L	T	P	C
		3	0	0	3

1. Course Description:

This course explores Generative AI, a type of AI that creates new content, from images to music. Learn core concepts, applications, and the impact of this revolutionary technology.

2. Course Objectives:

1. Understand the core concepts and applications of Generative AI, including text generation, Generative Adversarial Networks (GANs), and Prompt Engineering.
2. Explore the capabilities of Large Language Models (LLMs) and implement them using LangChain libraries for real-world tasks.
3. Gain practical knowledge of advanced Generative AI models like Gemini and LLAMA2 for creative content generation and information retrieval applications.

3. Syllabus

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UNIT I: Introduction to Generative AI
Introduction to Generative AI, Importance and Applications of Gen AI. Text Generation: Generating Text using RNN, Limitation of RNN in text generation. Transformer: Encoder, Self-Attention layer, Decoder. Benefits of Attention for text generation Case Study: Generating Creative Content with GPT-3. A marketing agency is tasked with creating engaging social media content for a client's new product launch. They want to explore innovative ways to capture audience attention.
UNIT II: Introduction to Prompt Engineering
Introduction to Prompt Engineering: Prompt Engineering, benefits and applications of prompt engineering, Core concept of prompt design. Prompt types: Instructional prompts, Few shot prompts, Cloze detection prompts and template based prompts. Fine-tuning Prompts for Improved Performance. Case Study: Scientific Research and Data Exploration. Researchers use prompt engineering to help analyse complex scientific data. By crafting prompts that highlight specific research questions or areas of interest, the LLM can summarize findings, identify potential trends, or even suggest new hypotheses for further investigation.
UNIT III: Generative Adversarial Networks
Introduction to Generative Adversarial Networks, Generator and Discriminator model, Types of Generative Adversarial Models: Vanilla GAN, Conditional GAN and Deep Convolutional GAN. Case Study: Generating Personalized Workout Playlists with GANs. A fitness app wants to personalize workout experiences by creating music playlists that dynamically adapt to a user's exercise intensity and preferences.
UNIT IV: Introduction to LLM and Pertained LLM Models
Introduction to LLM Models: Understanding the LLM models: Bidirectional Encoder Representations from Transformers, T5, and GPT. Implementing various language models using Lang chain libraries and fine-tuning. Case Study: Building a Chat with PDF using Lang Chain and Astra DB. Build a chat interface using Lang Chain to understand user questions in natural language. Astra DB, a NoSQL database, stores vector representations of the PDF text for efficient retrieval
UNIT V: Advanced Generative AI
Advanced Generative AI: Gemini and Gemini pro model, Fine Tuning to LLAMA2 using LORA and QLORA, Vector Database, Building a RAG LLM app using LLAMA2 and LLAMA index. Fine-tuning with google Gemma with LORA. Case Study: Build Large Language model and Large Image Model using pre trained models. Develop a versatile creative assistant application that leverages the power of pre-trained large language models (LLMs) and large image models (LIMs) to assist users in various creative tasks.
References:
Reference Books: 1. Wani, M.A., Raj, B., Luo, F., Dou, D. (Eds.), Deep Learning Applications, Volume 3,Springer Publications 2022 2. Charu C. Aggarwal, ``Neural Networks and Deep Learning: A Textbook", Springer International Publishing, 2018. 3. Numa Dhamani, Maggie Engler "Introduction to Generative AI" Manning Publications,2024 4. Joseph Babcock, Raghav Bali "Generative AI with Python and Tensor Flow 2: Create images, text, and music with VAEs, GANs, LSTMs, Transformer models" PACKT Publishing, 2021

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5. Iqbal Hussain "Introduction to Prompt Engineering with Chat GPT: A Beginner's Guide" Amazon Kindle edition, 2023.
6. Jacob Emerson "Ripples of Generative AI: How Generative AI Impacts, Informs, and Transforms Our Lives" Amazon Kindle Edition, 2023.
7. Ian Goodfellow, Yoshua Bengio, Aaron Courville, ``Deep Learning", MIT Press, 2016.
Stone, James. "Artificial Intelligence Engines: A Tutorial Introduction to the Mathematics of Deep Learning", Sebtel Press, United States, 2019
8. Kulkarni, A., Shivananda, A., Kulkarni, A., & Gudivada, D. (2023). Diffusion Model and Generative AI for Images. In Applied Generative AI for Beginners: Practical Knowledge on Diffusion Models, ChatGPT, and Other LLMs (pp. 155-177). Berkeley, CA: Apress.

Journals (Reference):

1. International Journal of Data Science and Analytics
2. Journal of Data Science
3. Knowledge and Information system

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19AM516.1	Recall and define core concepts of Generative AI and its applications.
R19AM516.2	Explain the differences and limitations of RNNs and Transformers in text generation.
R19AM516.3	Analyze the working principles of Generative Adversarial Networks
R19AM516.4	Compare and differentiate between various GAN architectures (Vanilla GAN, Conditional GAN, Deep Convolutional GAN) based on their functionalities.
R19AM516.5	Design effective prompts using prompt engineering principles and assess their impact on different tasks.

R19AM517	Multi-Prompt Engineering	L	T	P	C
		3	0	0	3

1. Course Description:

This course provides an in-depth exploration of multi-prompt engineering, a specialization within artificial intelligence (AI) that focuses on utilizing multiple prompts to refine and improve the responses generated by AI models. Students will gain the skills to craft effective prompts that leverage the power of large language models (LLMs) for complex tasks involving multiple instructions or outputs.

2. Course Objectives:

1. Understand the concept of multi-prompt engineering and its advantages over single prompts.
2. Analyze the key applications of multi-prompt engineering across various domains.
3. Implement ethical considerations and best practices in multi-prompt engineering to ensure fairness, transparency, and responsible use of AI technologies.
4. Develop skills in formulating prompts for various tasks, including generating creative text formats, chaining outputs, and achieving specific goals across multiple steps
5. Evaluate the effectiveness of multi-prompting strategies and analyze the generated outputs critically.

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3. Syllabus
Unit-I: Introduction to AI, NLP, and Language Models
History and Evolution of AI; Basics of Machine Learning; Introduction to Natural Language Processing, Key Challenges in NLP; Overview of Language Models; Understanding Transformers and their impact; Introduction to GPT and BERT Models; How Language Models Learn; Applications of Language Models in the Real World; Setting Up a Python Environment for NLP.
Unit-II: Foundations of Prompt Engineering
Prompt Engineering: Importance of Prompt Design in AI Interactions, Types of Prompts: Zero-shot, One-shot, Few-shot; Algorithm, Case Studies, Troubleshooting and Optimizing models; Chain-of-Thought Prompting: Introduction; The Role of Chain-of-Thought in Complex Problem Solving; Designing Effective Chain-of-Thought Prompts; Examples; Evaluating the Effectiveness of Chain-of-Thought Responses; Building Chain-of-Thought Prompts for AI Models; Hands-on: Solving Math Word Problems Using Chain-of-Thought; Case Studies: Chain-of-Thought in Various Domains.
Unit-III: Multi-Prompt Engineering Ethics and Society
Iterative Prompting: The Process of Refining AI Outputs Through Iteration, Implementation, Analysing and Improving Iterative Responses; Negative Prompting and Hybrid Prompting: Crafting Negative Prompts for Specific Outcomes, Designing and Evaluating the Efficacy of Hybrid Prompts for Complex Applications; Prompt Chaining: Designing Effective Prompt Chains for Sequential Tasks, Understanding the Logic Flow in Prompt Chains, Analysing Results and Feedback Loops in Prompt Chaining; Ethical Considerations in Prompt Engineering: Bias, Fairness, and Transparency in AI Responses, Privacy Concerns with Language Models, Ethical Design and Implementation of Prompts, Global Perspectives on AI Ethics, Developing Ethical Guidelines for Prompt Engineering.
Unit-IV: Advanced Techniques and Applications
Overview of Advanced Prompting Techniques; Meta-Prompting: Theory and Applications; Prompt Tuning and Fine-Tuning Language Models; Leveraging External Knowledge Bases in Prompting; Advanced Evaluation Metrics for Prompting Strategies; Practical Implementations of Advanced Techniques; Hands-on: Meta-Prompting for Custom Use Cases; Developing a Fine-Tuned Model for a Specific Task; Integrating Prompt Engineering with Other AI Techniques; Challenges and Solutions in Advanced Prompting.
Unit-V: Industry Applications and Case Studies
Prompt Engineering in Content Creation and Journalism; Applications in Healthcare: Diagnostic Assistance and Patient Care; Enhancing Customer Service with AI and Prompt Engineering. Creating LLM model using pretrained model. Developing Large Image Model.
Text Books: 1. John Schulman, "Prompt Engineering for Generative AI", O'Reilly Media, 2023. 2. Emily M. Bender and Timnit Gebru, "The Prompt: A Practical Guide to Crafting Prompts for ChatGPT and Other Large Language Models", Manning Publications, 2023.
References:
Reference Books: 1. Lewis Liu, "Natural Language Processing with Transformers", Manning Publications, 2020 2. Steve McConnell, "Code Complete", Third Edition, Microsoft Press, 2020.
MOOC/NPTEL/SWAYAM Courses: 1. https://www.deeplearning.ai/short-courses/chatgpt-prompt-engineering-for-developers/

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2. https://www.coursera.org/learn/prompt-engineering

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19AM517.1	Understand the foundational concepts of artificial intelligence, machine learning, and natural language processing, with practical experience in setting up Python environments and applying machine learning to NLP tasks.
R19AM517.2	Analyze and compare the advantages of multi-prompt engineering over single prompts, demonstrating a comprehensive understanding of its benefits across various applications.
R19AM517.3	Develop proficiency in formulating effective prompts for diverse tasks, including generating creative text formats, chaining outputs, and achieving specific goals across multiple steps.
R19AM517.4	Evaluate the effectiveness of different multi-prompting strategies for specific tasks, focusing on clarity, coherence, and adherence to instructions in the generated outputs.
R19AM517.5	Assess the performance and accuracy of multi-prompt engineering models, utilizing advanced evaluation metrics to measure their efficacy and reliability.

R19AM518	Robot Kinematics and Dynamics	L	T	P	C
		3	0	0	3

1. Course Description:

This course introduces the basic concepts and tools used to analyze the kinematics and dynamics of robot manipulators. Topics include kinematic representations and transformations, positional and differential kinematics, singularity and workspace analysis, inverse and forward dynamics techniques, and trajectory planning and control.

2. Course Objectives:

1. To impart knowledge about kinematics and dynamic analysis of robot manipulators.
2. To control both the position and orientation of the tool in the three dimension space.
3. The relationship between the joint variables and the position and orientation of the tool.
4. Planning trajectories for the tool to follow in order to perform meaningful tasks.
5. To precisely control the high speed motion of the system.

3. Syllabus

UNIT-I: Introduction

Introduction - position and orientation of objects - objects coordinate frame Rotation matrix - Euler angles Roll - pitch and yaw angles coordinate Transformations - Joint variables and position of end effector - Dot and cross products - coordinate frames - Rotations - Homogeneous coordinates

UNIT-II: Direct Kinematics

Link coordinates D-H Representation - The ARM equation. Direct kinematic analysis for Four axis - SCARA Robot and three - five and six axis Articulated Robots.

UNIT-III: Inverse Kinematics

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Inverse kinematics problem - General properties of solutions. Tool configuration - Inverse kinematics of four axis SCARA robot and three & five axis - Articulated robot.
UNIT-IV: Workspace Analysis and Trajectory Planning
Workspace Analysis - work envelope of a Four axis SCARA robot and five axis articulated robot workspace fixtures - the pick and place operations - Joint space technique – continuous path motion - Interpolated motion - straight line motion and Cartesian space technique in trajectory planning.
UNIT-V: Manipulator Dynamics
Introduction - Lagrange's equation kinetic and potential energy. Link inertia Tensor - link Jacobian Manipulator inertia tensor. Gravity - Generalized forces - Lagrange-Euler Dynamic model - Dynamic model of a Two-axis planar robot - Newton Euler formulation - Lagrange Euler formulation - problems.
Text Books: 1. Robert J. Schilling, Fundamentals of Robotics Analysis and Control, PHI Learning, 2009. 2. Richard D. Klafter, Thomas A, Chri Elewski, Michael Negin, Robotics Engineering an Integrated Approach, Phi Learning., 2009.
References:
Reference Books: 1. P.A. Janaki Raman, Robotics and Image Processing An Introduction, Tata Me Graw Hill Publishing company Ltd., 1995. 2. Francis N-Nagy Andras Siegler, Engineering foundation of Robotics, Prentice Hall Inc., 1987. 3. Bernard Hodges, Industrial Robotics, Second Edition, Jaico Publishing house, 1993. 4. Tsuneo Yohikwa, Foundations ofRobotics Analysis and Control, MIT Press., 2003. 5. John J. Craig, Introduction to Robotics Mechanics and Control, Third Edition, Pearson, 2008. 6. Bijay K. Ghosh, Ning Xi, T.J. Tam, Control in Robtics and Automation Sensor – Based integration, Academic Press, 1999.
Journals (Reference): 1. International Journal of Mechanical Engineering Education - https://researchwith.njit.edu/en/publications/studying-robot-kinematics-and-dynamics-with-the-aid-of-mathematic. 2. MDPI - https://www.mdpi.com/journal/machines/special_issues/7K21Q6202L
MOOC/NPTEL/SWAYAM Courses: 1. https://archive.nptel.ac.in/courses/112/105/112105236/. 2. https://archive.nptel.ac.in/courses/112/108/112108298/.

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19AM518.1	Control both the position and orientation of the tool in the three dimensional space & establish a relationship between the joint variables and the position and orientation of the tool
R19AM518.2	Apply the direct kinematics analysis to the SCARA robots
R19AM518.3	Apply the inverse kinematics analysis to the SCARA robots

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R19AM518.4	Planning trajectories for the tool to follow in order to perform meaningful tasks.
R19AM518.5	Precisely control the high speed motion of the system.

R19AM519	Robotic Process Automation	L	T	P	C
		3	0	0	3

1. Course Description:

This course presents the fundamental concepts in construction of software bots along with the tools for data processing. The course will enable the students to learn the components of RPA, perform app integration and involve in deployment of developed bots into action.

2. Course Objectives:

1. To learn the fundamentals of RPA and Tools.
2. To apply data manipulation techniques for event handling.
3. To effectively perform integration of data and logging.
4. To precisely manage exceptions with required debugging techniques.
5. To deploy RPA with extended support.

3. Syllabus

UNIT-I: Introduction to Robotic Process Automation

Emergence of Robotic Process Automation (RPA), Evolution of RPA, Differentiating RPA from Automation - Benefits of RPA - Application areas of RPA, Components of RPA, RPA Platforms. Robotic Process Automation Tools – Templates, User Interface, Domains in Activities, Workflow Files.

UNIT-II: Automation Process Activities

Sequence, Flowchart & Control Flow: Sequencing the Workflow, Activities, Flowchart, Control Flow for Decision making. Data Manipulation: Variables, Collection, Arguments, Data Table, Clipboard management, File operations Controls: Finding the control, waiting for a control, Act on a control, UiExplorer, Handling Events

UNIT-III: App Integration, Recording and Scraping

App Integration, Recording, Scraping, Selector, Workflow Activities. Recording mouse and keyboard actions to perform operation, Scraping data from website and writing to CSV. Process Mining.

UNIT-IV: Exception Handling and Code Management

Exception handling, Common exceptions, Logging- Debugging techniques, Collecting crash dumps, Error reporting. Code management and maintenance: Project organization, Nesting workflows, Reusability, Templates, Commenting techniques, State Machine.

UNIT-V: Deployment and Maintenance

Publishing using publish utility, Orchestration Server, Control bots, Orchestration Server to deploy bots, License management, Publishing and managing updates. RPA Vendors - Open Source RPA, Future of RPA.

Text Books:

1. Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool - UiPath by Alok Mani Tripathi, Packt Publishing, 2018.
2. Tom Taulli, "The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems", Apress publications, 2020.

References:

Reference Books:

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1. Frank Casale (Author), Rebecca Dilla (Author), Heidi Jaynes (Author), Lauren Livingston (Author), Introduction to Robotic Process Automation: a Primer, Institute of Robotic Process Automation, Amazon Asia-Pacific Holdings Private Limited, 2018. 2. Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant, Amazon Asia-Pacific Holdings Private Limited, 2018. 3. A Gerardus Blokdyk, "Robotic Process Automation Rpa A Complete Guide ", 2020.
Journals (Reference): 1. Business process automation journal - https://www.emerald.com/insight/publication/issn/1463-7154. 2. Journal of Web Engineering https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=10243554 3. IEEE Access - https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=6287639. 4. JISTEM - https://www.scielo.br/j/jistm/a/m7cqFWJPsWSk8ZnWRN6fR5m/
MOOC/NPTEL/SWAYAM Courses: 1. https://archive.nptel.ac.in/courses/112/104/112104316/ 2.https://archive.nptel.ac.in/content/storage2/courses/108105063/pdf/L-01(SM)(IA&C)%20((EE)NPTEL).pdf

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19AM519.1	Understand the basic concepts of Robotic Process Automation.
R19AM519.2	Expose to the key RPA design and development strategies and methodologies.
R19AM519.3	Learn the fundamental RPA logic and structure.
R19AM519.4	Explore the Exception Handling, Debugging and Logging operations in RPA.
R19AM519.5	Learn to deploy and maintain the software bot.

R19AD511	Health Care Analytics	L	T	P	C
		3	0	0	3

1. Course Description:

Health Care Analytics is designed to equip students with the skills and knowledge necessary to analyze and interpret data in the context of healthcare delivery and management. This course covers fundamental concepts, tools, and techniques used in health care analytics to derive actionable insights for improving patient care, optimizing operations, and enhancing decision-making processes.

2. Course Objectives:

1. Understand the health data formats, health care policy and standards
2. Learn the significance and need of data analysis and data visualization
3. Understand the health data management frameworks
4. Learn the use of machine learning and deep learning algorithms in healthcare
5. Apply healthcare analytics for critical care applications

3. Syllabus

Unit-I: Introduction to Healthcare Analysis

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Overview - History of Healthcare Analysis Parameters on medical care systems- Health care policy- Standardized code sets – Data Formats – Machine Learning Foundations: Tree Like reasoning, Probabilistic reasoning and Bayes Theorem, Weighted sum approach.
Unit-II: Analytics on Machine Learning
Machine Learning Pipeline – Pre-processing –Visualization – Feature Selection – Training model parameter – Evaluation model: Sensitivity, Specificity, PPV, NPV, FPR , Accuracy, ROC, Precision Recall Curves, Valued target variables –Python: Variables and types, Data Structures and containers, Pandas Data Frame: Operations – Scikit –Learn: Pre-processing, Feature Selection.
Unit-III: Health Care Management
IoT- Smart Sensors – Migration of Healthcare Relational database to NoSQL Cloud Database – Decision Support System – Matrix block Cipher System – Semantic Framework Analysis – Histogram bin Shifting and Rc6 Encryption – Clinical Prediction Models – Visual Analytics for Healthcare
Unit-IV: Advanced Analytical Techniques in Healthcare
Introduction to Deep Learning – DFF network CNN- RNN for Sequences – Biomedical Image and Signal Analysis – Natural Language Processing and Data Mining for Clinical Data – Mobile Imaging and Analytics – Clinical Decision Support System.
Unit-V: Case Studies
Predicting Mortality for Cardiology Practice –Smart Ambulance System using IOT – Hospital Acquired Conditions (HAC) program- Healthcare and Emerging Technologies – ECG Data Analysis.
Text Books: 1. Chandan K. Reddy, Charu C. Aggarwal, "Health Care data Analysis", First edition, CRC, 2015. 2. Vikas Kumar, "Health Care Analysis Made Simple", Packt Publishing, 2018.
References:
Reference Books: 1. Nilanjan Dey, Amira Ashour, Simon James Fong, Chintan Bhatl, "Health Care Data Analysis and Management, First Edition, Academic Press, 2018. 2. Hui Jang, Eva K. Lee, "HealthCare Analysis: From Data to Knowledge to Healthcare Improvement", First Edition, Wiley, 2016. 3. Kulkarni, Siarry, Singh, Abraham, Zhang, Zomaya, Baki, "Big Data Analytics in HealthCare", Springer, 2020.
Journals: 1. https://www.pharmasug.org/proceedings/2018/LD/PharmaSUG-2018-LD20.pdf 2. https://link.springer.com/article/10.1007/s12553-023-00736-4 3. https://www.mdpi.com/2227-9032/6/2/54
Video References: 1. https://www.youtube.com/watch?v=zMdPAwXX8-M 2. https://www.youtube.com/watch?v=3W9_BfbNkSs
MOOC/NPTEL/SWAYAM Courses: 1. https://onlinecourses.nptel.ac.in/noc22_hs40/preview 2. https://www.coursera.org/articles/healthcare-analytics

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome

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R19AD511.1	Use machine learning and deep learning algorithms for health data analysis
R19AD511.2	Apply the data management techniques for healthcare data
R19AD511.3	Evaluate the need of healthcare data analysis in e-healthcare, telemedicine and other critical care applications
R19AD511.4	Design health data analytics for real time applications
R19AD511.5	Design emergency care system using health data analysis

R19AD512	Knowledge Engineering	L	T	P	C
		3	0	0	3

1. Course Description:

This course provides an in-depth study of knowledge engineering, focusing on reasoning under uncertainty, methodology and modeling, ontologies design and development, reasoning with ontologies and rules, and learning and rule learning. Students will learn to develop intelligent systems that can reason, learn, and solve problems effectively in uncertain and complex environments.

2. Course Objectives:

1. To understand various forms of reasoning under uncertainty, including abductive reasoning, probabilistic reasoning, and belief functions, and their applications in intelligent systems.
2. To learn methodologies and tools for developing intelligent agents, including the use of ontologies and learning technologies for problem-solving and analysis.
3. To explore the design and development of ontologies, including concepts, instances, hierarchies, features, and their representation, with a focus on ontology matching and specification.
4. To develop skills in reasoning with ontologies and rules, including production system architecture, ontology-based concepts, and inference engine usage for hypothesis analysis and rule matching.
5. To study machine learning concepts, rule learning, and refinement, and their application in learning and problem-solving, with an emphasis on hypothesis learning and analysis.

3. Syllabus

Unit-I: Reasoning under Uncertainty

Introduction – Abductive reasoning – Probabilistic reasoning: Enumerative Probabilities – Subjective Bayesian view – Belief Functions – Baconian Probability – Fuzzy Probability – Uncertainty methods - Evidence-based reasoning – Intelligent Agent – Mixed-Initiative Reasoning – Knowledge Engineering.

Unit-II: Methodology and Modeling

Conventional Design and Development – Development tools and Reusable Ontologies – Agent Design and Development using Learning Technology – Problem Solving through Analysis and Synthesis – Inquiry-driven Analysis and Synthesis – Evidence-based Assessment – Believability Assessment – Drill-Down Analysis, Assumption-based Reasoning, and What-If Scenarios.

Unit-III: Ontologies – Design and Development

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Concepts and Instances – Generalization Hierarchies – Object Features – Defining Features – Representation – Transitivity – Inheritance – Concepts as Feature Values – Ontology Matching.
Design and Development Methodologies – Steps in Ontology Development – Domain Understanding and Concept Elicitation – Modelling-based Ontology Specification.

Unit-IV: Reasoning with Ontologies And Rules

Production System Architecture – Complex Ontology-based Concepts – Reduction and Synthesis rules and the Inference Engine – Evidence-based hypothesis analysis – Rule and Ontology Matching – Partially Learned Knowledge – Reasoning with Partially Learned Knowledge.

Unit-V: Learning and Rule Learning

Machine Learning – Concepts – Generalization and Specialization Rules – Types – Formal definition of Generalization. Modelling, Learning and Problem Solving – Rule Learning and Refinement – Overview – Rule Generation and Analysis – Hypothesis Learning.

Text Books:

1. Gheorghe Tecuci, Dorin Marcu, Mihai Boicu, David A. Schum, Knowledge Engineering: Building Cognitive Assistants for Evidence-based Reasoning, Cambridge University Press, First Edition, 2016. (Unit 1 – Chapter 1 / Unit 2 – Chapter 3,4 / Unit 3 – Chapter 5, 6 / Unit 4 - 7, Unit 5 – Chapter 8, 9

References:

Reference Books:

1. Ronald J. Brachman, Hector J. Levesque: Knowledge Representation and Reasoning, Morgan Kaufmann, 2004.
2. Ela Kumar, Knowledge Engineering, I K International Publisher House, 2018.
3. John F. Sowa: Knowledge Representation: Logical, Philosophical, and Computational Foundations, Brooks/Cole, Thomson Learning, 2000.
4. King, Knowledge Management and Organizational Learning, Springer, 2009.
5. Jay Liebowitz, Knowledge Management Learning from Knowledge Engineering, 1st Edition,2001.

Journals (Reference):

1. IEEE Transactions on Knowledge and Data Engineering
2. Journal of Knowledge Engineering and Data Mining.
3. ACM Transactions on Knowledge Discovery from Data

Video references:

1. https://www.youtube.com/watch?v=tKxcYkRxcbM
2. https://study.com/learn/lesson/video/knowledge-engineering-process-examples.html

MOOC/NPTEL/SWAYAM Courses:

1. https://www.youtube.com/watch?v=3_-HGnI6AZ0 (online course)
2. https://www.youtube.com/watch?v=eJ9H1SakPoA&list=PLoOmvuyo5UAcBXlhTti7kzetSsi1PpJGR

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19AD512.1	Understand the basics of Knowledge Engineering.

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R19AD512.2	Apply methodologies and modelling for Agent Design and Development
R19AD512.3	Design and develop ontologies
R19AD512.4	Apply reasoning with ontologies and rules.
R19AD512.5	Implement the concept of learning and rule learning.

R19AD513	Soft Computing Techniques	L	T	P	C
		3	0	0	3

1. Course Description:

This course offers a comprehensive introduction to the fundamental concepts and techniques in soft computing. Students will explore various methodologies that form the backbone of soft computing, including fuzzy sets, fuzzy logic, neural networks, and evolutionary algorithms. Emphasis will be placed on understanding how these methods leverage heuristics based on human experience and how they can be applied to solve complex real-world problems.

2. Course Objectives:

1. To introduce the ideas of fuzzy sets, fuzzy logic and use of heuristics based on human Experience.
2. To provide the mathematical background for carrying out the optimization associated with neural network learning
3. To learn various evolutionary Algorithms.
4. To become familiar with neural networks that can learn from available examples and generalize to form appropriate rules for inference systems.
5. To introduce case studies utilizing the above and illustrate the Intelligent behavior of programs based on soft computing.

3. Syllabus

Unit-1: Introduction To Soft Computing and Fuzzy Logic

Introduction - Fuzzy Logic - Fuzzy Sets, Fuzzy Membership Functions, Operations on Fuzzy Sets, Fuzzy Relations, Operations on Fuzzy Relations, Fuzzy Rules and Fuzzy Reasoning, Fuzzy, Inference Systems.

Unit-II: Neural Networks

Supervised Learning Neural Networks – Perceptrons - Backpropagation -Multilayer Perceptrons –Unsupervised Learning Neural Networks – Kohonen Self-Organizing Networks.

Unit-III: Genetic Algorithms

Chromosome Encoding Schemes -Population initialization and selection methods – Evaluation function - Genetic operators- Cross over – Mutation - Fitness Function – Maximizing function.

Unit-IV: Neuro Fuzzy Modeling

ANFIS architecture – hybrid learning – ANFIS as universal approximator – Coactive Neuro fuzzy modeling – Framework – Neuron functions for adaptive networks – Neuro-fuzzy spectrum -Analysis of Adaptive Learning Capability.

Unit-V: Applications

Modeling a two-input sine function - Printed Character Recognition – Fuzzy filtered neural networks – Plasma Spectrum Analysis – Hand-written neural recognition - Soft Computing for Color Recipe Prediction.

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Text Books:

1. SaJANG, J.-S. R., SUN, C.-T., & MIZUTANI, E. (1997). Neuro-fuzzy and soft computing: a computational approach to learning and machine intelligence. Upper Saddle River, NJ, Prentice Hall,1997
2. Himanshu Singh, Yunis Ahmad Lone, Deep Neuro-Fuzzy Systems with Python. With Case Studies and Applications from the Industry, Apress, 2020

References:

Reference Books:

1. Roj Kaushik and Sunita Tiwari, Soft Computing-Fundamentals Techniques and Applications,1st Edition, McGraw Hill, 2018.
2. S. Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI, 2003.
3. Samir Roy, Udit Chakraborthy, Introduction to Soft Computing, Neuro Fuzzy and Genetic Algorithms, Pearson Education, 2013.
4. S.N. Sivanandam, S.N. Deepa, Principles of Soft Computing, Third Edition, Wiley India Pvt Ltd, 2019.
5. R.Eberhart, P.Simpson and R.Dobbins, "Computational Intelligence - PC Tools", AP Professional, Boston, 1996.

Journals (Reference):

1. IEEE Transactions on Neural Networks and Learning Systems
2. Applied Soft computing
3. IEEE Transactions on Evolutionary Computation
4. Engineering Applications of Artificial Intelligence

Video References:

1. https://www.youtube.com/watch?v=tvu0guol-tA
2. https://www.youtube.com/watch?v=tvu0guol-tA

MOOC/NPTEL/SWAYAM Course:

1. NOC: Introduction to Soft Computing, IIT Kharagpur.

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19AD513.1	Understand the fundamentals of fuzzy logic operators and inference mechanisms
R19AD513.2	Understand neural network architecture for AI applications such as classification and clustering
R19AD513.3	Learn the functionality of Genetic Algorithms in Optimization problems
R19AD513.4	Use hybrid techniques involving Neural networks and Fuzzy logic
R19AD513.5	Apply soft computing techniques in real world applications.

R19AD514	Social Media Analytics	L	T	P	C
		3	0	0	3

1. Course Description:

This course will introduce concepts and approaches to mining social media data. It focuses on obtaining and exploring those data, mining networks, and mining text from social platforms. Students will learn how to apply previously learned data mining concepts to a

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domain that will likely be familiar to all of them: social media. Students will learn to explore, model, and predict with network and textual data from existing social platforms.

2. Course Objectives:

1. To study marketing analytics and Data Exploration.
2. To study the community building and the viral impact.
3. To study the social media policies and measurements.
4. To study web analytics and search analytics.

3. Syllabus

Unit-I: Marketing Analytics

Marketing Budget and Marketing Performance Measure, Marketing - Geographical Mapping, Data Exploration, Market Basket Analysis.

Unit-II: Community Building and Management

History and Evolution of Social Understanding Science of social media –Goals for using Social Media- Social Media Audience and Influencers - Digital PR- Promoting Social Media Pages - Linking Social Media Accounts-The Viral Impact of Social Media.

Unit-III: Social Media Policies and Measurements

Social Media Policies-Etiquette, Privacy- ethical problems posed by emerging social media technologies - The Basics of Tracking Social Media.

Unit-IV: Web Analytics

Data Collection, Overview of Qualitative Analysis, Business Analysis, KPI and Planning, Critical Components of a Successful Web Analytics Strategy, Proposals & Reports, Web Data Analysis.

Unit-V: Search Analytics

Search engine optimization (SEO), user engagement, user-generated content, web traffic analysis, online security, online ethics, data visualization.

Case Study: Knowledge Graph: Knowledge graph model representation of a multi-layer social network

Text Books:

1. K. M. Shrivastava, Social Media in Business and Governance, Sterling Publishers Private Limited, 2013.
2. Christian Fuchs, Social Media a critical introduction, SAGE Publications Ltd, 2014.

References:

Reference Books:

1. Bittu Kumar, Social Networking, V & S Publishers, 2013
2. Avinash Kaushik, Web Analytics - An Hour a Day, Wiley Publishing, 2007
3. Ric T. Peterson, Web Analytics Demystified, Celilo Group Media and CafePress 2004
4. Takeshi Moriguchi, Web Analytics Consultant Official Textbook, 7th Edition, 2016.

Journals (Reference):

1. https://www.pharmasug.org/proceedings/2018/LD/PharmaSUG-2018-LD20.pdf
2. https://link.springer.com/article/10.1007/s12553-023-00736-4
3. https://www.mdpi.com/2227-9032/6/2/54

Video References:

1. https://www.youtube.com/watch?v=Z1KJ-16Rfs0
2. https://www.youtube.com/watch?v=1fg58Kjkme4

MOOC/NPTEL/SWAYAM Courses:

1. https://onlinecourses.nptel.ac.in/noc22_cs117/preview

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2. https://www.coursera.org/learn/social-media-analytics-introduction

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19AD514.1	Understand the concepts of marketing analytics and Data Exploration.
R19AD514.2	Understand the science of social media and goals.
R19AD514.3	Understand the Etiquette and privacy in social media.
R19AD514.4	Apply the Qualitative analysis and critical components of web analytics strategy
R19AD514.5	Apply the concepts of Search engine optimization and data visualization

R19AD515	Cognitive Science	L	T	P	C
		3	0	0	3

1. Course Description:

This course delves into the integration of philosophy, psychology, and neuroscience with advanced computing, focusing on cognitive processes and probabilistic programming languages like WebPPL. It covers inference and learning models, exploring techniques from basic syntax to complex cognitive modeling.

2. Course Objectives:

1. To know the theoretical background of cognition.
2. To understand the link between cognition and computational intelligence.
3. To explore probabilistic programming language.
4. To study the computational inference models of cognition.
5. To study the computational learning models of cognition.

3. Syllabus

Unit-I: Philosophy, Psychology and Neuroscience

Philosophy: Mental-physical Relation – From Materialism to Mental Science – Logic and the Sciences of the Mind – Psychology: Place of Psychology within Cognitive Science – Science of Information Processing –Cognitive Neuroscience – Perception – Decision – Learning and Memory – Language Understanding and Processing.

Unit-II: Probabilistic Programming Language

Machines and Cognition – Artificial Intelligence – Architectures of Cognition – Knowledge Based Systems – Logical Representation and Reasoning – Logical Decision Making – Learning – Language – Vision

Unit-III: Probabilistic Programming Language

WebPPL Language – Syntax – Using Javascript Libraries – Manipulating probability types and distributions – Finding Inference – Exploring random computation – Coroutines: Functions that receive continuations –Enumeration

Unit-IV: Inference Models of Cognition

Generative Models – Conditioning – Causal and statistical dependence – Conditional dependence – Data Analysis – Algorithms for Inference.

Unit-V: Learning Models of Cognition

Learning as Conditional Inference – Learning with a Language of Thought – Hierarchical Models – Learning (Deep) Continuous Functions – Mixture Models.

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Text Books:

1. Vijay V Raghavan, Venkat N.Gudivada, VenuGovindaraju, C.R. Rao, Cognitive Computing: Theory and Applications: (Handbook of Statistics 35), Elsevier publications, 2016.
2. Judith Hurwitz, Marcia Kaufman, Adrian Bowles, Cognitive Computing and Big Data Analytics, Wiley Publications, 2015.
3. Robert A. Wilson, Frank C. Keil, "The MIT Encyclopaedia of the Cognitive Sciences", The MIT Press, 1999.
4. Jose Luis Bermúdez, Cognitive Science -An Introduction to the Science of the Mind, Cambridge University Press 2020

References:

Reference Books:

1. Noah D. Goodman, Andreas Stuhlmuller, "The Design and Implementation of Probabilistic Programming Languages", Electronic version of the book, https://dippl.org/.
2. Noah D. Goodman, Joshua B. Tenenbaum, The ProbMods Contributors, "Probabilistic Models of Cognition", Second Edition, 2016, https://probmods.org/.

Journals (Reference):

1. https://link.springer.com/journal/41809
2. https://www.researchgate.net/publication/275544715_Cognition_as_a_Subject_of_Research_in_Cognitive_Science

Video References:

1. https://www.youtube.com/watch?v=LTThtJMTew8
2. https://www.youtube.com/watch?v=Ysl_UBI0wh8

MOOC/NPTEL/SWAYAM Courses:

1. https://nptel.ac.in/courses/109103134
2. https://onlinecourses.nptel.ac.in/noc22_ee122/preview
3. https://onlinecourses.nptel.ac.in/noc22_hs97/preview

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19AD515.1	Discover the underlying theory behind cognition.
R19AD515.2	Analyze the transition from materialism to mental science
R19AD515.3	Inspect the mathematical functions through WebPPL.
R19AD515.4	Examine applications using cognitive inference model.
R19AD515.5	Examine applications using cognitive learning model.

R19AD516	Ethics and Artificial Intelligence	L	T	P	C
		3	0	0	3

1. Course Description:

This course explores the ethical implications of artificial intelligence, examining its societal, legal, and environmental impacts. Students will analyze global ethical initiatives, regulatory

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standards, and the moral considerations in robotics, preparing them to navigate and shape the future responsibly with AI.

2. Course Objectives:

1. Study the morality and ethics in AI
2. Learn about the Ethical initiatives in the field of artificial intelligence
3. Study about AI standards and Regulations
4. Study about social and ethical issues of Robot Ethics
5. Study about AI and Ethics- challenges and opportunities

3. Syllabus

Unit-I: Introduction

Definition of morality and ethics in AI-Impact on society-Impact on human psychology-Impact on the legal system-Impact on the environment and the planet-Impact on trust

Unit-II: Ethical Initiatives in AI

International ethical initiatives-Ethical harms and concerns-Case study: healthcare robots, Autonomous Vehicles , Warfare and weaponization.

Unit-III: AI Standards and Regulation

Model Process for Addressing Ethical Concerns During System Design - Transparency of Autonomous Systems-Data Privacy Process- Algorithmic Bias Considerations - Ontological Standard for Ethically Driven Robotics and Automation Systems

Unit-IV: Robo Ethics: Social and Ethical Implication Of Robotics

Robot-Robo ethics- Ethics and Morality- Moral Theories-Ethics in Science and Technology - Ethical Issues in an ICT Society- Harmonization of Principles- Ethics and Professional Responsibility-Robo ethics Taxonomy

Unit-V: AI and Ethics- Challenges and Opportunities

Challenges - Opportunities- ethical issues in artificial intelligence- Societal Issues Concerning the Application of Artificial Intelligence in Medicine- decision-making role in industries-National and International Strategies on AI.

Text Books:

1. Y. Eleanor Bird, Jasmin Fox-Skelly, Nicola Jenner, Ruth Larbey, Emma Weitkamp and Alan Winfield," The ethics of artificial intelligence: Issues and initiatives", EPRS | European Parliamentary Research
2. Service Scientific Foresight Unit (STOA) PE 634.452 – March 2020. Patrick Lin, Keith Abney, George A Bekey," Robot Ethics: The Ethical and Social Implications of Robotics", The MIT Press- January 2014.
3. Ethics and Artificial Intelligence: A Comprehensive Guide by Byte-Sized Press,AJ Kelly

References:

Reference Books:

1. Towards a Code of Ethics for Artificial Intelligence (Artificial Intelligence: Foundations, Theory, and Algorithms) by Paula Boddington, November 2017.
2. Mark Coeckelbergh," AI Ethics", The MIT Press Essential Knowledge series, April 2020.
3. https://fivebooks.com/best-books/ethics-artificial-intelligence/

Journals (Reference):

1. https://link.springer.com/article/10.1007/s10892-017-9252-2
2. https://ieeexplore.ieee.org/abstract/document/8436265

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3. https://gprjournals.org/journals/index.php/AJIT/article/view/142
Video references: 1. https://www.youtube.com/watch?v=VqFqWIqOB1g 2. https://www.youtube.com/watch?v=lEvoMBwD49M 3. https://www.youtube.com/watch?v=e-t2Zi0sZqM
MOOC/NPTEL/SWAYAM Courses: 1. https://archive.nptel.ac.in/courses/106/102/106102220/ 2. https://nptel.ac.in/courses/109106184

4. Course Outcomes:

After successful completion of the course, the student should be able to:

R19AD516.1	Identify the morality and ethics in AI
R19AD516.2	Analyze the ethical initiatives in the field of artificial intelligence
R19AD516.3	Analyze AI standards and regulations
R19AD516.4	Examine social and ethical implications of robotics
R19AD516.5	Evaluate challenges and opportunities in AI and ethics

R19AD517	Information Retrieval	L	T	P	C
		3	0	0	3

1. Course Description:

Information Retrieval (IR) is the process of accessing and retrieving relevant information from a large collection of data or documents. In this course, students will gain a comprehensive understanding of the fundamental principles, techniques, and algorithms used in information retrieval systems.

2. Course Objectives:

1. To acquire knowledge about the fundamentals of information retrieval.
2. Comprehending the various query languages used for information retrieval.
3. To enhance the Knowledge of multimedia and text operations in information retrieval.
4. To investigate visualization and Human Computer Interaction.
5. To explain the fundamental concepts of multimedia data modelling and the genetic indexing method.

3. Syllabus

Unit-I: Introduction to Information Retrieval

Introduction-Retrieval Process-Modelling: Introduction-A Taxonomy of Information Retrieval Models-characteristics of IR models-Classic Information Retrieval-Set Theoretic, Algebraic and Probabilistic Models – Structured Text Retrieval Models – Retrieval Evaluation-IR applications.

Unit-II: Query Languages and Operations

Introduction to Languages – Key Word-based Querying – Pattern Matching – Structural Queries – Query Operations – User Relevance Feedback – Local and Global Analysis – Text and Multimedia languages.

Unit-III: Text Operations and Multimedia Languages

Introduction- Document Preprocessing- Document Clustering-Text Compression-Text Compression Techniques - Metadata-Markup Languages-Multimedia-Content Based Image Retrieval

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Unit-IV: User Interface and Visualization
Introduction-Human Computer Interaction: Design Principles-Roles of visualization-Information Access Process-Query Specification-Interface support for the search Process.
Unit-V: Multimedia Information Retrieval
Introduction-Data Modelling-Query Languages-Genetic Multimedia indexing approach-Automatic Feature Extraction.
Text Books: 1. Ricardo Baeza-Yate, Berthier Ribeiro-Neto, "Modern Information Retrieval: The Concepts and Technology behind search", ACM Press Books, 2nd edition, 2011. 2. Ricci, F, Rokach, L. Shapira, B.Kantor, —Recommender Systems Handbook, First Edition, 2011.
References:
Reference Books: 1. Chowdhury. G.G, "Introduction to Modern Information Retrieval," Neal-Schuman Publishers, 3rd edition, 2010. 2. Christopher D. Manning, Prabhakar Raghavan, and Hinrich Schütze, "Introduction to Information Retrieval", Cambridge University Press. 2008.
Journals (Reference): 1. K. A. Hambarde and H. Proença, "Information Retrieval: Recent Advances and Beyond," in IEEE Access, vol. 11, pp. 76581-76604, 2023, doi: 10.1109/ACCESS.2023.3295776. 2. Yu, B. Research on information retrieval model based on ontology. J Wireless Com Network 2019, 30 (2019). https://doi.org/10.1186/s13638-019-1354-z. 3. L. Frew, M. L. Nelson and M. C. Weigle, "Making Changes in Webpages Discoverable: A Change-Text Search Interface for Web Archives," 2023 ACM/IEEE Joint Conference on Digital Libraries (JCDL), Santa Fe, NM, USA, 2023, pp. 71-81, doi: 10.1109/JCDL57899.2023.00021.
Video references: 1. https://youtu.be/JuW1mTFk1Qo 2. https://youtu.be/U6KgqeJkhU0 3. https://www.coursera.org/learn/text-retrieval 4. https://www.udemy.com/course/information-retrieval-and-mining-massive-data-sets
MOOC/NPTEL/SWAYAM Courses: 1. https://youtu.be/Sn_Wkf9KNEg?feature=shared. 2. https://youtu.be/aaGPJzO9FIk?feature=shared.

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19AD517.1	Identify the basic concepts of modelling and information retrieval principles.
R19AD517.2	Analyze the concepts underlying query language, pattern matching, and other operations.

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R19AD517.3	Analyze the text operations for the notions of metadata and data processing applied to multimedia.
R19AD517.4	Apply the principles of visualization design and Query Specification.
R19AD517.5	Discuss the fundamental concepts of multimedia data modeling and the genetic indexing technique.

R19AD518	Business Intelligence	L	T	P	C
		3	0	0	3

1. Course Description:

Business Intelligence (BI) refers to the technologies, strategies, and practices used by organizations to analyze data and provide actionable insights for informed decision-making. This course provides students with a comprehensive introduction to the concepts, tools, and techniques of business intelligence. Students will learn how to gather, store, analyze, and visualize data to support strategic and operational decisions within organizations.

2. Course Objectives:

1. To acquire the fundamental concepts of business intelligence.
2. To enhance the knowledge about business intelligence visualization and types.
3. To Apply various kinds of techniques and evaluation for business modeling
4. To Apply business intelligence techniques to assess different scenarios.
5. To Investigate data science techniques and ideas in business intelligence.

3. Syllabus

Unit-I: Introduction to Business Intelligence

Introduction - BI concept, Business intelligence architectures: cycle of business intelligence analysis-Enabling factors in BI projects-Development of a business intelligence system, Ethics and business intelligence- BI in today's perspective.

Unit-II: Knowledge Delivery

Business intelligence user types, Standard reports, Interactive Analysis and AdHoc Querying, Parameterized Reports and Self-Service Reporting, Dimensional analysis, Alerts/Notifications, Visualization: Charts, Graphs, Widgets, Scorecards and Dashboards, Geographic Visualization, Integrated Analytics.

Unit-III: Modelling And Analysis

Exploring Excel Modelling capabilities to solve business problems, summarize and present selected data, introduction to business metrics and KPIs, creating cubes using Microsoft Excel.BI in Decision Modelling: Optimization, Decision making under uncertainty.

Unit-IV: Future of Business Intelligence and Application of BI

Emerging Technologies, Machine Learning, Predicting the Future with the help of Data Analysis, BI Search & Text Analytics – Advanced Visualization – Rich Report, Future beyond Technology, Applications of BI -Financial analysis, statistical analysis, sales analysis, CRM, result pattern and ranking analysis, Balanced Scorecard.

Unit-V: Data Science and Tools for BI

Introduction to Data Science, process and typical tools in data science. Algorithm: segmentation, classification, validation, regressions, recommendations. Tool for BI: Microsoft SQL server: Introduction to Data Analysis using SSAS tools Introduction to data Analysis using SSIS tools- Introduction to Reporting Services using SSRS tools- Data Mining Implementation Methods.

Text Books:

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1. Efraim Turban, Ramesh Sharda, Dursun delen, "Decision Support and Business Intelligence Systems",9th Edition, Pearson 2013.
2. David Loshin Morgan, Kaufman, "Business Intelligence: The Savvy Manager"s Guide", Second Edition, 2012.

References:

Reference Books:

1. Cindi Howson, "Successful Business Intelligence: Secrets to Making BI a Killer App", McGraw- Hill, 2013, Second Edition.
2. Business Intelligence Guidebook: From Data Integration to Analytics 1st Edition, Morgan Kaufmann; 1st edition.
3. Carlo Vercellis, "Business Intelligence: Data Mining and Optimization for Decision Making", Wiley Publications, 2009.

Journals (Reference):

1. Gaardboe, R., & Jonasen, T. S. (2018). Business Intelligence Success Factors: A Literature Review. Journal of Information Technology Management, XXIX(1), 1-15. http://jitm.ubalt.edu/XXIX-1/article1.pdf
2. Ahmad S, Miskon S, Alkanhal TA, Tlili I. Modeling of Business Intelligence Systems Using the Potential Determinants and Theories with the Lens of Individual, Technological, Organizational, and Environmental Contexts-A Systematic Literature Review. Applied Sciences. 2020; 10(9):3208. https://doi.org/10.3390/app10093208
3. A. Shatat, M. Altahoo and M. Almannaei, "The Impact of Business Intelligence on Decision-Making Process and Customer Service," 2024 ASU International Conference in Emerging Technologies for Sustainability and Intelligent Systems (ICETSIS), Manama, Bahrain, 2024, pp. 355-360, doi: 10.1109/ICETSIS61505.2024.10459599.

Video references:

1. https://youtu.be/eEwq_mPd1iI
2. https://youtu.be/iLe345QCs3c
3. https://www.udeSmy.com/course/the-business-intelligence-analyst-course-2018
4. https://www.udacity.com/course/business-intelligence-analytics-nanodegree--nd429
5. https://www.udemy.com/course/microsoft-business-intelligence-tools-ssisssrsssasbi/

MOOC/NPTEL/SWAYAM Course:

1. https://youtube.com/playlist?list=PLyqSpQzTE6M_68YmFFmjAAvTMne3xq9jf&feature=shared.

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19AD518.1	Understand the rudiments of business intelligence.
R19AD518.2	Apply the ability to deliver knowledge.
R19AD518.3	Apply the various Modelling techniques and analysis.
R19AD518.4	Apply business intelligence methods to various situations and decide on appropriate techniques.
R19AD518.5	Understand the basics of data science and tools of Business Intelligence.

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R19AD519	Big Data Analytics	L	T	P	C
		3	0	0	3

1. Course Description:

This course provides an in-depth exploration of big data analytics, focusing on the tools, techniques, and methodologies used to extract meaningful insights from large and diverse datasets. Through a combination of lectures, hands-on exercises, and real-world case studies, students will develop the skills and knowledge necessary to effectively analyze big data and derive actionable insights for decision-making.

2. Course Objectives:

1. Gain a comprehensive understanding of the characteristics of big data, including volume, velocity, variety, veracity, and value, and the challenges and opportunities associated with analyzing large datasets.
2. Acquire skills in collecting, cleaning, and preprocessing data from various sources, including structured and unstructured data sources such as databases, social media, sensor data, and text documents
3. Familiarize yourself with the technologies and platforms used for big data storage, processing, and analysis, including Hadoop, Spark, NoSQL databases, and cloud-based solutions.

3. Syllabus

Unit-I: Fundamentals of Big Data

Introduction: Types of Digital Data, Characteristics of Data, evolution of big data, definition and challenges; Why Big Data, Business Intelligence vs Big Data, Coexistence of Big Data and Data Warehouse, Big Data Analytics: Terminologies used in Big Data Environments, CAP Theorem; Introduction to Distributed Computing: Definition, Relation to Computer System Components, A Distributed Program – A Model of Distributed Executions – Models of Communication Networks.

Unit-II: Hadoop Basics

Introduction to Hadoop ecosystems: Features of Hadoop, Advantages, Hadoop Distributions, Hadoop vs SQL, Hadoop vs RDBMS, Distributed computing challenges; Hadoop overview: Use case, design of Hadoop distributed file system (HDFS), Processing data with Hadoop, Managing Resources and Applications with Hadoop, YARN, Hadoop Streaming, Hadoop Pipes

Unit-III: Big Data tools

Pig – Grunt – pig data model – Pig Latin – developing and testing Pig Latin scripts. Hive – data types and file formats – HiveQL data definition – HiveQL data manipulation – HiveQL queries. Setting up PySpark environment -PySpark basics- PySpark background - PySpark RDD- Data Manipulation-Utility function and Visualizations

Unit-IV: Azure Databricks

Introducing Azure Databricks Microsoft Azure Services and Portal Overview: What is Databricks &Why Databricks Databricks Pricing, Infrastructure and Software Charges, Different Cloud Providers offering Databricks Databricks Features Databricks Community Edition, Memory Optimized, Storage Optimized, Compute Optimized, General Purpose, GPU Accelerated Module; Azure Databricks: Databricks File System (DBFS), Databricks Architecture, Control and Data Plane DBFS in detail Object Store, Blob, Datalake Gen2 Filesystem utility, dbutils Data Utility &Notebook Utility &Widgets Utility Parameter passing from one Notebook to another Mount Point, Howto create Mount Point Databricks, Workspace Databricks, CLI; Ways to access Storage Account: AccessKey, Account Key, SASKey&Service Principal Secret Scope, Azure Keyvault Backed Secret Scope, Databricks Backed Secret Scope; Delta Lake: Delta Table Creation, Lakehouse Architecture, Azure

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Delta Engine, Optimizations Delta Architecture, Medallian Architecture Cluster Creation, Autoloader Delta Live Table Unity Catalog
Unit-V: Working with NoSQL
Introduction to NoSQL: Aggregate data models, aggregates, key-value and document data models, relationships, graph databases, schemaless databases, materialized views, distribution models, sharding, master-slave replication, peer-peer replication, sharding and replication.
Text Book(s): 1. Seema Acharya, Subhashini Chellappan, "Big Data and Analytics", Wiley Publication, 2015 2. Kshemkalyani Ajay D, Mukesh Singhal, "Distributed Computing: Principles, Algorithms and Systems", Cambridge Press, 2011.
References:
Reference Books: 1. Judith Hurwitz, Alan Nugent, Dr. Fern Halper, Marcia Kaufman, "Big Data for Dummies", John Wiley & Sons, Inc., 2013 2. Tom White, "Hadoop: The Definitive Guide", O'Reilly Publications, 2011 3. Jimmy Lin and Chris Dyer, "Data-Intensive Text Processing with MapReduce", Synthesis Lectures on Human Language Technologies, Vol. 3, No. 1, Pages 1-177, Morgan Claypool publishers, 2010 4. Eric Sammer, "Hadoop Operations", O'Reilley, 2012
MOOC/NPTEL/SWAYAM Course: 1. Big Data Computing (https://onlinecourses.nptel.ac.in/noc23_cs112/preview)

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19AD519.1	Apply the introductory knowledge on big data to create basic analytics for a dataset
R19AD519.2	Implement the HDFS commands for a given dataset
R19AD519.3	Apply big data tools to analyse details and present visualizations
R19AD519.4	Implement Azure Databricks for storing, analysing and visualising data
R19AD519.5	Understand the detailed architecture and apply it to define objects, load data, query data and performance tune Column-oriented NoSQL databases

R19AD520	Data Exploration and Visualization	L	T	P	C
		3	0	0	3

1. Course Description:

This course covers principles and tools for creating impactful visualizations, using software like Tableau, Power BI, and Python libraries. Students learn to analyze and communicate data effectively, developing interactive dashboards and compelling visual narratives for decision-making across industries.

2. Course Objectives:

1. To learn the essential exploratory techniques for analyzing and visualizing data.

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2. To gain hands-on experience of using software tools for data preparation, analytics, and visualization.
3. To utilize visualization for exploratory data analysis, identifying patterns and trends.
4. To apply visualization techniques to practical, real-world datasets.
5. To develop compelling visual narratives to communicate insights effectively.

3. Syllabus

Unit-I: Data Exploration

Data: Aesthetics, Types of Data, Coordinate systems and axes, Colour Scales; Data Cleanup Basics: Normalizing and standardizing the data; Exploring the data: Importing the data, exploring table functions, identifying correlation and outliers; Introduction to Single variable: Distribution Variables, Numerical Summaries of Level and Spread, Scaling and Standardizing, Inequality, Smoothing Time Series.

Unit-II: Data Analysis

Data collection and management: Introduction, Sources of data, Data collection, APIs; Data Pre- processing Techniques; Data Analysis and Data Analytics: Descriptive Analysis, Diagnostic Analytics, Predictive Analytics, Prescriptive Analytics, Exploratory Analysis, Mechanistic Analysis; Analysis Method: Quantitative Methods, Qualitative Methods; Evaluation: Comparing Models, Cross Validation; Data storage and management, using multiple data sources.

Unit-III: Data Visualization

The Seven Stages of Visualizing Data, Univariate Plots: Histogram, Single and multiple distributions, Probability Distribution plots, Run Sequence Plots; Bivariate Plots: Bar graphs, Heat maps; Density Plots, Pair plots, Contour plots; Empirical cumulative distribution functions and q-q plots; Time series Data: Individual time series, Multiple time series and dose–response curves; Geo-spatial Data: Cartograms.

Unit-IV: Introduction to Tableau

Overview of Tableau and its applications, Installation and setup, connecting to data sources (Excel, CSV, databases), Understanding Tableau's interface; Data Preparation in Tableau, Maps and geographical data visualization, Intermediate Visualization Techniques, Storytelling with Tableau, Real-time data connections and live dashboards.

Unit-V: Power BI for Data Visualization And Analysis

Data Preparation and Transformation, Basic Visualization Techniques, Advanced DAX functions and calculations, Power BI Data Modelling; Case Study: Wildfire Activity in the Western United States, Single Family Residential Home and Rental Values.

Text Books:

1. Claus O Wilke, "Fundamentals of Data Visualization A Primer on Making Informative and Compelling Figures", O'Reilly Media, Inc., First Edition, 2019.
2. David Baldwin," Mastering Tableau: Smart Business Intelligence techniques to get maximum insights from your data", Packt, First Edition, 2016.

References:

Reference Books:

1. Catherine Marsh, Jane Elliott, Exploring Data: An Introduction to Data Analysis for Social Scientists, Wiley Publications, 2nd Edition, 2008.
2. Alberto Cairo, "The Functional Art: An Introduction to Information Graphics and Visualization", New Riders, 2012.
3. Nathan Yau, "Visualize This: The Flowing Data Guide to Design, Visualization and Statistics", John Wiley & Sons, 3rd Edition, 2011.
4. Ben Fry, "Visualizing Data", O'Reilly Media, Inc., 2007.

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Journals (Reference):

1. Deepmala Srivastava, "An Introduction to Data Visualization Tools and Techniques in Various Domains," International Journal of Computer Trends and Technology, vol. 71, no. 4, pp. 125-130, 2023. Crossref, https://doi.org/10.14445/22312803/IJCTT-V71I4P116
2. Diamond, Michael and Angela Mattia. "Data Visualization: An Exploratory Study into the Software Tools Used by Businesses." Journal of Instructional Pedagogies 17 (2015).

Video References:

1. https://www.youtube.com/watch?v=TPMlZxRRaBQ
2. https://youtu.be/64-eK-tdTPc

MOOC/NPTEL/SWAYAM Courses:

1. https://www.udemy.com/course/data-exploration-data-analysis-data-visualization/
2. https://www.coursera.org/courses?query=data%20visualization

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19AD520.1	Apply the key techniques and theory behind Data Exploration.
R19AD520.2	Apply the statistical techniques and methods for Data visualization
R19AD520.3	Apply various data visualization techniques for a variety of tasks
R19AD520.4	Implement data visualization techniques using Tableau and Power BI
R19AD520.5	Create story telling Dashboards using Tableau and Power BI

R19CC521	Ethical Hacking	L	T	P	C
		3	0	0	3

1. Course Description:

This course is designed to immerse participants in the realm of ethical hacking, offering a comprehensive understanding of cybersecurity practices. From mastering the basics of computer-based vulnerabilities to delving into advanced penetration testing and footprinting techniques, students will gain practical expertise. Analyze the intricacies of social engineering and scanning methods while demonstrating proficiency in enumeration and vulnerability analysis. Through hands-on application of ethical hacking tools, participants will learn to effectively identify and expose vulnerabilities, contributing to heightened cybersecurity measures.

2. Course Objectives:

1. To help students examine the basics of computer-based vulnerabilities in order to develop a comprehensive understanding of cybersecurity threats.
2. To ensure students understand various penetration testing and footprinting techniques for the effective assessment of system vulnerabilities.
3. To guide students in exploring the characteristics of social engineering and different scanning methods to analyze potential attack vectors.
4. To facilitate student learning in describing and demonstrating enumeration and vulnerability analysis methods for identifying system weaknesses.

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5. To enable students to proficiently apply ethical hacking tools to expose vulnerabilities and enhance cybersecurity measures.
3. Syllabus:
Unit-I: Introduction
Ethical Hacking Overview – Legality and Ethics - Overview of TCP/IP- The Application Layer - The Transport Layer - The Internet Layer - IP Addressing - Network and Computer Attacks - Malware - Protecting Against Malware Attacks – Intruder Attacks - Addressing Physical Security.
Unit-II: Penetration Testing and Footprinting
Role of Security and Penetration Testers - Penetration-Testing Methodologies - Footprinting Concepts - Footprinting through Search Engines, Web Services, Social Networking Sites, Website, Email - Competitive Intelligence - Footprinting through Social Engineering - Footprinting Tools.
Unit-III: Social Engineering and Scanning
Introduction to Social Engineering – Importance of Social Engineering in Hacking – Common Social Engineering techniques – Phishing, Baiting, Tailgating, Vishing – Mitigation Strategies - Network Scanning Concepts - Port-Scanning Tools - Scanning Techniques - Scanning Beyond IDS and Firewall.
Unit-IV: Enumeration and Vulnerability Analysis
Enumeration Concepts - NetBIOS Enumeration – SNMP, LDAP, NTP, SMTP and DNS Enumeration - Vulnerability Assessment Concepts - Desktop and Server OS Vulnerabilities - Windows OS Vulnerabilities - Tools for Identifying Vulnerabilities in Windows- Linux OS Vulnerabilities.
Unit-V: System Hacking Techniques
Password guessing - Password Sniffing – Keystroke Loggers – Privilege Escalation – Password Cracking – Password Cracking Techniques – Cracking Tools – Covering Tracks – Countermeasures – Case studies of various attacks.
Text Books:
1. Michael T. Simpson, Kent Backman, and James E. Corley, Hands-On Ethical Hacking and Network Defense, Course Technology, Delmar Cengage Learning, 2010. 2. The Basics of Hacking and Penetration Testing - Patrick Engebretson, SYNGRESS, Elsevier, 2013. 3. The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, 4. Dafydd Stuttard and Marcus Pinto, 2011.
References:
1. Black Hat Python: Python Programming for Hackers and Pentesters, Justin Seitz, 2014. 2. The CEH Prep Guide, Ronald L.Krutz and Russell Dean Vines, Wiley India Pvt. Ltd., 2008

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CC521.1	Demonstrate knowledge on basics of computer-based vulnerabilities.
R19CC521.2	Understand different penetration testing and footprinting techniques.

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R19CC521.3	Analyze the characteristics of Social Engineering and various scanning methods.
R19CC521.4	Demonstrate enumeration and vulnerability analysis methods.
R19CC521.5	Apply tools to perform ethical hacking to expose vulnerabilities.

R19CC522	Digital and Mobile Forensics	L	T	P	C
		3	0	0	3

1. Course Description:

This course is designed to provide a thorough understanding of digital and mobile forensics. Through theoretical exploration and practical applications, students will acquire knowledge on digital crime investigations and forensic readiness. Specifically tailored to address the complexities of contemporary technology, participants will learn to investigate, identify, and extract digital evidence from iOS and Android devices, preparing them for real-world challenges in the field of digital investigation.

2. Course Objectives:

1. To help students examine digital forensics, ensuring they thoroughly understand its principles and methodologies.
2. To guide students in understanding digital crime and investigations, allowing them to comprehend the dynamics of cybercrime and investigative procedures.
3. To emphasize the importance of forensic readiness, helping students recognize its role in preparedness for digital investigations.
4. To instruct students on techniques for effectively investigating, identifying, and extracting digital evidence from iOS devices.
5. To enable students to investigate, identify, and extract digital evidence from Android devices using appropriate forensic methods.

3. Syllabus:

Unit-I: Introduction to Digital Forensics

Forensic Science – Digital Forensics – Digital Evidence – The Digital Forensics Process – Introduction – The Identification Phase – The Collection Phase – The Examination Phase – The Analysis Phase – The Presentation Phase – Forensics and social networking sites.

Unit-II: Digital Crime and Investigation

Digital Crime – Substantive Criminal Law – General Conditions – Offenses – Investigation Methods for Collecting Digital Evidence – International Cooperation to Collect Digital Evidence.

Unit-III: Digital Forensic Readiness

Introduction – Law Enforcement versus Enterprise Digital Forensic Readiness – Rationale for Digital Forensic Readiness – Frameworks, Standards and Methodologies – Enterprise Digital Forensic Readiness – Challenges in Digital Forensics.

Unit-IV: iOS Forensics

Crimes using mobile phones, SIM Card, SIM Security – Mobile Hardware and Operating Systems - iOS Fundamentals – Acquisition via Jailbreaking – File System – Hardware – iPhone Security – iOS Forensics – Procedures and Processes – Tools – Oxygen Forensics – MobilEdit – iCloud.

Unit-V: Android Forensics

Android basics – Key Codes – ADB – Rooting Android – Boot Process – File Systems – Security – Tools – Android Forensics – Forensic Procedures – ADB – Android Only Tools – Dual Use Tools – Oxygen Forensics – MobilEdit – Android App Decompiling.

Text Books:

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1. Andre Arnes, "Digital Forensics", Wiley, 2018.
2. Chuck Easttom, "An In-depth Guide to Mobile Device Forensics", First Edition, CRC Press, 2022.

References:

1. Vacca, J, Computer Forensics, Computer Crime Scene Investigation, 2nd Ed, Charles River Media, 2005, ISBN:1-58450-389.

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CC522.1	Demonstrate knowledge on digital forensics.
R19CC522.2	Understand digital crime and investigations.
R19CC522.3	Develop readiness for forensic procedures.
R19CC522.4	Investigate, identify, and extract digital evidence from iOS devices.
R19CC522.5	Investigate, identify, and extract digital evidence from Android devices.

R19CC523	Social Network Security	L	T	P	C
		3	0	0	3

1. Course Description:

This course is designed to delve into the intricacies of social network security, providing participants with practical skills and theoretical understanding. Explore the development of semantic web applications and analyze privacy and security issues inherent in social networking platforms. Gain insights into data extraction, mining, and prediction of human behavior within social communities while examining various applications of social networks.

2. Course Objectives:

1. To guide students in examining semantic web development to understand its application in creating simple applications for social networks.
2. To help students understand privacy and security issues in social networking and explain their impact on user data protection.
3. To assist students in exploring data extraction and mining techniques in social networks, describing their utilization for gathering insights.
4. To instruct students on methods for predicting human behavior in social communities and discuss their implications for security measures.
5. To enable students to understand the applications of social networks and explore their diverse functionalities and usage scenarios.

3. Syllabus:

Unit-I: Fundamentals of Social Networking

Introduction to Semantic Web, Limitations of current Web, Development of Semantic Web, Emergence of the Social Web, Social Network analysis, Development of Social Network Analysis, Key concepts and measures in network analysis, Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities – Web-based networks – Applications of Social Network Analysis.

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Unit-II: Security Issues in Social Networks
The evolution of privacy and security concerns with networked technologies, Contextual influences on privacy attitudes and behaviors, Anonymity in a networked world.
Unit-III: Extraction and Mining in Social Networking Data
Extracting evolution of Web Community from a Series of Web Archive, Detecting communities in social networks, Definition of community, Evaluating communities, Methods for community detection and mining, Applications of community mining algorithms, Tools for detecting communities social network infrastructures and communities, Big data and Privacy
Unit-IV: Predicting Human Behavior and Privacy Issues
Understanding and predicting human behavior for social communities, User data Management, Inference and Distribution, Enabling new human experiences, Reality mining, Context, Awareness, Privacy in online social networks, Trust in online environment, What is Neo4j, Nodes, Relationships, Properties
Unit-V: Access Control, Privacy and Identity Management
Understand the access control requirements for Social Network, Enforcing Access Control Strategies, Authentication and Authorization, Roles-based Access Control, Host, storage and network access control options, Firewalls, Authentication, and Authorization in Social Network, Identity & Access Management, Single Sign-on, Identity Federation, Identity providers and service consumers, The role of Identity provisioning
Text Books:
1. Peter Mika, Social Networks and the Semantic Web, First Edition, Springer 2007. 2. BorkoFurht, Handbook of Social Network Technologies and Application, First Edition, Springer, 2010. 3. Learning Neo4j 3.x –Second Edition By Jérôme Baton, Rik Van Bruggen, Packt publishing. 4. David Easley, Jon Kleinberg, Networks, Crowds, and Markets: Reasoning about a Highly Connected World‖, First Edition, Cambridge University Press, 2010.
References:
1. Easley D. Kleinberg J., Networks, Crowds, and Markets – Reasoning about a Highly Connected World, Cambridge University Press, 2010. 2. Jackson, Matthew O., Social and Economic Networks‖, Princeton University Press, 2008. 3. GuandongXu ,Yanchun Zhang and Lin Li, Web Mining and Social Networking – Techniques and applications‖, First Edition, Springer, 2011. 4. Dion Goh and Schubert Foo, Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively‖, IGI Global Snippet, 2008 5. Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modeling‖, IGI Global Snippet, 2009. 6. John G. Breslin, Alexander Passant and Stefan Decker, The Social Semantic Web‖, Springer, 2009.

4. Course Outcomes:

After successful completion of the course, the student should be able to:

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CO. No.	Course Outcome
R19CC523.1	Create semantic web-related simple applications
R19CC523.2	Analyze privacy and security issues in social networking
R19CC523.3	Demonstrate data extraction and mining techniques in social networks
R19CC523.4	Evaluate the prediction of human behavior in social communities
R19CC523.5	Explore various applications of social networks

R19CC524	Modern Cryptography	L	T	P	C
		3	0	0	3

1. Course Description:

This course is designed to provide a thorough exploration of modern cryptography, offering participants a comprehensive understanding of its principles and applications. From network security fundamentals to cryptographic operations of both symmetric and public key algorithms, students will gain practical skills in securing digital communication. Through the study of authentication schemes and cybercrime awareness, participants will be equipped to address contemporary cybersecurity challenges with confidence and proficiency.

2. Course Objectives:

1. To guide students in examining the fundamentals of network security, security architecture, threats, and vulnerabilities to develop a comprehensive understanding.
2. To help students understand the different cryptographic operations of symmetric cryptographic algorithms for secure data encryption and decryption.
3. To assist students in exploring various cryptographic operations of public key cryptography and grasp its role in secure communication.
4. To instruct students on describing and applying various authentication schemes, simulating different applications for enhanced cybersecurity.
5. To enable students to understand various cyber crimes and cybersecurity measures to effectively mitigate digital threats and protect information assets.

3. Syllabus:

Unit-I: Introduction to Security

Computer Security Concepts – The OSI Security Architecture – Security Attacks – Security Services and Mechanisms – A Model for Network Security – Classical encryption techniques: Substitution techniques, Transposition techniques, Steganography – Foundations of modern cryptography: Perfect security – Information Theory – Product Cryptosystem – Cryptanalysis.

Unit-II: Symmetric Ciphers

Number theory – Algebraic Structures – Modular Arithmetic - Euclid's algorithm – Congruence and matrices – Group, Rings, Fields, Finite Fields

SYMMETRIC KEY CIPHERS: SDES – Block Ciphers – DES, Strength of DES – Differential and linear cryptanalysis – Block cipher design principles – Block cipher mode of operation – Evaluation criteria for AES – Pseudorandom Number Generators – RC4 – Key distribution.

Unit-III: Asymmetric Cryptography

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MATHEMATICS OF ASYMMETRIC KEY CRYPTOGRAPHY: Primes – Primality Testing – Factorization – Euler's totient function, Fermat's and Euler's Theorem – Chinese Remainder Theorem – Exponentiation and logarithm ASYMMETRIC KEY CIPHERS: RSA cryptosystem – Key distribution – Key management – Diffie Hellman key exchange.
Unit-IV: Integrity and Authentication Algorithms
Authentication requirement – Authentication function – MAC – Hash function – Security of hash function: HMAC, CMAC – SHA – Digital signature and authentication protocols – DSS – Schnorr Digital Signature Scheme – ElGamal cryptosystem – Entity Authentication: Biometrics, Passwords, Challenge Response protocols – Authentication applications – Kerberos MUTUAL TRUST: Key management and distribution – Distribution of public keys – X.509 Certificates.
Unit-V: Cyber Crimes and Cyber Security
Cyber Crime and Information Security – classifications of Cyber Crimes – Tools and Methods – Password Cracking, Keyloggers, Spywares, SQL Injection – Network Access Control – Cloud Security – Web Security – Wireless Security.
Text Books:
1. William Stallings, "Cryptography and Network Security - Principles and Practice", Seventh Edition, Pearson Education, 2017. 2. Nina Godbole, Sunit Belapure, "Cyber Security: Understanding Cyber crimes, Computer Forensics and Legal Perspectives", First Edition, Wiley India, 2011.
References:
1. Behrouz A. Ferouzan, Debdeep Mukhopadhyay. "Cryptography and Network Security", 3rd Edition, Tata Mc Graw Hill, 2015. 2. Charles Pfleeger, Shari Pfleeger, Jonathan Margulies, "Security in Computing", Fifth Edition, Prentice Hall, New Delhi, 2015.

4. **Course Outcomes:**

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CC524.1	Explain the fundamentals of network security, security architecture, threats, and vulnerabilities
R19CC524.2	Apply the different cryptographic operations of symmetric cryptographic algorithms
R19CC524.3	Apply the different cryptographic operations of public key cryptography
R19CC524.4	Apply various authentication schemes to simulate different applications
R19CC524.5	Explain various cybercrimes and cybersecurity

R19CC525	Engineering Secure Software Systems	L	T	P	C
		3	0	0	3

1. Course Description:

This course is designed to equip participants with the necessary skills and knowledge to engineer secure software systems. Through a comprehensive curriculum, students will learn to utilize tools effectively for software security, identify vulnerabilities such as memory attacks, and apply fundamental security principles in software development. Additionally,

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the course will focus on risk assessment and selection of testing techniques to ensure robust security measures are implemented at every stage of software development.

2. Course Objectives:

1. To guide students in examining software security tools to ensure their effective implementation in securing software systems.
2. To help students understand memory attack vulnerabilities and develop strategies to mitigate these risks effectively.
3. To assist students in exploring security principles in software development for their comprehensive application throughout the development process.
4. To instruct students on describing and assessing risks in software systems, enabling them to prioritize mitigation strategies effectively.
5. To enable students to identify and apply testing techniques that ensure software security during the development phase.

3. Syllabus:

Unit-I: Need of Software Security and Low-Level Attacks

Software Assurance And Software Security - Properties Of Software- Defensive And Attacker Perspectives In Addressing- Desirable Traits Of Software To Its Security- Key Resources Of Attack Patterns And Assurance- SDLC.

Unit-II: Secure Software Design

Requirements Engineering for secure software - SQUARE process Model – Requirements elicitation and prioritization- Isolating the Effects of untrusted Executable Content – Stack Inspection – Policy Specification Languages – Vulnerability Trends – Buffer Overflow – Code Injection - Session Hijacking. Secure Design - Threat Modeling and Security Design Principles.

Unit-III: Security Risk Management

Risk Management Life Cycle – Risk Profiling – Risk Exposure Factors – Risk Evaluation and Mitigation – Risk Assessment Techniques – Threat and Vulnerability Management.

Unit-IV: Security Testing

Traditional Software Testing – Comparison - Secure Software Development Life Cycle – Risk Based Security Testing – Prioritizing Security Testing with Threat Modeling – Penetration Testing – Planning and Scoping - Enumeration – Remote Exploitation – Web Application Exploitation - Exploits and Client Side Attacks – Post Exploitation – Bypassing Firewalls and Avoiding Detection - Tools for Penetration Testing.

Unit-V: Secure Project Management

Governance and security - Adopting an enterprise software security framework - Security and project management - Maturity of Practice.

Text Books:

1. Julia H. Allen, "Software Security Engineering", Pearson Education, 2008.
2. Evan Wheeler, "Security Risk Management: Building an Information Security Risk Management Program from the Ground Up", First edition, Syngress Publishing, 2011.
3. Chris Wysopal, Lucas Nelson, Dino Dai Zovi, and Elfriede Dustin, "The Art of Software Security Testing: Identifying Software Security Flaws (Symantec Press)", Addison-Wesley Professional, 2006

References:

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1. Robert C. Seacord, "Secure Coding in C and C++ (SEI Series in Software Engineering)", Addison-Wesley Professional, 2005.
2. Jon Erickson, "Hacking: The Art of Exploitation", 2nd Edition, No Starch Press, 2008.
3. Mike Shema, "Hacking Web Apps: Detecting and Preventing Web Application Security Problems", First edition, Syngress Publishing, 2012
4. Bryan Sullivan and Vincent Liu, "Web Application Security, A Beginner's Guide", Kindle Edition, McGraw Hill, 2012
5. Lee Allen, "Advanced Penetration Testing for Highly-Secured Environments: The Ultimate Security Guide (Open Source: Community Experience Distilled)", Kindle Edition, PacktPublishing, 2012

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CC525.1	Implement tools for securing software
R19CC525.2	Identify various vulnerabilities related to memory attacks
R19CC525.3	Apply security principles in software development
R19CC525.4	Inspect the extent of risks
R19CC525.5	Identify selection of testing techniques related to software security in the testing phase of software development

R19CC526	Cryptocurrency and Block Chain Technologies	L	T	P	C
		3	0	0	3

1. Course Description:

This course is designed to provide a comprehensive understanding of cryptocurrency and blockchain technologies. Through theoretical exploration and hands-on application, students will gain insight into emerging abstract models and alternative consensus mechanisms. By applying Hyperledger Fabric and Ethereum platforms, participants will develop the skills to implement blockchain applications effectively. Additionally, the course will empower learners to leverage blockchain technology across various domains, fostering innovation and real-world solutions.

2. Course Objectives:

1. To guide students in examining blockchain technology to understand its underlying principles and functionalities.
2. To help students understand emerging abstract models in blockchain technology through exploration and analysis.
3. To assist students in exploring the processes of cryptocurrency issuance, proof of work, and alternative consensus mechanisms, enabling them to describe their functioning effectively.

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4. To instruct students on the application of Hyperledger Fabric and Ethereum platforms for implementing blockchain applications.
5. To enable students to apply blockchain technology across various domains, leveraging diverse perspectives to develop innovative solutions.

3. Syllabus:

Unit-I: Introduction to Blockchain

Blockchain- Public Ledgers, Blockchain as Public Ledgers – Block in a Blockchain, Authorizing Transactions – Permissioned model of Blockchain, Cryptographic – Hash function, Properties of a Hash Function – Hash Pointer and Merkle tree.

Unit-II: Bitcoin and Cryptocurrency

A basic cryptocurrency, creation of coins, Payments and double spending — the precursor for Bitcoin scripting, Bitcoin Scripts, Bitcoin P2P Network, Transaction in bitcoin network, Block mining.

Unit-III: Bitcoin Consensus

Bitcoin Consensus, Proof of Work (PoW) – Hashcash PoW, Bitcoin PoW, Attacks on PoW, Proof of Stake – Proof of Burn – Bitcoin Miner – Mining difficulty, Mining pool.

Unit-IV: Hyperledger Fabric & Ethereum

Architecture of Hyperledger fabric v1.1 – Ethereum: Ethereum construction DAO, Smart Contracts, GHOST, Vulnerability attacks, Sidechain, Namecoin.

Unit-V: Blockchain Applications

Blockchain applications in Supply Chain Management, Medical Record Management System, Logistics, Smart cities, Finance and banking.

Text Books:

1. Bashir and Imran, Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks, 2017.
2. Andreas Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies" O'Reilly, 2014.
3. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).

References:

1. Daniel Drescher, "Blockchain Basics", First Edition, Apress, 2017
2. Ritesh Modi, "Solidity Programming Essentials: A Beginner's Guide to Build Smart Contracts for Ethereum and Blockchain", Packt Publishing
3. BikramadityaSinghal, Gautama, PriyansuSekhar Panda, "Beginning Blockchain: A Beginner's Guide to Building Blockchain Solutions", Apress.
4. Dr. Gavin Wood, "ETHEREUM: A Secure Decentralized Transaction Ledger", Yellow paper, 2014.

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CC526.1	Describe and explain block chain technology
R19CC526.2	Understand emerging abstract models for Blockchain Technology
R19CC526.3	Apply the process of cryptocurrencies issuance, proof of work and alternative consensus mechanisms and transaction

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R19CC526.4	Apply Hyperledger Fabric and Ethereum platform to implement the Block chain Application.
R19CC526.5	Apply the knowledge from various domains and implement them using blockchain technology in different perspectives

R19CC527	Malware Analysis	L	T	P	C
		3	0	0	3

1. Course Description:

This course is designed to provide comprehensive knowledge and skills in security and privacy within cloud computing environments. Participants will explore legal, business, and privacy requirements for cloud deployment models, along with critical analysis of ethical concerns. Understand cloud policies, Identity and Access Management, and architectural considerations for enhanced security. Delve into various risks, audit, and monitoring mechanisms in the cloud to develop effective strategies for mitigating threats and ensuring data protection.

2. Course Objectives:

1. To guide students in examining legal, business, and privacy requirements for cloud deployment models to understand their implications for data security and privacy.
2. To help students understand and critically analyze legal, ethical, and business concerns related to data security and privacy in cloud environments.
3. To assist students in exploring cloud policies and Identity and Access Management (IAM) to understand their roles in enforcing security measures.
4. To instruct students on describing various architectural and design considerations for security in the cloud, enabling them to implement effective safeguards.
5. To enable students to understand various risks and audit and monitoring mechanisms in the cloud, developing comprehensive security strategies accordingly.

3. Syllabus:

Unit-I: Characteristics

Architectural and Technological Influences of Cloud Computing-Understand the Cloud deployment models Public, Private, Community and Hybrid models-Scope of Control-Software as a Service (SaaS)

Platform as a Service (PaaS)-Infrastructure as a Service (IaaS)-Cloud Computing Roles-Risks and Security Concerns-Overview of cloud security- Security Services – Confidentiality, Integrity, Authentication, Nonrepudiation, Access Control – Basic of cryptography – Conventional and public-key cryptography, hash functions, authentication, and digital signatures.

Unit-II: Security Design and Architecture for Cloud Computing

Security design principles for Cloud Computing Secure Isolation Comprehensive data protection End-to-end access control Monitoring and auditing Quick look at CSA, NIST and ENISA guidelines for Cloud Security-Secure Isolation of Physical & Logical

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Infrastructure Compute, Network and Storage Common attack vectors and threats Secure Isolation Strategies Multitenancy, Virtualization strategies Inter-tenant network segmentation strategies Storage isolation strategies.
Unit-III: Access Control and Identity Management
Access control requirements for Cloud infrastructure – User Identification – Authentication and Authorization – Roles-based Access Control – Multi-factor authentication – Single Sign-on, Identity Federation – Identity providers and service consumers – Storage and network access control options – OS Hardening and minimization –Firewalls, IDS, IPS and honeypots Verified and measured boot – Intruder Detection and prevention- Auditing – Record generation, Reporting and Management Tamper-proofing audit logs
Unit-IV: Cloud Design Patterns
Introduction to Design Patterns Understanding Design Patterns Template Architectural patterns for Cloud Computing Platform-to-Virtualization & Virtualization-to-Cloud Cloud bursting-Security Patterns for Cloud Computing- Trusted Platform- Geo-tagging- Cloud VM Platform Encryption- Trusted Cloud Resource Pools Secure Cloud Interfaces- Cloud Resource Access Control-Cloud Data Breach Protection Permanent Data Loss Protection- In-Transit Cloud Data Encryption.
Unit-V: Monitoring, Auditing and Management
Proactive activity monitoring – Incident Response, Monitoring for unauthorized access, malicious traffic, abuse of system privileges – Events and alerts – Auditing – Record generation, Reporting and Management, Tamper-proofing audit logs, Quality of Services, Secure Management, User management, Identity management, Security Information and Event Management
Text Books:
1. Tim Mather, SubraKumaraswamy, and ShahedLatif, " Cloud Security and Privacy", Published by O'Reilly Media, Inc., 2009. 2. Dave shackleford, Virtualization Security!, SYBEX a wiley Brand 2013. 3. Ronald L. Krutz, Russell Dean Vines, "Cloud Security: A Comprehensive Guide to Secure Cloud Computing", Wiley Publishing, 2010.
References:
1. Mather, Kumaraswamy and Latif, Cloud Security and Privacy, OREILLY 2011 2. Raj Kumar Buyya , James Broberg, Andrzej Goscinski, Cloud Computing:!!, Wiley 2013 3. NIST (Authors: P. Mell and T. Grance), "The NIST Definition of Cloud Computing (ver. 15)," National Institute of Standards and Technology, Information Technology Laboratory (October 7 2009). 4. J. McDermott, (2009) "Security Requirements for Virtualization in Cloud Computing," presented at the ACSAC CloudSecurity Workshop, Honolulu, Hawaii, USA, 2009.

4. **Course Outcomes**:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CCXXX.1	Explain the legal, business, and privacy requirements for a cloud deployment model

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R19CC527.2	Analyze the legal, ethical, and business concerns for the security and privacy of data to be deployed to the cloud
R19CC527.3	Explain cloud policy and Identity and Access Management
R19CC527.4	Explore various architectural and design considerations for security in the cloud
R19CC527.5	Explain various risks and audit and monitoring mechanisms in the cloud

R19CC528	Network Security	L	T	P	C
		3	0	0	3

1. Course Description:

This course is designed to provide a comprehensive understanding of network security principles and practices. Participants will delve into various encryption techniques, key management, and authentication methods to secure data transmission effectively. Explore security techniques applied to network and transport layers, along with application layer security standards, to ensure robust protection against cyber threats. Additionally, learn to apply security practices tailored for real-time applications, enhancing overall network resilience and integrity.

2. Course Objectives:

1. To guide students in examining various encryption techniques to understand their functionality and suitability for different security requirements.
2. To help students understand key management techniques and authentication protocols, enabling them to describe their role in ensuring secure data transmission.
3. To assist students in exploring security techniques applied to network and transport layers, helping them understand their impact on overall network resilience."
4. To instruct students on describing application layer security standards and understanding their significance in safeguarding software applications.
5. To enable students to understand and apply security practices tailored for real-time applications, exploring effective protection measures in dynamic network environments.

3. Syllabus:

Unit-I: Introduction

Basics of cryptography, conventional and public-key cryptography, hash functions, authentication, and digital signatures.

Unit-II: Key Management and Authentication

Key Management and Distribution: Symmetric Key Distribution, Distribution of Public Keys, X.509 Certificates, Public-Key Infrastructure. User Authentication: Remote User-Authentication Principles, Remote User-Authentication Using Symmetric Encryption, Kerberos Systems, Remote User Authentication Using Asymmetric Encryption.

Unit-III: Access Control and Security

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Network Access Control: Network Access Control, Extensible Authentication Protocol, IEEE 802.1X Port-Based Network Access Control - IP Security - Internet Key Exchange (IKE). Transport-Level Security: Web Security Considerations, Secure Sockets Layer, Transport Layer Security, HTTPS standard, Secure Shell (SSH) application
Unit-IV: Application Layer Security
Electronic Mail Security: Pretty Good Privacy, S/MIME, DomainKeys Identified Mail. Wireless Network Security: Mobile Device Security
Unit-V: Security Practices
Firewalls and Intrusion Detection Systems: Intrusion Detection Password Management, Firewall Characteristics Types of Firewalls, Firewall Basing, Firewall Location and Configurations. Blockchains, Cloud Security and IoT security
Text Books:
1. Cryptography and Network Security: Principles and Practice, 6th Edition, William Stallings, 2014, Pearson, ISBN 13:9780133354690.
References:
1. Network Security: Private Communications in a Public World, M. Speciner, R. Perlman, C. Kaufman, Prentice Hall, 2002. 2. Linux iptables Pocket Reference, Gregor N. Purdy, O'Reilly, 2004, ISBN-13: 978-0596005696. 3. Linux Firewalls, by Michael Rash, No Starch Press, October 2007, ISBN: 978-1-59327-141- 4. Network Security, Firewalls And VPNs, J. Michael Stewart, Jones & Bartlett Learning, 2013, 5. The Network Security Test Lab: A Step-By-Step Guide, Michael Gregg, Dreamtech Press, 2015.

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CC528.1	Classify the encryption techniques
R19CC528.2	Illustrate the key management technique and authentication.
R19CC528.3	Evaluate the security techniques applied to network and transport layer
R19CC528.4	Discuss the application layer security standards
R19CC528.5	Apply security practices for real time applications

R19CB531	Software Quality Management	L	T	P	C
		3	0	0	3

1. Course Description:

Software Quality Management is a complementary to the core course of Software Engineering designed to provide students a holistic view of managing software quality from the perspective of programmer to quality manager. It aims at equipping students with the

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knowledge and skills necessary to ensure the quality of software products throughout the software development lifecycle. This course includes the processes, methods, and techniques for developing quality software, and maintaining quality software.

2. Course Objectives:

1. To implement adaptive software quality management approaches in dynamic environments.
1. To analyze software quality principles to formulate effective quality assurance strategies.
2. To synthesize software quality control techniques, identify and rectify defects.
3. To assess software quality metrics and measurement techniques for continuous improvement.
4. To evaluate software quality standards and models for application in diverse development contexts.

3. Syllabus

Unit-I: Fundamentals of Software Quality

Software Quality: Software quality challenge, Software quality factors, Components of the software quality assurance system; Pre-project software quality components: Contract review, Development and quality plans; Hierarchical models of Quality: Boehm and McCall, Gilb's approach, GQM model.

Unit-II: Software Quality Assurance

Quality tasks: SQA plan, Integrating quality activities in the project life cycle, Teams, Characteristics, Implementation, Documentation, Reviews and Audits; Product versus process quality management; Techniques to enhance software quality.

Unit-III: Quality Control and Reliability

Tools for quality: Ishikawa's basic tools, CASE tools; Defect prevention and removal; Reliability models: Rayleigh model, Reliability growth models for quality assessment.

Unit-IV: Quality Management System

Elements of QMS, Rayleigh model framework, Reliability growth models for QMS; Software quality metrics: Process metrics, Product metrics, Complexity metrics and models; Software quality costs: Classic model of cost of software quality; Customer satisfaction analysis.

Unit-V: Quality Standards

Quality management Standards: Need for standards, ISO 9000 series, ISO 9001:2015, Six Sigma concepts; Software validation and verification: Quality plans, Software process assessment; Management and its role in quality assurance: SQA trustees and committees.

Text Books:

1. Daniel Galin, "Software Quality: Concepts and Practice", First edition, John Wiley & Sons, 2018.

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2. Alan C Gillies, "Software Quality: Theory and Management", CENGAGE Learning, Second edition (Reprint), 2015.

References:

Reference Books:

1. Stephen H. Kan, "Metrics and Models in Software Quality Engineering", Second edition, Addison- Wesley 2014.
2. Stephan Goericke, "The Future of Software Quality Assurance", First edition, Springer Cham, 2020.
3. Roger S Pressman, Bruce R. Maxim, "Software Engineering – A Practitioner's approach", Ninth edition, McGraw Hill Education, 2020.

Journals:

1. IEEE Transactions on Software Engineering
2. Software Quality Journal.
3. Journal of Software Engineering Research and Development
4. Journal of Software: Practice and Experience

Video References:

1. https://www.youtube.com/watch?v=sCuY6xVOBPM
2. https://www.youtube.com/watch?v=Ln_LP7c23WM
3. https://www.youtube.com/watch?v=4EDYfSI-fmc
4. https://www.youtube.com/watch?v=z6hgu4jvEUs
5. https://www.youtube.com/watch?v=Lpp-DXSUMDU
6. https://www.youtube.com/watch?v=T_-tWQZDzSU
7. https://www.youtube.com/watch?v=e-jDBB-pE-E

MOOC/NPTEL/SWAYAM Courses:

1. https://nptel.ac.in/courses/106105182
2. https://nptel.ac.in/courses/106101163

4.Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CB531.1	Apply statistical methods in software quality.
R19CB531.2	Apply Model quality plan for implementation and documentation.
R19CB531.3	Apply modern tools for visualization of trends in software quality management.
R19CB531.4	Analyze the quality management system model, complexity metrics and cost.
R19CB531.5	Apply basic software quality assurance practices to ensure software quality and standards.

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R19CB532	Free and Open Source Software	L	T	P	C
		3	0	0	3

1. Course Description:

The Free and Open Source Software (FOSS) course provides students a working understanding of the economic and technical background of the Free / Open Source Software and its effective use. The course is designed to familiarise students with the development process using free and open source software, which includes Linux operating system, service configuration management, open source databases, programming languages, application software, and development tools. Students will explore the philosophy of FOSS, understand its licensing models, learn about various development methodologies, and gain practical experience with popular FOSS tools and platforms.

2. Course Objectives:

1. To explore free open source software environment.
2. To perform the installation of various packages in open source operating systems.
3. To recognize the applications, benefits and features of Open-Source Technologies.
4. To implement the mechanisms by which open-source software development projects operate.
5. To gain practical experience with popular FOSS tools and platforms.

3. Syllabus

Unit-I: Introduction to Open-Source Technologies

Introduction to open-source software: Overview of Free/Open-source software, Definition of FOSS & GNU, History of GNU/ Linux and the free software movement; Linux distribution: Advantages of free software and GNU/Linux, Free software licenses; Understanding build systems: Constructing make files and using make, using autoconf and autogen; Apache Web Server: Introduction, Starting, Stopping and restarting Apache, Configuring, Securing Apache.

Unit-II: Open Source Non - Relational Databases

Need of NoSQL; Data models: Aggregate data models, Details on data models, Distribution models, Consistency, Key value databases, Document Databases, Column, Family stores, Graph databases; Beyond NoSQL: Case study, Querying on non-relational databases.

Unit-III: Open-Source Tools

Introduction to open-source tools for web conferencing: Apache open meetings, Big Blue button, JITSI; Open-source tools for web development: Canva, AngularJS, XAMPP, Nginx model; Reliability growth models for quality assessment.

Unit-IV: Open-Source Programming Languages

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PHP and SQL database: PHP and LDAP, PHP connectivity; Sending and receiving E-mails, Debugging and error Handling, Security, Templates, Django, Go-Flask.

Unit-V: Open-source applications

Open-source desktop applications: Graphical desktops, Web browsers, The Office Suite, Mail and Calendar clients Personal software; Cost of OSS and Licensing; Case study: Samba, LibreOffice.

Text Books:

1. Ben Cotton, "Program Management for Open Source Projects: How to Guide Your Community-Driven, Open Source Project", First edition, The Pragmatic Bookshelf, 2022.
2. Ellen Siever, Stephen Figgins, Robert Love, Arnold Robbins, "Linux in a Nutshell", Sixth Edition, O'Reilly Media, 2009.

References:

Reference Books:

1. N. B. Venkateshwarlu, "Introduction to Linux: Installation and Programming (Ed)", Reprint edition, BS Publications(A NRCFOSS Series), 2016.
2. Roderick W. Smith, "Linux Essentials", 1st edition, Wiley Publications, 2012.
3. James Lee, BrentWare , "Open Source Development with LAMP: Using Linux, Apache, MySQL, Perl, and PHP", Pearson Education, 2009.

Journals:

1. Journal of Open Source Software
2. International Journal of Open Source Software and Processes
3. Open Source Systems Journal
4. Journal of Open Research Software

Video References:

1. https://www.youtube.com/watch?v=SpeDK1TPbew
2. https://www.youtube.com/watch?v=Rgc28TRuy00
3. https://www.youtube.com/watch?v=rCr3-YlL5S8
4. https://www.youtube.com/watch?v=WYbDT4iT-5E
5. https://www.youtube.com/watch?v=PMyzRfZDXYA
6. https://www.youtube.com/watch?v=uD3p_rZPBUQ
7. https://www.youtube.com/watch?v=j3koOJRUWCc

MOOC/NPTEL/SWAYAM Courses:

1. https://nptel.ac.in/courses/106105214
2. https://nptel.ac.in/courses/117106113

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4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CB532.1	(Apply) Practice skills in installing, configuring, securing, and managing the Apache Web Server for hosting web applications.
R19CB532.2	(Apply) Use the concept of NoSQL database and to choose the appropriate No-SQL database types.
R19CB532.3	(Apply) Use tools in the open-source category for application development.
R19CB532.4	(Apply) Develop web application using PHP with SQL connectivity.
R19CB532.5	(Analyze) Examine solutions to problems using Open-source desktop applications.

R19CB533	Agile Software Development	L	T	P	C
		3	0	0	3

1. Course Description:

Agile Software Development is a dynamic approach to software development that emphasizes flexibility, collaboration, and customer feedback. This course provides an in-depth understanding of Agile principles, methodologies, and practices, equipping students with the knowledge and skills to deliver high-quality software in rapidly changing environments.

2. Course Objectives:

1. To provide the students with an understanding of the principles and values of Agile Software Development
2. To provide the students to develop proficiency in various Agile methodologies, including Scrum, Kanban, and Extreme Programming (XP)
3. To provide the students with an understanding and gain proficiency in Agile practices such as iterative development, continuous integration, and test-driven development (TDD).
4. To enable the students to acquire skills in agile tools and techniques for project management, communication, and collaboration
5. To provide the students to learn insights to develop teamwork, communication, and problem-solving skills essential for Agile software development teams

3. Syllabus

Unit-I: Introduction to Agile Software Development

Overview of Agile Manifesto and Principles-Evolution of Agile methodologies-Agile vs. Waterfall: Contrasting approaches-Benefits and challenges of Agile adoption-Agile mindset and cultural implications

Unit-II: Agile Methodologies

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Scrum Framework: Sprint Planning-Daily Stand-ups-Sprint Review and Retrospective-Kanban Method: Visualizing Workflow-Work-in-Progress (WIP) Limits-Cumulative Flow Diagrams (CFDs)-Extreme Programming (XP):-Pair Programming-Continuous Integration-Refactoring Techniques

Unit-III: Agile Practices

User Stories: Writing Effective User Stories-Acceptance Criteria-Story Mapping-Backlog Management: Prioritization Techniques (e.g., MoSCoW, WSJF)-Release Planning-Product Increment and Definition of Done-Test-Driven Development (TDD):Red-Green-Refactor Cycle-Unit Testing vs. Integration Testing-Test Automation Frameworks (e.g., JUnit, NUnit)

Unit-IV: Agile Tools and Techniques

Agile Project Management Tools: Jira: User Stories, Epics, Sprints-Trello: Kanban Boards, Cards, Labels VersionOne, Rally, Asana-Version Control Systems: Git: Branching Strategies, Pull Requests-SVN, Mercurial Continuous Integration and Deployment (CI/CD):Jenkins: Automated Builds and Tests-Travis CI, CircleCI

Unit-V: Agile Project Implementation

Scaling Agile:Large-Scale Scrum (LeSS)-Scaled Agile Framework (SAFe)-Disciplined Agile Delivery (DAD ,Agile Transformation:Creating Agile Culture-Leadership and Change Management-Agile Coaching and Mentoring-Agile Metrics and Reporting:Burndown Charts, Burnup Charts-Velocity, Lead Time, Cycle Time, Agile Health Radars, Cumulative Flow Diagrams

Text Books:

1. James Shore and Shane Warden," The Art of Agile Development",Second edition, O'Reilly Media, 2021.
2. Scrum: The Art of Doing Twice the Work in Half the Time" by Jeff Sutherland,First Edition, Currency, 2014

References:

Reference Books:

1. Ambler, Scott W. (2012). "Agile Modeling: Effective Practices for eXtreme Programming and the Unified Process". Wiley.
2. Kenneth S. Rubin ,"Essential Scrum: A Practical Guide to the Most Popular Agile Process",First Edition, Addison-Wesley, 2012

Journals:

1. Journal of Agile Methodologies
2. Agile Journal
3. International Journal of Agile Management Systems
4. Journal of Software: Evolution and Process

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Video References:

1. https://www.youtube.com/watch?v=9TycLR0TqFA
2. https://www.youtube.com/watch?v=R8dYLbJiTUE
3. https://www.youtube.com/watch?v=RpQ2fs7H6JQ
4. https://www.youtube.com/watch?v=Z9QbYZh1YXY
5. https://www.youtube.com/watch?v=502ILHjX9EE
6. https://www.youtube.com/watch?v=S9QwP2eoHdk

MOOC/NPTEL/SWAYAM Courses:

1. https://nptel.ac.in/courses/110104073
2. https://nptelvideos.com/video.php?id=904

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CB533.1	Apply agile practices to real-world software development scenarios
R19CB533.2	Analyze agile frameworks to identify strengths and weaknesses
R19CB533.3	Apply agile methodologies in diverse software development projects to enhance productivity and quality
R19CB533.4	Apply agile practices to adapt to changing project requirements and stakeholder needs effectively
R19CB533.5	Design agile solutions for complex software development challenges projects.

R19CB534	Advanced Software Testing	L	T	P	C
		3	0	0	3

1. Course Description:

This course offers a comprehensive exploration of advanced software testing concepts and techniques, highlighting the crucial role of testing in the software development lifecycle. It covers a range of testing strategies, automation methods, and frameworks for evaluating complex software systems. Additionally, the course delves into modern challenges such as security testing, performance testing, and testing within Agile and DevOps environments.

2. Course Objectives:

3. To grasp the fundamentals of software testing.
4. To develop skills in effective test planning and execution.
5. To learn how to design and implement test cases.
6. To explore various dimensions of testing and gain a broader understanding of its multiple aspects.

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7. To gain insights into test automation and familiarize with the tools used for automating tests.

3. Syllabus

Unit-I: Introduction to Advanced Software Testing

Overview of testing methodologies: Black-box, White-box, Grey-box testing, V- model of Software Testing, Program Correctness and Verification, Reliability versus Safety, Failures, Errors and Faults (Defects), Software Testing Principles, Program Inspections, Importance of testing in the software lifecycle, Evolution of testing practices and tools,

Unit-II: Test Planning and Assessment

The Goal of Test Planning, High Level Expectations, Intergroup Responsibilities, Test Phases, Test Strategy, Resource Requirements, Tester Assignments, Test Schedule, Test Cases, Bug Reporting, Metrics and Statistics.

Unit-III: Test Design and Implementation

Test Objective Identification, Test Design Factors, Requirement identification, Testable Requirements, Modeling a Test Design Process, Modeling Test Results, Boundary Value Testing, Equivalence Class Testing, Path Testing, Data Flow Testing, Test Design Preparedness Metrics, Test Case Design Effectiveness, Model-Driven Test Design, Test Procedures, Test Case Organization and Tracking, Bug Reporting, Bug Life Cycle.

Unit-IV: Advanced Test Design Techniques

Performance Testing: Load Testing, Stress Testing, Volume Testing, Fail-Over Testing, Recovery Testing, Configuration Testing, Compatibility Testing, Usability Testing, Testing the Documentation, Security testing, Testing in the Agile Environment, Testing Web and Mobile Applications, Testing strategies in DevOps (CI/CD integration).

Unit-V: Test Tools and Automation

Automated Software Testing, Automate Testing of Web Applications, Selenium: Introducing Web Driver and Web Elements, Locating Web Elements, Actions on Web Elements, Different Web Drivers, Understanding Web Driver Events, Testing: Understanding Testing.xml, Adding Classes, Packages, Methods to Test, Test Reports.

Text Books:

1. Yogesh Singh, "Software Testing", Cambridge University Press, 2012.
2. Unmesh Gundecha, Satya Avasarala, "Selenium WebDriver 3 Practical Guide" – Second Edition 2018.

References:

Reference Books:

1. Glenford J. Myers, Corey Sandler, Tom Badgett, The Art of Software Testing, 3rd Edition,2012, John Wiley & Sons, Inc.
2. Ron Patton, Software testing, 2nd Edition, 2006, Sams Publishing.Paul C. Jorgensen, Software Testing: A Craftsman's Approach, Fourth Edition, 2014, Taylor & Francis Group
3. Carl Cocchiaro, Selenium Framework Design in Data-Driven Testing, 2018, Packt Publishing.
4. Elfriede Dustin, Thom Garrett, Bernie Gaurf, Implementing Automated Software Testing, 2009, Pearson Education, Inc.

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5. Satya Avasarala, Selenium WebDriver Practical Guide, 2014, Packt Publishing.
6. Varun Menon, TestNg Beginner's Guide, 2013, Packt Publishing.

Web Resources:

1. https://cinutedigital.com/advanced-software-testing/
2. https://lingming.cs.illinois.edu/courses/cs598ast-f20.html

Journals:

1. ACM Transactions on Software Engineering and Methodology (TOSEM)
2. IEEE Transactions on Software Engineering

MOOC/NPTEL/SWAYAM Courses:

1. https://www.coursera.org/learn/software-engineering-testing
2. Software Testing: https://onlinecourses.nptel.ac.in/noc20_cs19/preview

4.Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CB534.1	Understand the basic concepts of software testing and the need for software testing.
R19CB534.2	Design Test planning and different activities involved in test planning.
R19CB534.3	Design effective test cases that can uncover critical defects in the application
R19CB534.4	Carry out advanced types of testing.
R19CB534.5	Automate the software testing using Selenium and Testing.

R19CB535	Software Architecture	L	T	P	C
		3	0	0	3

1. Course Description:

The general goal of the Software Architecture course is to give students a broad yet sound view of creating software architecture and development methodologies, documentation and its usage in practice. This course also complements with key information and best-practices to be successful working with software architecture in industrial projects at any scale. The content of this course also includes the creation and evaluation of software designs from different perspectives and recognize the importance of quality attributes and learn tactics.

2. Course Objectives:

1. To understand the need, design approaches for software architecture to bridge the dynamic requirements and implementation.
2. To learn the design principles and to apply for large scale systems.

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3. To identify key architectural structures and design document for a given architecture.
4. To evaluate and implement different types of design patterns based on the requirement and functionality.
5. To develop appropriate architectures for various case studies.

3. Syllabus

Unit-I: Architecture Models and Styles

Basic Concepts of Software Architecture: Architecture business cycle, Architectural patterns, Reference models, Architectural structures, Views; Introduction to Styles: Simple Styles, Distributed and Networked Architectures, Architecture for network based applications, Decentralized Architectures.

Unit-II: Design Methodologies

Structured Design: Design Practices, Stepwise Refinement, Incremental Design, Structured System Analysis and Design; Jackson Structured Programming: Jackson System Development.

Unit-III: Architecture Description, Documentation and Evaluation

Early Architecture Description Languages: Domain and Style Specific ADLs, Extensible ADLs; Documenting Software architecture; Architecture Evaluation, ATAM.

Unit-IV: Architecture Design

Typical Architectural Design: Data Flow, Independent Components, Call and Return; Using Styles in Design: Choices of styles; Architectural design space: Theory of Design Spaces, Design space of Architectural Elements, Design space of Architectural styles.

Unit-V: Creating an Architecture

Understanding Quality Attributes: Functionality and Architecture, Architecture and Quality Attributes, System Quality Attributes, Quality attribute Scenarios in Practice; Introducing Tactics: Availability Tactics, Modifiability Tactics, Performance Tactics, Security Tactics, Testability Tactics, Usability Tactics, Relationship of Tactics to Architectural Patterns; Architectural Patterns and Styles.

Text Books:

1. Len Bass, Paul Clements, Rick Kazman, "Software Architecture in Practice", Fourth Edition, Addison Wesley, 2021.
2. David Budgen, "Software Design", Third Edition, Chapman and Hall/CRC, 2020.

References:

Reference Books:

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1. Mark Richards, Neal Ford, "Fundamentals of Software Architecture an Engineering Approach", First edition, Shroff/O'Reilly Publishers, 2020.
2. P. Clements, F. Bachmann, L. Bass, D. Garlan, J. Ivers, R. Little, P. Merson, R. Nord, and J. Stafford. "Documenting Software Architectures: Views and Beyond", Second Edition. Addison-Wesley, 2010.
3. Richard N. Taylor, Nenad Medvidovic and Eric M. Dashofy, —Software Architecture, Foundations, Theory and Practice‖, Wiley 2010.

Journals:

1. Journal of Systems Architecture.
2. International Journal of Software Innovation.
3. Journal of Software Engineering Research and Development
4. Journal of Software: Practice and Experience

Video References:

1. https://www.youtube.com/watch?v=8UlLgOf20Ho
2. https://www.youtube.com/watch?v=71iOgJmyCQg
3. https://www.youtube.com/watch?v=x0souHGurm8
4. https://www.youtube.com/watch?v=Ym9nhVZs89o
5. https://www.youtube.com/watch?v=nyisnHBJj5A
6. https://www.youtube.com/watch?v=2Pp0BcXN9YY

MOOC/NPTEL/SWAYAM Courses:

1. https://nptel.ac.in/courses/106105182
2. https://nptel.ac.in/courses/106105153
3. https://nptel.ac.in/courses/106101235
4. https://nptel.ac.in/courses/106105218

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CB535.1	Experiment various distinct architecture styles and views.
R19CB535.2	Apply different types of systems analysis techniques and software design strategies.
R19CB535.3	Learn and examine existing software architectures.
R19CB535.4	Develop software applications starting from software architecture and design.
R19CB535.5	Recognize the importance of quality attributes and learn tactics and patterns that help to realize quality attribute requirements.

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R19CB536	Software Requirement Engineering	L	T	P	C
		3	0	0	3

1. Course Description:

Software Requirements Engineering is a critical discipline within software engineering that focuses on identifying, documenting, and managing the requirements of software systems. This course provides students with comprehensive knowledge and practical skills to elicit, analyze, specify, validate, and manage software requirements throughout the software development lifecycle. By learning the principles and practices of requirements engineering, students will be equipped to ensure that software systems meet the needs and expectations of stakeholders effectively and efficiently.

2. Course Objectives:

1. To understand the basics of requirements engineering.
2. To learn different techniques used for requirements elicitation.
3. To know the role played by requirements analysis in requirement integration.
4. To know the role played by requirements analysis in requirement integration.
5. To study the current trends in requirements prioritization and validation.

3. Syllabus

Unit-I: Introduction

Introduction to Requirements: System, Stakeholder, Requirement, Attribute, Vision, Function ,Performance , Objective, Quality, Resource Saving , Workload Capacity, Resource, Cost. Budget Design Idea; Condition, Target, Constraint, Benchmark; Introduction to Requirements Engineering: What is Requirements Engineering, What are requirements, Requirements Engineering activities, Understanding requirements, classification based on functionality considerations, product construction, source, Levels of requirement, Evolution , Ambiguity in requirements specification

Unit-II: Requirements Elicitation

Requirements Elicitation: Preparing for requirements elicitation. Elicitation techniques survey eliciting non-functional requirements- prevalence of requirements elicitation techniques, eliciting hazards , Elicitation and gathering of requirements, Process of requirements elicitation, approaches for requirements elicitation methodology based requirements elicitation , tool support – issues –trends and challenges

Unit-III: Requirements Analysis

Identification of Functional and Non Functional Requirements, Identification of Performance Requirements, Six Quality Attributes: Analysis, Identification of safety Requirements, Analysis Feasibility and Internal Compatibility of System Requirements; Definition of Human Requirements Baseline.

Unit-IV: Requirements Development

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Requirements analysis; Requirements Documentation; Requirements Development Workflow: Fundamentals of Requirements Development, Requirements Attributes Guidelines Document Supplementary Specification Document, Use Case Specification Document, Methods for Software Prototyping , Evolutionary prototyping , Throwaway prototyping

Unit-V: Requirements Validation

Validation objectives: Analysis of requirements validation, Activities, Properties, Requirement reviews , Requirements testing ; Case tools for requirements engineering, Requirements engineering for Agile methods, Requirements Engineering for Web, Based Information Systems.

Text Books:

1. Al Sweigart, "Automate the Boring Stuff with Python: Practical Programming for Total Beginners," 2nd Edition, No Starch Press, 2019.
2. Liang Y. Daniel, "Introduction to Programming Using Python", Pearson Education, 2017.
3. Alan D. Moore, "Python GUI Programming with Tkinter: Develop responsive and powerful GUI applications with Tkinter," Packt Publishing Limited, 2018.

References:

Reference Books:

1. Software Requirements" by Karl E. Wiegers and Joy Beatty, Third Edition, Microsoft Press, 2013
2. Phillip A. Laplante – Requirements Engineering for Software and Systems-Auerbach Publications(Applied Software Engineering Series) ,2017

Web Resources:

1. https://www.javatpoint.com/software-engineering-requirement-engineering
2. https://www.geeksforgeeks.org/software-engineering-requirements-engineering-process/

4.Course Outcomes

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CB536.1	Apply SRS including the details of requirements engineering.
R19CB536.2	Apply the stages of requirements elicitation.
R19CB536.3	Analyse software requirements gathering.
R19CB536.4	Apply the various methodologies for requirements development.
R19CB536.5	Analyze the requirements validation to ensure accuracy and completeness.

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R19CB537	Continuous Integration and Continuous Deployment	L	T	P	C
		3	0	0	3

1. Course Description:

This course provides an in-depth exploration of Continuous Integration (CI) and Continuous Deployment (CD) practices, which are integral components of modern software development and deployment pipelines. Participants will gain a comprehensive understanding of the principles, tools, and best practices associated with CI/CD, enabling them to effectively implement these methodologies within their development workflows.

2. Course Objectives:

1. Understand the fundamental concepts of Continuous Integration (CI) and Continuous Deployment (CD), including their significance in modern software development practices.
2. Design, implement, and optimize robust CI/CD pipelines to automate software build, test, and deployment processes effectively.
3. Evaluate and select appropriate tools and technologies for CI/CD implementation based on project requirements and organizational needs.
4. Integrate version control systems with CI/CD workflows to enable seamless collaboration and version management within development teams.
5. Analyze case studies and real-world examples of successful CI/CD implementations to glean insights and best practices for application in their own projects.

3. Syllabus

Unit-I: Introduction

Continuous Integration and Continuous Delivery, Automated approach to software development, Benefits of DevOps pipeline.

Unit-II: Continuous Integration (Ci)

CI/CD tools, Infrastructure as Code (IaC), Provision and management of infrastructure.

Unit-III: Continuous Integration Tools

Module provides an overview of Continuous Integration, Features of CI, Benefits for DevOps, Social Coding, Tools of Continuous Integration.

Unit-IV: Continuous Delivery (CD)

Overview of Continuous Delivery (CD), CD's goals, Benefits, Key principles, Best practices.

Unit-V: Requirements of a CI/CD Pipeline

Requirements of a CI/CD pipeline, The difference between Continuous Delivery and Continuous Deployment, A closely related process. Standard CD tools, Argo CD.

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Text Books:
1. Henry van Merode ," Continuous Integration (CI) and Continuous Delivery (CD): A Practical Guide to Designing and Developing Pipelines" Bio-Green,2023 2. Amit Bhanushali, Alekhya Achanta, Beena Bhanushali ," Continuous Integration and Delivery with Test-driven Development: Cultivating quality, speed, and collaboration through automated pipelines (English Edition),2024
References:
Reference Books: 1. Continuous Integration vs. Continuous Delivery, Brent Laster,2017. 2. Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation ,Addison-Wesley Signature Series,2010. **Web Resources:** 1. https://docs.microsoft.com/en-us/azure/devops/?view=azure-devops 2. https://docs.gitlab.com/ee/ci/

4.Course Outcomes :

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CB537.1	Apply the fundamental concepts of Continuous Integration (CI) and Continuous Deployment (CD) and critically evaluate their significance in modern software development practices.
R19CB537.2	Apply the appropriate tools and technologies, demonstrating proficiency in automating software build, test, and deployment processes.
R19CB537.3	Analyze the different CI/CD tools and technologies, compare their features, and select the most suitable ones based on project requirements and organizational needs.
R19CB537.4	Analyze the CI/CD workflows to facilitate seamless collaboration and effective version management within development teams.
R19CB537.5	Apply the best practices of successful CI/CD implementations to innovate and enhance their own software development projects.

R19CB538	Software Reliability Metrics and Models	L	T	P	C
		3	0	0	3

1. Course Description:

Software Reliability Metrics and Models explores key concepts in Software Reliability Engineering, including fault prevention, fault tolerance, and reliability modeling. It covers

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developing operational profiles, selecting testing methods, and applying reliability models like Poisson and Weibull. The course also focuses on assessing reliability using software metrics and understanding the impact of complexity on software quality.

2. Course Objectives:

1. Understand the fundamental concepts of software reliability, including fault prevention, fault tolerance, and the software reliability engineering process.
2. Analyze the dependability concepts and failure behavior of X-ware systems, including systems with service restoration, and develop operational profiles for testing.
3. Explore various software reliability models such as the Non-Homogeneous Poisson Process and Weibull models, and their application in predicting reliability during early software development phases.
4. Evaluate the relationship between software complexity and quality through the use of static and dynamic program complexity metrics for reliability assessment.
5. Apply software testing techniques, including time/structure-based reliability estimation, to assess and improve the reliability of software systems.

3. Syllabus

Unit-I: Introduction to Software Reliability Engineering

The need for reliable software – Concepts of Software Reliability Engineering (SRE) – Basic definitions and technical terms: Fault prevention, Fault removal, Fault tolerance, Fault/Failure forecasting – Software reliability process – Software reliability vs Hardware reliability.

Unit-II: Software Reliability and System Reliability

Dependability concepts – Failure behavior of X-ware systems – Failure behavior with service restoration – Operational profiles: Concepts and development procedure – Test selection based on operational profiles.

Unit-III: Software Reliability Modeling

Introduction to software reliability models – Historical perspective – Exponential failure time models: Non-Homogeneous Poisson Process (NHPP), Musa's basic execution time model – Weibull and Gamma failure time models – Infinite failure category models: Duane's model – Model relationships – Software reliability prediction in early lifecycle phases.

Unit-IV: Software Metrics for Reliability Assessment

Introduction to software metrics – Static program complexity – Dynamic program complexity – Relationship between software complexity and software quality – Software reliability modeling using metrics.

Unit-V: Software Testing and Reliability

Introduction to software testing – Overview of software testing strategies – Role of operational profiles in testing – Time/structure-based software reliability estimation – Testing for reliability improvement.

Text Books:

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1. Aditya Mathur, "Foundations of Software Testing and Reliability Engineering," Pearson, 1st Edition, 2023.
2. Paul Ammann, Jeff Offutt, "Introduction to Software Testing," Cambridge University Press, 3rd Edition, 2023.

References:

Reference Books:

1. Norman Fenton, James Bieman, "Software Metrics: A Rigorous and Practical Approach," CRC Press, 3rd Edition, 2014.
2. John D. Musa, "Software Reliability Engineering: More Reliable Software Faster and Cheaper," McGraw-Hill, 2nd Edition, 2004.
3. Michael R. Lyu, "Handbook of Software Reliability Engineering," IEEE Computer Society Press and McGraw-Hill, 1st Edition, 1996.
4. Patrick D. T. O'Connor, Andre Kleyner, "Practical Reliability Engineering," Wiley, 6th Edition, 2023.
5. E. Balagurusamy, "Reliability Engineering," McGraw-Hill, 1st Edition, 2023.

Web Resource:

1. https://www.slideshare.net/rameshsinghpardeshi/operation-management-32601309, 22nd Mar 2014.

Journals:

1. IEEE Transactions on Software Engineering
2. Journal of Systems and Software

Video References:

1. Introduction to Software Reliability Engineering (SRE)
   https://www.youtube.com/watch?v=5NHiKpkF5GASoftware Reliability Modeling
2. Software Reliability Models by NPTEL.
   https://www.youtube.com/watch?v=VfmbSWBvNso
3. Operational Profiles and Software Testing
   https://www.youtube.com/watch?v=OGHdfJMt8Ds
4. Software Testing Techniques and Reliability by NPTEL
   https://www.youtube.com/watch?v=2EpW-n-kUBM.
5. Software Metrics and Reliability Assessment
   https://www.youtube.com/watch?v=arGfxLxE6gM

MOOC/NPTEL/SWAYAM Course:

1. SWAYAM: Software Engineering and Project Management, https://onlinecourses.nptel.ac.in/noc19_cs70/preview

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4.Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CB538.1	Apply fundamental concepts of Software Reliability Engineering to improve software reliability, including fault prevention and fault tolerance.
R19CB538.2	Analyse the dependability and failure behaviour of systems, and develop operational profiles to guide effective testing.
R19CB538.3	Apply software reliability models, such as Non-Homogeneous Poisson Process and Weibull models, to predict software failures.
R19CB538.4	Evaluate the impact of software complexity on quality and reliability using static and dynamic program complexity metrics.
R19CB538.5	Analyse software testing strategies and apply operational profiles to improve the reliability of software systems.

R19CB539	Software Project Management	L	T	P	C
		3	0	0	3

1. Course Description:

This course aims to equip students with the necessary knowledge and skills to effectively manage software projects. It covers a wide range of topics including project planning, effort estimation, risk management, people management, project control, and the use of modern project management tools and practices such as DevOps. Students will learn how to navigate the complexities of software project management to deliver successful projects.

2. Course Objectives:

1. To introduce the fundamental concepts and techniques of software project management, ensuring a strong foundation in key principles.
2. To facilitate the understanding and application of various methods for software effort estimation and activity planning.
3. To provide a comprehensive understanding of risk management and people management within the context of software projects.
4. To develop effective project schedules and implement control mechanisms for project success.
5. To familiarize with the latest industry tools and standards in software project management to align with current professional practices.

3. Syllabus:

Unit-I: Introduction

Introduction to Software Project Management - Software Projects - ways of categorizing software projects – problems with software projects – Project Life Cycle -Software Projects versus Other Types of Projects – Contract Management and Technical Project Management – Activities – Plans, Methods and Methodologies – Requirement Specification –

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Management Control – Overview of Project Planning –Introduction to Step Wise Project Planning – Programme Management and Project Evaluation.

Unit-II: Software Effort Estimation and Activity Planning

Software Effort Estimation: Problems with Over and Under Estimates – Basis of Software Estimating – Techniques – Expert Judgment – Cosmic Full Function Points – A Procedural Code Oriented Approach –COCOMO: A Parametric Model – Activity Planning: Objectives – Project Schedules – Projects and Activities – Sequencing and Scheduling Activities – Network Planning Models – Formulating A Network Model – Identifying Critical Path – Shortening the Project Duration – Identifying Critical Activities –Activity-on-arrow Networks.

Unit-III: Risk Management and Resource Allocation

Categories of Risk – Framework for Dealing with Risk – Risk Identification – Risk Assessment – Risk Planning – Risk Management – Evaluating Risks to the Schedule – Applying the PERT Technique – Monte Carlo Simulation – Critical Chain Concepts – Resource Allocation: Nature of Resources – Identifying Resource Requirements – Scheduling Resources – Creating Critical Paths – Counting the Cost – Cost Schedules – Scheduling Sequence.

Unit-IV: Project Data Collection and Reporting

Creating the Framework – Collecting the Data: Partial Completion Reporting – Risk Reporting – Visualizing Progress: Gantt chart – Slip chart – Ball Charts – The Timeline – Cost Monitoring – Earned Value Analysis – Prioritizing Monitoring – Getting the Project Back to Target – Change Control.

Unit-V: Project Management Tools & DevOps

Introduction to Project Management tools-Trello – JIRA – Zoho Projects –Introduction to DevOps – GitLab-Issues-Milestones Tracking

Text Books:

1. "Project Management: A Systems Approach to Planning, Scheduling, and Controlling" by Harold Kerzner,13th Edition, 2022.
2. Software Project Management: A Process-Driven Approach" by Ashfaque Ahmed, 2021.
3. Strategic Project Management Made Simple" by Terry Schmidt,2nd Edition, 2021

References:

Reference Books:

1. Pressman R. S., —Software Engineering – A Practitioner 's Approach‖, Ninth Edition, McGraw Hill Publishers, 2020.
2. "Project Management in the Hybrid Workplace" by Phil Simon (2022)

Journals:

1. Information and Software Technology
2. International Journal of Project Management

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1. https://onlinecourses.nptel.ac.in/noc19_cs70/preview
2. https://nptelvideos.com/video.php?id=918

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CB539.1	Identify various techniques for requirements gathering, planning, and managing a technology project.
R19CB539.2	Estimate the software effort and plan activities effectively.
R19CB539.3	Examine the levels of software risks and strategies for effective team management.
R19CB539.4	Develop project schedules and create work products to support the project timeline.
R19CB539.5	Implement industry knowledge, utilize appropriate tools, and ensure adherence to global project management standards

R19CS521	FULL STACK TECHNOLOGIES	L	T	P	C
		3	0	0	3

1. Course Description:

This is a comprehensive course designed to equip students with the knowledge and skills required to become proficient full stack developers. The course covers essential front-end and back-end technologies, including HTML5, CSS3, JavaScript, React.js, Node.js with Express.js, Spring Boot backend framework, and fundamentals of MongoDB. Through a combination of theoretical lectures, hands-on coding exercises, and real-world examples, students will gain a deep understanding of each technology's role in the development process and how they work together to build modern web applications

2. Course Objectives:

1. To empower students to design, develop, and deploy dynamic web applications using HTML5, CSS3, and JavaScript
2. To introduce students to build fast, scalable, and maintainable front-end applications using ReactJS
3. To familiarize students with the skills to effectively use MongoDB to build robust, scalable, and data-driven applications
4. To acquaint students to build scalable and efficient web applications using Node.js and Express.js
5. To equip students with the skills to master Spring Boot's core features

3. Syllabus :

Unit-I: HTML5, CSS3 and JavaScript

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Components of a full stack application-HTML5 – Tags – Attributes– Properties –Importance of Semantic HTML – Classes - CSS3 – CSS3 syntax and Properties – Borders – Text – Image – Grid layout – Media Queries – Animations – Types of CSS frameworks – Overview of JavaScript – Advanced Working with Functions – JavaScript Namespaces – Prototypes – Error Handling – Modules in JavaScript – Chaining JavaScript Methods – Promises

Case Study: Website design for an automobile industry

Unit-II: Reactjs

ReactJS – Library & directory – React Components – Types of Components –Component composition – Component styling – Adding styles – Component intercommunication – Data sharing – Routing – Hooks – States – Hooks vs States – Types of Hooks – Redux – Using Redux as state container for react apps – React Bootstrap – Props and Router

Case Study: Portfolio development with authentication

Unit-III: MongoDB

MongoDB – Features – Environment – Data Modelling – Schema creation using Mongoose (ODM) -Create Database –Data Types – Drop Database –Collection –Insert Document – Query Document – Update Document – Delete Document – Projection – Limiting Records – Sorting Records – Indexing – Aggregation

Case Study: Design of a simple search engine

Unit-IV: Nodejs and Expressjs

NodeJS – Node Module System - Node Package Manager (NPM) - Building RESTful API's Using Express - Express Advanced Topics - Asynchronous JavaScript - CRUD Operations Using Mongoose - Mongo Data Validation - Mongoose Modeling Relationships between Connected Data - Authentication and Authorization- Deployment

Case Study: QR Code Generator application

Unit-V: Spring Boot

Spring Boot – Configuration - Spring data JPA - Create Spring Data Repositories for JPA – web application with Spring Boot – RESTful controllers - Message Converters - WAR or JAR deployment – Creating a RESTful application with Spring Boot – HTTP GET, PUT, POST, DELETE

Case Study: Real time message transfer application

Text Books:

1. Vasan Subramanian, 'Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node', Second Edition, Apress, 2019
2. Brad Dayley, Brendan Dayley, Caleb Dayley, 'Node.js, MongoDB and Angular Web Development', Addison-Wesley, Second Edition, 2018

References:

1. Chris Northwood, 'The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer', Apress; 1st edition, 2018.
2. Kirupa Chinnathambi, 'Learning React: A Hands-On Guide to Building Web Applications Using React and Redux', Addison-Wesley Professional, 2nd edition, 2018.

Web Resources:

1. https://www.tutorialspoint.com/the-full-stack-web-development/index.asp
2. https://www.youtube.com/playlist?list=PL9ooVrP1hQOGTHk2auXsk3cyqRBbbsQ6l

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3. https://www.freecodecamp.org/news/learn-web-development-free-full-stack-developer-courses-for-beginners/

MOOC/NPTEL /SWAYAM Courses:

1. https://www.udemy.com/course/ultimate-web/?couponCode=SKILLS4SALEB
2. https://www.coursera.org/professional-certificates/ibm-full-stack-cloud-developer

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CS521.1	Build dynamically enriched web pages with HTML5, CSS3, and JavaScript
R19CS521.2	Implement data handling and fetching in React applications using state management libraries
R19CS521.3	Develop a web application with MongoDB as the backend
R19CS521.4	Develop ExpressJS applications that define routes and handle HTTP requests and responses
R19CS521.5	Develop RESTful APIs with Spring Boot for resource representation, HTTP methods and error handling

R19CS522	MVC Frameworks	L	T	P	C
		3	0	0	3

1.Course Description:

The course aims to equip students with the knowledge and skills necessary to design, develop, and deploy full-stack web applications using MVC frameworks. Students will gain a comprehensive understanding of MVC architecture and learn to implement basic web applications using various MVC frameworks. They will apply their knowledge by integrating AngularJS for frontend view components and configuring PostgreSQL for database management within the Django framework. By the end of the course, students will be proficient in developing and deploying secure full-stack web applications, leveraging both Angular and Django frameworks, and deploying them in diverse and secure cloud environments.

2.Course Objectives:

1. To understand MVC Framework Concepts
2. To develop frontend view components as part of their MVC-based web applications.
3. To configuring and Implementing Django with PostgreSQL.
4. To develop full-stack web applications.
5. To deploy applications in Secure Cloud Environments.

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3.Syllabus:
Unit-I: Web Development and MVC
Web technologies - Client-side vs. Server-side Development - Understanding MVC Architecture - Explanation and roles - Benefits of using MVC pattern in web development - Overview of Angular, Django, and PostgreSQL - Setting up Development Environment - Differences between Angular, Django, and PostgreSQL - Open-source relational database management system **Project Work**: Set up a basic web application using Angular, Django, and PostgreSQL with a simple MVC structure
Unit-II: View with Angular
AngularJS vs. Angular - Angular CLI - Components - Templates and interpolation - Data Binding - Property binding and event binding – Directives - Structural directives - Pipes - Services and Dependency Injection - Routing and Navigation - Forms and Form Validation **Project Work**: Implement a multi-page application using Angular with routing and navigation
Unit-III: Back-End Development with Django and Postgresql
Introduction to Django - Models and Database Configuration with PostgreSQL - Django Admin Interface - Views and URL Patterns - Template Language (Django Templates) - Forms and Form Handling in Django - User Authentication and Permissions **Project Work**: Develop a back-end API using Django and PostgreSQL to handle user registration and authentication
Unit-IV: Full Stack Development and Integration
Building RESTful APIs with Django - Consuming API in Angular - Authentication and Authorization with JWT - Error Handling and Validation - Implementing CRUD Operations - File Uploads and Handling **Project Work**: Create a full-stack web application integrating Angular and Django, allowing users to perform CRUD operations on data with authentication
Unit-V: Advanced Topics and Deployment
Real-time features with Web Sockets - Dockerizing Angular, Django, and PostgreSQL - Performance Optimization Techniques - Security Best Practices - Integrating with Third-Party Services (e.g., payment gateways) - Deployment of Angular, Django, and PostgreSQL applications **Project Work**: Deploy the full-stack web application to a cloud platform (e.g., Heroku, AWS, Azure) with proper security measures and optimizations
Text Books:
1. Yakov Fain and Anton Moiseev,"Angular Development with TypeScript",2018 2. William S. Vincent,"Django for Beginners: Build websites with Python and Django",2020
References:
References Books: 1. Jeremy Wilken "Angular in Action" 2018

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2. Daniel Roy Greenfeld and Audrey Roy Greenfeld,"Two Scoops of Django: Best Practices for Django 3.x" ,2020

Video References:

1. https://www.youtube.com/watch?v=1IsL6g2ixak
2. https://www.youtube.com/watch?v=d--mEqEUybA
3. https://www.youtube.com/watch?v=uiPSnrE6uWE

MOOC/NPTEL /SWAYAM Courses:

1. https://www.udemy.com/course/complete-aspnet-core-21-course/?couponCode=ST11MT91624A

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CS522.1	To understand the concepts and implement the basic web application using various MVC frameworks
R19CS522.2	To implement the view components services using angular js
R19CS522.3	To understand the configuration of postgreSQL and implement the Django framework
R19CS522.4	To develop the full stack web application by integrating angular and Django frameworks
R19CS522.5	To deploy the full stack web application in various secure cloud environment

R19CS523	Web Application Security	L	T	P	C
		3	0	0	3

1.Course Description:

The course aims to equip students with the knowledge and skills necessary to understand, develop, and maintain secure web applications. Students will gain a comprehensive understanding of web application security principles and practices, preparing them to implement secure development processes and deploy applications resilient to common cyber threats. By the end of the course, students will be proficient in designing and developing secure web applications utilizing secure APIs, conducting vulnerability assessments, penetration testing, and adopting a hacker's mindset to proactively defend against cyber threats.

2.Course Objectives:

1. To understand Web Application Security Fundamentals
2. To apply secure development methodologies to create and deploy web applications.
3. To design and develop secure web applications.

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4. To understand the importance of vulnerability assessments and penetration testing.
5. To develop the ability to use appropriate tools and techniques to identify and mitigate security risks

3.Syllabus:

Unit-I: Fundamentals of Web Application Security

The history of Software Security – Recognizing Web Application Security Threats – Web Application Security – Authentication and Authorization – Secure Socket layer – Transport layer Security – Session Management –Input Validation – Attack Surface Reduction Rules of Thumb – Classifying and Prioritizing Threads.

Unit-II: Secure Development and Deployment

Web Applications Security – Security Testing – Security Incident Response Planning –The Microsoft Security Development Lifecycle (SDL) – OWASP Comprehensive Lightweight Application Security Process (CLASP) – The Software Assurance Maturity Model (SAMM)

Unit-III: Secure API Development

API Security – Session Cookies –Token Based Authentication – Securing Natter APIs: Addressing threats with Security Controls – Rate Limiting for Availability – Encryption – Audit logging – Securing service-to-service APIs: API Keys – OAuth2 – Securing Micro service APIs: Service Mesh – Locking Down Network Connections – Securing Incoming Requests.

Unit-IV: Vulnerability Assessment and Penetration Testing

Vulnerability Assessment Lifecycle – Vulnerability Assessment Tools: Cloud-based vulnerability Scanners – Host-based vulnerability scanners – Network-based vulnerability scanners – Database based vulnerability scanners –Types of Penetration Tests: External Testing – Web Application Testing – Internal Penetration Testing – SSID or Wireless Testing – Mobile Application Testing.

Unit-V: Hacking Techniques and Tools

Social Engineering – Injection – Cross-Site Scripting(XSS) – Broken Authentication and Session Management – Cross-Site Request Forgery – Security Misconfiguration – Insecure Cryptographic Storage – Failure to Restrict URL Access – Tools: Comodo, OpenVAS, Nexpose, Nikto, Burp Suite.

Text Books:

1. Andrew Hoffman, Web Application Security: Exploitation and Countermeasures for Modern
2. Web Applications, First Edition, O'Reilly Media, Inc, 2020
3. Bryan Sullivan, Vincent Liu, Web Application Security: A Beginners Guide, The McGrawHill Companies,2012.
4. Neil Madden, API Security in Action, Manning Publications Co., NY, USA,2020

References:

References Books:

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1. Ravi Das and Greg Johnson, Testing and Securing Web Applications, Taylor & FrancisGroup, LLC, 2021.
2. Prabath Siriwardena, Advanced API Security, Apress Media LLC, USA,2020
3. Malcom McDonald, Web Security for Developers, No Starch Press, Inc,2020

Video References:

1. https://www.youtube.com/watch?v=-7OX58nHPb8
2. https://www.youtube.com/watch?v=ZqY4tQQXjnk

MOOC/NPTEL /SWAYAM Course:

1. https://nptel.ac.in/courses/106106248

4.. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CS523.1	Understanding the basic concepts of web application security and the need for it
R19CS523.2	Be acquainted with the process for secure development and deployment of web applications
R19CS523.3	Acquire the skill to design and develop Secure Web Applications that use Secure APIs
R19CS523.4	Be able to get the importance of carrying out vulnerability assessment and penetration testing
R19CS523.5	Acquire the skill to think like a hacker and to use hackers tool sets

R19CS524	MONGODB and MYSQL	L	T	P	C
		3	0	0	3

1.Course Description:

This course offers an in-depth exploration of MySQL and MongoDB a leading NoSQL database, one of the most popular relational database management systems. Students will gain a solid understanding of SQL (Structured Query Language) and learn how to design, implement, manage MySQL databases and MongoDB's document-oriented data model, its powerful querying capabilities, and its scalability features. The course covers fundamental concepts such as database design, normalization, and advanced SQL queries and also data modeling, CRUD operations, indexing, and aggregation in MongoDB databases

2.Course Objectives:

1. Describe the architecture of MongoDB, including its document-oriented data model and distributed database design
2. Teach students how to perform Create, Read, Update, and Delete (CRUD) operations using MongoDB.
3. Demonstrate the use of MongoDB's aggregation framework to perform complex data analysis.
4. Learn to deploy and manage MongoDB instances in different environments,

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including cloud platforms

5. Complete a capstone project that synthesizes course concepts into a comprehensive application development project

3.Syllabus:

Unit-I: Overview of NoSQL databases

Different types of Databases - Hierarchical - Relational - Object Oriented - Cloud - Centralized and distributed - Operational-Enterprise databases. NoSQL database - Characteristics - Categories - Key-Value- Document - Column - Graph database, The CAP theorem - Storage Layout -Challenges in migrating from RDBMS to NOSQL Databases.

Unit-II: Document databases using MongoDB

Introduction to Document Databases - MongoDB A Database for the Modern Web – Features - Data types - Mongo DB Query language - CRUD operations - Creating, Updating/Deleting documents- Querying - MongoDB query operators - Arrays - Functions: Count – Sort – Limit – Skip – Aggregate - Map Reduce, Mongo Import – Mongo Export.

Unit-III: Indexing and Aggregation

Performance Tuning in MongoDB, Aggregation framework, Replication and Sharding in MongoDB- Creating Backup for database

Unit-IV: MongoDB Cloud Deployment and Management

MongoDB Cloud on AWS - Amazon Document DB instance - Data Migration to AWS - Optimization. MongoDB on Azure - MongoDB API - Azure Cosmos DB - Configuring Security and Networking. MongoDB Cloud on GCP - Google Cloud Firestore - Monitoring and Scaling - Data consistency and transactions - Best Practices in the Cloud deployment.

Unit-V: Application Development in MongoDB

Advanced Application Development – Connecting to MongoDB with Python, MongoDB and Python patterns, Creating Blog Application with PHP and MongoDB - Developing Node JS Application with MongoDB, Hosting web application using public web hosting services

Text Books:

1. MongoDB:The Definitive Guide by Shannon Bradshaw, Eoin Brazil, Kristina Chodorow, 3rd Edition,Oreilly,2019
2. NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence by Pramod J. Sadalageand Martin Fowler, 1st Edition, Pearson Education, 2012
3. MongoDb in Action by Kyle Banker, Peter Bakkum, Shaun Verch, Doug Garrett, Tim Hawkins, 2ndEdition, Manning publications,2016

References:

References Books:

1. MongoDBCookBook by Cyrus Dasadia & AmolNayak, 2nd Edition,PACKT Publishing, 2014
2. NoSQL for Mere Mortals,Dan Sullivan,1stEdition, Addison-Wesley Professional,Pearson Education,2015

Video References:

1. https://www.youtube.com/watch?v=c2M-rlkkT5o

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2. https://www.youtube.com/watch?v=5OdVJbNCSso

MOOC/NPTEL /SWAYAM Courses:

1. https://www.youtube.com/watch?v=SGbUm5MGHrU
2. https://www.youtube.com/watch?v=OWX4RvijwLw

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CS524.1	Understand the different types of NoSQL databases for the comparison of RDBMS with NoSQL
R19CS524.2	Apply the concept of MongoDB Query language to support the document-based databases
R19CS524.3	Demonstrate the advanced Mongo DB Queries for the efficient data retrieval
R19CS524.4	Apply the various cloud deployment services for data consistency and optimization
R19CS524.5	Generalize the connectivity in MongoDB and design the database systems for various applications

R19CS525	FLUTTER and DART	L	T	P	C
		3	0	0	3

1.Course Description:

The course aims to equip students with the knowledge and skills necessary to develop mobile applications using Flutter and Dart programming language. Students will understand the features and installation process of Flutter, as well as grasp essential concepts in Dart programming and the basics of Flutter widgets. They will apply their learning by building simple Flutter applications using various widgets and layouts, including developing animations using Dart packages. Additionally, students will learn to integrate and utilize databases within Flutter applications to store and retrieve data.

2.Course Objectives:

1. To understand the Flutter features and installation
2. To understand the Dart Programming and basics of Widgets.
3. To build the simple Flutter application.
4. To develop the Flutter animation applications.
5. To develop the Flutter applications using Database.

3.Syllabus:

Unit-I: Introduction to Flutter

Introduction Flutter. Flutter Installation, Installation in Windows- Installation in Mac OS- Configuration of Flutter Development- Creating Simple Application in Android Studio - Architecture of Flutter Applications

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Unit-II: Flutter Basics
Introduction to Dart Programming-Variables and Data types-keywords-Operators-Control flow statements and Loops- Functions-Exceptions- Object Oriented Programming-Classes-Introduction to Widgets- Widget Build Visualization.
Unit-III: Introduction to Layouts
Type of Layout Widgets- Single Child Widgets- Multiple Child Widgets- Advanced Layout Application-Introduction to Gestures- Statement Management in Flutter. Ephemeral State Management-Application State - scoped model- Navigation and Routing.
Unit-IV: Animation on Flutter
Introduction to Animation Based Classes-Work flow of the Flutter Animation- Working Application- Android Specific Code on Flutter- Introduction to Package- Types of Packages- Using a Dart Package- Develop a Flutter Plug-in Package- Accessing Rest API-Basic Concepts- Accessing Product service API
Unit-V: Database Concepts
Working with Firebase platform- Setting up a Firebase Project-Configuring Firebase Emulators-Testing on Flutter- Deployment- Android Application- IOS Application-Development Tools- Widget Sets- Flutter Development with Visual Studio Code- Dart DevTools- Flutter SDK
Text Books:
1. Eric Windmill," Flutter in Action", Manning Publications, 2020. 2. Marco L. Napoli, "Beginning Flutter A Hands on Guide To App Development", John Wiley & Sons ,Inc, 2019
References:
References Books: 1. Rap Payne, "Beginning App Development with Flutter: Create Cross-Platform Mobile Apps",Apress,2019 2. Alessandro Biessek ,"Flutter for BeginnersAn Introductory Guide to Building Cross-platform Mobile Applications with Flutter and Dart 2",Packt Publishing,2019 3. Richard Rose ,"Flutter and Dart Cookbook",O'Reilly Media,2022. **Video References:** 1. https://www.youtube.com/watch?v=GLSG_Wh_YWc 2. https://www.youtube.com/watch?v=Ej_Pcr4uC2Q **MOOC/NPTEL /SWAYAM Course:** 1. https://www.udemy.com/course/learn-flutter-dart-to-build-ios-android-apps/?couponCode=LETSLEARNNOWPP

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CS525.1	Understand the features and installation of Flutter

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R19CS525.2	Understand the concepts in dart programming and basics of widgets.
R19CS525.3	Build simple Flutter application using simple widgets and layouts
R19CS525.4	Develop Flutter animation applications using Dart packages
R19CS525.5	Develop Flutter application using database

R19CS526	Cloud Services Management	L	T	P	C
		3	0	0	3

1.Course Description:

The course aims to provide students with a comprehensive understanding of Cloud Service Management, enabling them to effectively design, deploy, and manage cloud-based services in a business environment. Students will gain proficiency in cloud service management terminology, concepts, and strategies, and compare these with traditional IT service management approaches. They will learn to identify and mitigate risks associated with adopting cloud services, while also exploring appropriate structures for designing and running cloud-based services. Moreover, students will develop the ability to illustrate the benefits of cloud-based services through practical applications to solve real-world problems, thereby driving adoption and maximizing business value..

2.Course Objectives:

1. To understand the Cloud Service Management Terminology & Concepts
2. To compare the Cloud Service Management with Traditional IT Service Management.
3. To identify, assess, and mitigate risks associated with adopting cloud services, ensuring integration and operational continuity.
4. To design, deploy, and run the Cloud-Based Services.
5. To illustrate the benefits and driving adoption of Cloud-Based Services

3.Syllabus:

Unit-I: Cloud Service Management Fundamentals

Cloud Ecosystem - The Essential Characteristics - Basics of Information Technology Service Management and Cloud Service Management, Service Perspectives, Cloud Service Models, Cloud Service Deployment Models

Unit-II: Cloud Services Strategy

Cloud Strategy Fundamentals - Cloud Strategy Management Framework - Cloud Policy - Key Driver for Adoption - Risk Management - IT Capacity and Utilization - Demand and Capacity matching – Demand Queueing- Change Management - Cloud Service Architecture.

Unit-III: Cloud Service Management

Cloud Service Reference Model - Cloud Service Life Cycle - Basics of Cloud Service Design - Dealing with Legacy Systems and Services - Benchmarking of Cloud Services - Cloud Service Capacity Planning – Cloud Service Deployment and Migration - Cloud Marketplace - Cloud Service Operations Management.

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Unit-IV: Cloud Service Economics
Pricing models for Cloud Services – Freemium - Pay Per Reservation - Pay per User - Subscription based Charging - Procurement of Cloud-based Services - Capex vs Opex Shift - Cloud service Charging – Cloud Cost Models.
Unit-V: Cloud Service Governance & Value
IT Governance Definition - Cloud Governance Definition - Cloud Governance Framework - Cloud Governance Structure - Cloud Governance Considerations - Cloud Service Model Risk Matrix - Understanding Value of Cloud Services - Measuring the value of Cloud Services - Balanced Scorecard - Total Cost of Ownership
Text Books:
1. Thomas Erl, Ricardo Puttini, ZaighamMohammad, "Cloud Computing: Concepts, Technology & Architecture",Prentice Hall Press, United States 2013. 2. Thomas Erl, Robert Cope, Amin Naserpour, "Cloud Computing Design Patterns", PearsonPublisher, 2017. 3. EnamulHaque, "Cloud Service Management and Governance: Smart Service Management in Cloud Era", Enel Publications, 2020.
References:
References Books: 1. Praveen Ayyappa . "Economics of Cloud Computing", LAP Lambert Academic Publishing. 2020. 2. Rajkumar Buyya, ChristianVechhiola, S. Thamarai Selvi, "Mastering Cloud Computing Foundations and Applications Programming", Morgan Kaufmann Publisher, 2013. **Video References:** 1. https://www.youtube.com/watch?v=BCjJQgScL3Y 2. https://www.youtube.com/watch?v=RWgW-CgdIk0 **MOOC/NPTEL /SWAYAM Courses:** 1. https://nptel.ac.in/courses/106105167 2. https://nptel.ac.in/courses/106105223

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CS526.1	Understand Cloud Service Management terminology& concepts
R19CS526.2	Understandand compare cloud service management with traditional IT service management
R19CS526.3	Identify strategies to reduce risk and eliminate issues associated with adoption of cloud services
R19CS526.4	Identify appropriate structures for designing, deploying and running cloud-based services in a business environment
R19CS526.5	Illustrate the benefits and drive the adoption of cloud-based services to solve real world problems

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R19CS527	User Experience Design	L	T	P	C
		3	0	0	3

1. Course Description:

This course on UI/UX Design using Figma is designed to equip participants with essential skills and knowledge in creating intuitive and user-centered digital experiences. Through a theoretical learning and hands-on practical exercises, students will delve into the core principles of UI/UX design and their critical role in shaping user interactions and satisfaction.

2. Course Objectives:

1. Make students to understand fundamental UX design principles, including usability, accessibility, and user-centered design
2. Equip students with various UX research methods, such as user interviews, surveys, usability testing
3. Students will learn to conduct effective user experience (UX) testing by employing various evaluation methods
4. Learn how to design, plan, and conduct various UX research methods, including user interviews, surveys, usability testing, and diary studies
5. Acquire the skills to facilitate focus group discussions

3. Syllabus

Unit-I: INTRODUCTION TO USER EXPERIENCE

Ux Introduction: User Interaction with the products- applications and services – Cognitive Model/Mental Model- Principles of Ux Design- Elements of Ux design - Core elements of User Experience, How these elements work together; Ux Design Process - Defining the UX Design Process and Methodology- Research and Define – Importance of research- Research methods and tools, Understanding the User Needs and Goals- Understanding the Business Goals-Deliverables of the Research & Define phase- Insight on User Goals and Business Goals

Unit-II: USER EXPERIENCE DESIGN AND TESTING

Ux Design Process Ideate and Design - Visual Design Principles- Information Design and Data Visualization- Interaction Design- Information Architecture- Wire framing & Storyboarding- UI Elements and Widgets- Screen Design and Layouts-Prototype and Test – Need for Design testing- Definition of Usability Testing-Types of Usability Testing-Usability Testing Process-Prepare and plan for the Usability Tests-Prototype Design to Test-Introduction of prototyping tools- Conducting Usability Tests- Communicating Usability Test Results

Unit-III: USER EXPERIENCE TESTING AND METRICS

Ux Design Process Iterate and Improve - Understanding the Usability Test findings-Applying the Usability Test feedback in improving the design- Deliver - Communication with implementation team- UX Deliverables to be given to implementation team- Ux Metrics – Overview- Types of metrics – CSAT- NPS- SUS- TPI-Choosing the right metrics-Future of Ux Design

Unit-IV: USER EXPERIENCE RESEARCH ACTIVITY

Methods- Diary Studies – Interviews - Surveys-Card sort - Field studies- Evaluation methods- Differences among the methods-Choosing the right method

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Unit-V: FOCUS GROUPS
Preparing & conducting focus group- Modifications-Data analysis & interpretation. Case Study: Morae software for usability testing
Text Books:
1. Platt D. The Joy of UX: User Experience and interactive design for developers. Addison-Wesley Professional; 2016 2. Kathy Baxter, Catherine Courage & Kelly Caine, "Understanding your users – A practical guide to user research methods", 2nd Edition, Morgan Kaufmann Publishers, Elsevier Inc., 2015
References:
Reference Books: 1.Gavin Allan wood, Peter Beare, "User Experience Design – Creating designs users really love", 1st Edition,Bloomsbury Publishers, 2014 2. Patrick J. Lynch & Sarah Horton, "Web Style Guide – Foundations of User Experience Design", 4th Edition, Yale University Press, 2016 **Video References:** 1. https://www.youtube.com/watch?reload=9&v=IGLfyTDgfDc 2.https://www.youtube.com/watch?v=BOt3MNB71gI&list=PLjiHFwhbHYlEmPhn68XdG2p2k4X47XR-8 **MOOC/NPTEL /SWAYAM Courses:** 1. https://www.udemy.com/course/learn-figma/ 2. https://www.figma.com/resource-library/design-basics/

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CS527.1	Define the critical issues and theoretical underpinnings of User Experience (UX) design
R19CS527.2	Establish requirements for UX design concepts
R19CS527.3	Develop alternatives for UX design concepts and demonstrate the Construction of UX design artifacts.
R19CS527.4	Analyze user experience and interpret the results of user experience research
R19CS527.5	Test user experience design using Morae tool

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R19CS528	DOCKER and KUBERNETES	L	T	P	C
		3	0	0	3

1.Course Description:

The course aims to provide students with a comprehensive understanding and practical skills necessary to work with Docker and Kubernetes, focusing on deploying microservices-based applications efficiently. Students will learn the basics of microservices architecture and understand the fundamental concepts of Docker containers. They will explore Docker's architecture, installation, and how to create container images for web applications. Additionally, students will gain proficiency in deploying, administering, and leveraging the Kubernetes platform to orchestrate containerized applications effectively. By the end of the course, students will be capable of creating and managing Kubernetes pods, deployments, and services, utilizing Kubernetes' advantages for scalable and resilient application deployments.

2.Course Objectives:

1. To make students to understand the basics of Microservices
2. To gain knowledge on basics of Docker and Container.
3. To make to install Docker and create Container images.
4. To equip students to understand, Deploy, and Administer Kubernetes.
5. To create pods, deployments, and services with Kubernetes

3.Syllabus:

Unit-I: Introduction to Microservices

Introduction to Microservices- Microservices Concepts-Microservices Anti Patterns-Microservices Advantages and Drawbacks - Microservices Architecture

Unit-II: Introduction to Dockers & Containers

Evolution of Dockers & Containers-Differences between VM's and Containers-Docker Use Cases-Benefits of using Containers-Working with Docker Commands-Installing & Configuring Docker toolbox on Windows- Images & Layers-Container Layers

Unit-III: Docker :Images, Docker Networking & Orchestration

Working with Docker Images-Building own Images using Dockerfile-Working with Docker Volumes and Docker Networking-Overview of Registries- Public and Private-Deep Dive into Docker Hub-Other Public & Private Registries-Defining and running multi-container applications-Overview of Docker Swarm-Build your own Docker Swarm Cluster-Filtering & Scheduling Containers

Unit-IV: Introduction to Kubernetes

Evolution of Kubernetes - Kubernetes Architecture- Kubernetes Master-Components of Kubernetes Master- Node Components- Installing & Configuring Kubernetes locally via Minikube-Creating Kubernetes Cluster in Google Cloud-Creating Kubernetes Cluster in AWS Cloud

Unit-V: Deploying Applications on Kubernetes Cluster

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Deploying applications on Kubernetes Cluster- Introduction to Pods-Pods Lifecycle-Working with Pods to manage multiple containers-Deploying Pods via Replication Controllers- Labels and Selectors-Scale out deployment using Replicas-Horizontal Pod Autoscaling-Load Balancing-Rolling Updates- Working with StatefulSet-Pod Management policies-OnDelete& Rolling Update Strategies-Cluster DNS-Persistent Volumes

Text Books:

1. Nisarg Vasavada, Dhwani Sametriya "Cracking Containers with Docker and Kubernetes:The Definitive Guide to Docker, Kubernetes, and the Container Ecosystem Across Cloud and On-premises",First Edition 2022
2. Scott Surovich, Marc Boorshtein "Kubernetes and Docker - An Enterprise Guide:Effectively Containerize Applications, Integrate Enterprise Systems, and Scale Applications in Your Enterprise", First Edition 2020

References:

References Books:

1. Thomas Uphill, John Arundel, Neependra Khare, Hideto Saito, Hui-Chuan Chloe Lee, Ke-Jou Carol Hsu,"DevOps: Puppet, Docker, and Kubernetes", First Edition 2017
2. Candel Jose Manuel Ortega, "DevOps and Containers Security", BPB Publications, March 2020

Video References:

1. https://www.youtube.com/watch?v=GbqTq_Cj_6w
2. https://www.youtube.com/watch?v=rOTqprHv1YE
3. https://www.youtube.com/watch?v=X48VuDVv0do

MOOC/NPTEL /SWAYAM Courses:

1. https://www.udemy.com/course/docker-kubernetes-the-practical-guide/?couponCode=LETSLEARNNOWPP

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CS528.1	Understand basics of Microservices
R19CS528.2	Understand basics of Dockers and Containers
R19CS528.3	Explore how to install Docker and the concepts around its architecture and create Docker container images for web applications.
R19CS528.4	Understand, deploy and administer Kubernetes Platform
R19CS528.5	Create Pods, deployments as well as services using Kubernetes and its advantages

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R19CS529	UI Design with FIGMA	L	T	P	C
		3	0	0	3

1. Course Description:

This course on UI/UX Design using Figma is designed to equip participants with essential skills and knowledge in creating intuitive and user-centered digital experiences. Through a theoretical learning and hands-on practical exercises, students will delve into the core principles of UI/UX design and their critical role in shaping user interactions and satisfaction.

2. Course Objectives:

1. Understand and apply fundamental UI/UX design principles to create effective and user-friendly digital interfaces.
2. Utilize Figma's features and tools proficiently to design, prototype, and collaborate on UI/UX projects.
3. Conduct user research and usability testing to inform design decisions and improve user experiences.
4. Develop wireframes, mockups, and interactive prototypes that align with user needs and business goals.
5. Analyze and critique existing digital products to identify strengths and areas for improvement in their design.

3. Syllabus

Unit-I: Foundations of UI/UX Design

Introduction to UI/UX Design: Overview of UI/UX Design - Importance of User-Centric Design - Key Principles and Concepts - Role of UI/UX Designer. Understanding Users and Research: - User Personas and User Stories- Conducting User Research- Usability Testing- User Interviews and Surveys

Unit-II: Information Architecture and Wire-framing

Information Architecture and Wire-framing: Introduction to Information Architecture (IA)- Site Maps and User Flows- Wire-framing Tools and Techniques. Visual Design Principles: Colour Theory and Psychology- Typography in UI Design- Iconography and Imagery- Visual Hierarchy.

Unit-III: : UI Design and Interaction

UI Design Tools: Introduction to UI Design Software- Hands-on Practice with UI Design Tools- Creating Basic UI Elements. Interaction Design and Prototyping -Principles of Interaction Design- Micro-interactions- Advanced Prototyping Techniques - Animations in UI/UX Design.

Unit-IV: Responsive Design and Design Systems

Responsive Design and Design Systems: Introduction to Responsive Design- Mobile-First Design- Design Systems and Component Libraries. Usability Testing and Feedback - Importance of Usability Testing- Planning and Conducting Usability Tests- Analysing and Incorporating User Feedback- Iterative Design Process

Unit-V: Advanced Topics and Career Development

Accessibility in UI/UX Design: Understanding Accessibility- Designing for Different Abilities- WCAG Guidelines- Testing for Accessibility. Portfolio Building and Career

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Advice:- Creating a UI/UX Design Portfolio- Job Search Strategies- Interview Preparation- Industry Networking
Text Books:
1. Fabio Staiano - Designing and Prototyping Interfaces with Figma_ Learn essential UX_UI design principles by creating interactive prototypes for mobile, tablet, and desktop (2022)
References:
Reference Books: 1. Rob Fitzpatrick, 'The Mom Test'. 2. Gojko Adzic and David Evans, 'Fifty Quick Ideas to Improve Your User Stories',2013 - 2014 Neuri Consulting LLP. **Video References:** 1. https://www.youtube.com/watch?reload=9&v=JGLfyTDgfDc 2.https://www.youtube.com/watch?v=BOt3MNB71gI&list=PLjiHFwhbHYlEmPhn68XdG2p2k4X47XR-8 **MOOC/NPTEL /SWAYAM Courses:** 1. https://www.udemy.com/course/learn-figma/ 2. https://www.figma.com/resource-library/design-basics/

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CS529.1	Understand the foundational principles of UI/UX design and its significance in creating user-centric experiences.
R19CS529.2	Demonstrate proficiency in information architecture and wireframing techniques for effective interface design.
R19CS529.3	Develop skills in UI design, interaction design, and prototyping to create engaging user interfaces.
R19CS529.4	Master responsive design principles and design systems to ensure consistent user experiences across devices.
R19CS529.5	Demonstrate proficiency in accessibility guidelines and career readiness skills for UI/UX design roles.

R19CS530	Groovy on Grails	L	T	P	C
		3	0	0	3

1. Course Description:

This course on Groovy and Grails is designed to provide participants with a deep understanding of both the Groovy programming language and the Grails framework. Through a mix of theoretical lessons and hands-on exercises, students will master the essential skills required to develop and secure dynamic web applications.

2. Course Objectives:

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1. Learn the fundamental concepts of the Groovy programming language.
2. Utilize various features and constructs of Groovy to enhance coding efficiency.
3. Apply the Grails framework to build robust web applications.
4. Navigate and manage the Grails project environment for successful application deployment.

3. Syllabus

Unit -I Introduction to Groovy

Overview of the Groovy programming language, Syntax and semantics of Groovy, Data types, operators, and control structures in Groovy, Groovy scripting and shell scripting, Functional programming features in Groovy

Unit II Groovy Features and Enhancements

Closures and higher-order functions, Metaprogramming and AST transformations, Groovy builders and DSLs (Domain-Specific Languages), Concurrency and parallel programming in Groovy, Unit testing and debugging in Groovy

Unit III Grails Framework

Overview of the Grails framework, Architecture and components of a Grails application, Understanding GORM (Grails Object-Relational Mapping), Building RESTful APIs with Grails, Managing dependencies and plugins in Grails

UNIT IV Grails Development Essentials

Setting up a development environment for Grails, Creating and configuring a Grails project, understanding controllers, views, and models in Grails, Handling requests and responses in a Grails application, Working with databases and migrations in Grails

UNIT V Advanced Techniques in Grails

Authentication and authorization in Grails applications, Internationalization and localization in Grails, Performance optimization and caching strategies, Securing Grails applications against common security vulnerabilities, Continuous integration and deployment with Grails applications

Text Book:

1.Ken Kousen , "Making Java Groovy", Manning Publication,1st Edition,2024.

References:

Reference Books:

1. Burt Beckwith, "Programming Grails: Best Practices for Experienced Grails Developers" ,O Reilly Publication,2013.

2. https://guides.grails.org/grails4/creating-your-first-grails-app/guide/index.html

Video Reference:

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1. https://www.youtube.com/watch?v=_lLJJp9RksA
MOOC/NPTEL /SWAYAM Course:
1. https://www.knowledgehut.com/web-development/groovy-and-grails

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CS530.1	Understand the fundamental concept of Groovy programming language
R19CS530.2	Understand the various features, constitute in Groovy programming language
R19CS530.3	Understand and apply the framework in grails.
R19CS530.4	Analyze the grail project environment and deploy the applications.
R19CS530.5	Analyze the authentication, authorization and security vulnerabilities in grail environment.

R19IT521	Cloud Virtualization	L	T	P	C
		3	0	0	3

1. Course Description:

Explore cloud computing and virtualization principles, deploying virtual environments in leading platforms. Learn networking and storage configuration, automation, security measures, and optimization techniques. Gain hands-on experience to architect and manage resilient cloud infrastructures effectively.

2. Course Objectives:

1. To Comprehend Cloud computing and virtualization fundamentals
2. To Deploy virtual environments in major cloud platforms proficiently
3. To Configure networking for interconnectivity with virtual environments
4. To Implement storage solutions for data management.

UNIT – I Cloud Computing

Introduction– Cloud Computing Architecture- Cloud Computing Technologies-Cloud Computing Characteristis-Applications of Cloud Computing- Types of Cloud: Private-Public –Hybrid- CommModuley- Cloud Service models: IaaS Layer-PaaS Layer –SaaS Layer- Security risks of Cloud Computing.

UNIT – II Virtualization

Introduction-Implementation levels of virtualization-VMM design requirements and Providers- Virtualization Structures/ Tools and Mechanisms- Types of Virtualization: Data

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Virtualization- Hardware Virtualization-Software Virtualization-Server Virtualization-Storage Virtualization-OS Virtualization.
UNIT– III Network Virtualization & Tools
Network Virtualization-Advantages- Functions-Tools for Network Virtualization-VLAN-WAN Architecture-WAN Virtualization- Virtualization Tools: VMWare-Amazon AWS-Microsoft HyperV- Oracle VM Virtual Box – IBM PowerVM- Google Virtualization- Case study.
UNIT- IV Hypervisor
Introduction- Type 1 Hypervisor- Type 2 Hypervisors-Comparing Hypervisors-Virtualization considerations for cloud providers- Role of Hypervisor
UNIT – V Virtualization Management
Management Life Cycle- Managing Heterogenous virtualization environment-Customized and modified virtual machines-virtual machine monitoring-management tools-Benefits of data center automation- Virtualization for autonomic service provisioning- software-defined data center- backup- disaster recovery
Text Books:
1. Rajkumar Buyya, James Broberg, Andrzej M, Goseinski, Cloud Computing Principles and Paradigms, Wiley, 2010. 2. Mathew Portney, Virtualization Essentials, John Wiley & Sons, 2012.
References:
Book References: 1. Nelson Ruest, Danielle Ruest, Virtualization, A beginners Guide, 2009, MGH 2. Kai Hwang, Geoffery C, Fox and Jack J.Dongarra, " Distributed and Cloud Computing: Clusters, Grids, Clouds and the Future of Internet, First Edition, Morgan Kaufman Publisher.

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19IT521.1	Apply the knowledge of cloud computing to build a cloud environment.
R19IT521.2	Develop a virtual environment in cloud
R19IT521.3	Utilize the appropriate tools to construct a virtual environment
R19IT521.4	Analyze the use of hypervisor in cloud virtualization
R19IT521.5	Experiment and manage the virtual environment with more security

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R19IT522	Cloud Economics	L	T	P	C
		3	0	0	3

1. Course Description:

Delve into the business context of Cloud Computing, examining standards, interoperability procedures, and security protocols. Analyze the pros and cons of cloud pricing models, while illustrating FinOp Development operations for enhanced cloud efficiency.

2. Course Objectives:

1. Grasp the significance of security standards in cloud computing, evaluating their effectiveness in safeguarding data and applications.
2. Evaluate various pricing models employed in cloud computing, discerning their benefits and drawbacks for businesses and users
3. Explore FinOp development operations, understanding their role in optimizing cloud efficiency and cost effectiveness.

UNIT – I Cloud Computing Business Context

Definition – Cloud Computing in Business – Biz clouds focused on Industry domains – Cloud Enablers – Cloud Interoperability scenario-motivations for cloud interoperability – Economic challenges and Enabling Approaches.

UNIT – II Cloud Computing, ITS standards & Interoperability

Overview of service models – Business Impact of cloud computing – Economics of cloud computing – Economic Benefits of cloud computing – Economic cost of cloud computing – Impact of the latency on the Economics of cloud computing – An Economic perspective – SWOT Analysis and Value Proposition – General Cloud Computing Risks.

UNIT– V Understanding the benefits, Security and Standards

Methodology for quantifying the macroeconomic benefits of cloud computing – Identification and quantification of the cloud computing to business – current and prospective cloud computing rates of adaption -Security in clouds- different vendors offering public/private clouds – Software as s Service Security

UNIT- III Cloud Pricing Models

Different Cloud Deployment Cloud Service Models-Cloud-based Solutions-Cloud Deployment Models-Public Cloud, Advantages and Disadvantages of Public Cloud-Private Cloud, Advantages and Disadvantages of Private Cloud- Hybrid Cloud-Advantages and Disadvantages of Hybrid Cloud-Cloud Service Models-Infrastructure as Service (IaaS)-Platform-as-a-Service (PaaS)- Software as a Service (SaaS).

UNIT – IV FinOps for Cloud Efficiency

Introduction – phases of FinOps life cycle – Optimize phases of FinOps life cycle – Cost optimization Techniques for AWS – Cost optimization techniques for Azure- Cost optimization techniques for GCP – Algorithms for analysing the FinOps data-Managing FinOps Operations

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Text Books:
1. Dr. DebabrattaSarddar, SudiptaSahana, Rajesh Bose, "Economics and Security Implications of Cloud Computing. (2019)", Educreation Publishing 2. Navin Sabharwal Piyush Pandey," FinOps: RoadMap to Cloud Efficiency(2022)", BPB Publications
References:
Book References:
1. Bill Williams," The Economics of Cloud Computing: An Overview for Decision Makers (2012)", CISCO. 2. Dr. V.V.L.N. Sastry, "Cloud Computing Economics for Information Technology industry (2020)", Blue Diamond Publishing

4. **Course Outcomes:**

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19IT522.1	Understand the concepts of Cloud Computing Business Context
R19IT522.2	Understand the Principles of various Standards and Interoperability procedures in cloud computing
R19IT522.3	Analyze the various security standards available in cloud computing
R19IT522.4	Analyze the advantages and disadvantages of cloud pricing models
R19IT522.5	Illustrate the various operations involved in FinOp Development for cloud efficiency

R19IT523	Cloud Networking and Connectivity	L	T	P	C
		3	0	0	3

1. Course Description:

Delve into the intricacies of cloud data center networks, exploring existing and emerging networking technologies. Trace the evolution from enterprise to public and private cloud networks. Examine network virtualization standards, software-defined networks, and the latest switch fabric technologies in detail.

2. Course Objectives:

1. To Analyze the amalgamation of networking technologies in cloud data centers, discerning their role in shaping modern infrastructure.
2. To trace the historical trajectory of data centers, elucidating the transition from enterprise to public and private cloud networks
3. To Evaluate network virtualization standards pertinent to multi-tenant data center environments, understanding their implications and applications

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4. To Comprehend software defined networks and cutting edge switch fabric technologies appreciating their significance in contemporary networking landscapes.
UNIT – I Introduction to Cloud Networking
Introduction - Networking basics - cloud data center - Data Center Evolution - Computer networks - Ethernet - Enterprise versus cloud data centers - Movement to the cloud - Switch Fabric Technology - Switch fabric architecture overview - Switch fabric topologies - Congestion management - Flow control - Traffic management - Cloud Data Center Networking Topologies - Traditional multitiered enterprise networks - Data center network switch types - Flat data center networks - Rack scale architectures - Network function virtualization
UNIT – II Data Center Networking Standards
Ethernet data rate standards - Virtual local area networks - Data center bridging - Improving network bandwidth - Remote direct memory access - Server Virtualization and Networking - VM overview - Virtual switching - PCI express - Edge virtual bridging - VM migration - Network Virtualization - Multi-tenant environments - Traditional network tunneling protocols - VXLAN - NVGRE - Tunnel locations - Load Balancing
UNIT– III Software Defined Networks
Storage Networks - Advanced storage technologies - Storage communication protocols - Network convergence - Software-defined storage - Storage in cloud data centers - Software-Defined Networking - Data center software background - OpenStack - OpenFlow - Network function virtualization - SDN deployment
UNIT- IV High-Performance Computing Networks
HPC system architectures - Multisocket CPU boards - HPC networking standards - HPC network performance factors - HPC networking software
UNIT – V Future Trends
Rack scale architectures - Memory technology - Switch fabric technology - Cabling technology - Software-defined infrastructure
Text Book:
1. Gary Lee. "Cloud Networking" , Morgan Kaufmann publisher
References:
Book Reference:
1. Martin Kleppmann "Designing Data-Intensive Applications, O'Reilly Media, Inc

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome

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R19IT523.1	Understand the existing and emerging networking technologies that combine to form cloud data center networks
R19IT523.2	Explore the evolution of data centers from enterprise to private and public cloud networks
R19IT523.3	Examine the Reviews network virtualization standards for multi-tenant data center environments.
R19IT523.4	Understand the concept of software defined networks
R19IT523.5	Understand the cutting-edge detail on the latest switch fabric technologies

R19IT524	Security on Cloud	L	T	P	C
		3	0	0	3

1. Course Description:

This course provides a comprehensive exploration of cloud computing, focusing on fundamental concepts and security considerations. Topics include cloud architecture, security challenges, policy frameworks, Identity and Access Management (IAM), risk assessment, audit, monitoring mechanisms, and architectural design for secure cloud implementations.

2. Course Objectives:

1. To master foundational cloud computing principles, encompassing service and deployment models, and essential technologies.
2. Identify and articulate unique security challenges in cloud environments, including data breaches, compliance issues, and shared responsibility models.
3. Develop expertise in defining cloud policy frameworks, implementing IAM principles for data protection and analyzing risks associated with cloud adoption.

UNIT – I Fundamentals of Cloud Security Concepts

Overview of cloud security- Security Services – Confidentiality, Integrity, Authentication, Nonrepudiation, Access Control – Basic of cryptography – Conventional and public-key cryptography, hash functions, authentication, and digital signatures.

UNIT – II Security Design and Architecture for Cloud

Security design principles for cloud computing-Comprehensive data protection-End-to-end access control-common attack vectors and threats-Network and security isolation strategies network segmentation strategies-Data protection Strategies: Data retention, deletion and archiving procedures for tenant data, Encryption, Data Redaction, Tokenization, Obfuscation,PKI and key.

UNIT– III Access Control and Identity Management

Access control requirements for Cloud infrastructure – User Identification – Authentication and Authorization – Roles-based Access Control – Multi-factor authentication – Single Sign-on, Identity Federation – Identity providers and service consumers – Storage and network access control options – OS Hardening and minimization – Verified and measured boot – Intruder Detection and prevention.

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UNIT- IV Cloud Security Design Patterns
Introduction to design patterns, cloud bursting, Geo-tagging, Secure cloud Interfaces, Cloud Resources Access control, Secure On-Premise, Internet access, Secure External cloud.
UNIT – V Monitoring, Compliance Auditing And Management
Proactive activity monitoring – Incident Response, Monitoring for unauthorized access, malicious traffic, abuse of system privileges – Events and alerts – cloud compliance auditing – Record generation, Reporting and Management, Tamper-proofing audit logs. Quality of Services, Secure Management, User management, Identity management, Security Information and Event Management.
Text Book:
1. O'Reilly Media, Inc. released the Cloud Native Security Cookbook in April 2022.
References:
Book Reference:
1. Mercury Learning & Information published the book, Empirical Cloud Security: Practical Intelligence to Evaluate Risks and Attacks on April 14, 2021
Video References:
1. https://www.youtube.com/watch?v=nrzgnXOOvr0 2. https://www.youtube.com/watch?v=MHtg2Au78LI&list=PLHivdWyY5sqLO-4ePY-A2yROgONOA6Cz4
MOOC/NPTEL/SWAYAM Course:
1. 1.https://onlinecourses.nptel.ac.in/noc21_cs14/preview

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19IT524.1	Understand the cloud concepts and fundamentals.
R19IT524.2	Explain the security challenges in the cloud.
R19IT524.3	Define cloud policy and Identity and Access Management.
R19IT524.4	Understand various risks and audit and monitoring mechanisms in the cloud.
R19IT524.5	Define the various architectural and design considerations for security in the cloud.

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R19IT525	Compute Solutions and Server Less Services	L	T	P	C
		3	0	0	3

1. Course Description:

This course provides hands-on experience in designing and implementing cloud architectural patterns tailored to specific use cases. Students learn to deploy applications using virtual machines, containers, and serverless computing, utilizing their advantages. Additionally, they analyze data privacy regulations, compliance requirements, and cost management trends in serverless computing environments.

2. Course Objectives:

1. To Implement various cloud architectural patterns for specific use cases, ensuring scalability and efficiency.
2. To deploy applications using virtual machines, containers and serverless computing, leveraging their benefits
3. To analyze data privacy regulations compliance requirements, and cost management trends in serverless computing environments.

UNIT – I Cloud Architecture

Architecture Framework, Computing Cloud Resource, Design network Infrastructure, Serverless computing and event-driven architectures, Cloud Storage Type, Security Principles, Implement Compute and Container Security.

UNIT – II Compute Services

Understanding Virtualization and its types, Resource allocation and management in virtualized environments, Cloud Computing and Infrastructure as a Service (IaaS), Emerging Trends in Virtualization, Docker and Kubernetes for container management, Managing clusters of virtual machines or containers

UNIT– III Serverless Services and Frameworks

Serverless Architectures and Design Patterns, Understanding FaaS platforms, Overview of popular serverless frameworks, Deployment and configuration of serverless applications, Serverless Computing Use cases, Role of serverless computing in digital transformation.

UNIT- IV Serverless Data Storage and Security

characteristics of serverless data storage systems, Integrating serverless functions with data storage, Real-time data processing in serverless architectures, Strategies for data archival and backup in serverless environments, Data protection and Managing sensitive data in serverless functions.

UNIT – V Cost Management

Overview of serverless cost considerations, Key cost management challenges and importance of cost optimization, Techniques to optimize serverless function performance, Automation for cost control and resource management, Reviewing best practices for cost optimization in serverless computing.

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Text Books:
1. Serverless Computing: Principles and Paradigms. Germany, Springer International Publishing, 2023. 2. Mishra, Abhishek. Mastering Azure Serverless Computing: Design and Implement End-to-End Highly Scalable Azure Serverless Solutions with Ease. India, BPB PUBN, 2020.
References:
1. Automated Secure Computing for Next-Generation Systems. United Kingdom, Wiley, 2023. 2. Calles, Miguel. Serverless Security: Understand, Assess, and Implement Secure and Reliable Applications in AWS, Microsoft Azure, and Google Cloud. United States, Apress, 2020.
Video References:
1. https://www.youtube.com/watch?v=YO_oiVe6_ZY. 2. https://www.youtube.com/watch?v=ENHPZax3I7A.
MOOC/NPTEL/SWAYAM Course:
1. https://archive.nptel.ac.in/courses/106/105/106105167/

4. **Course Outcomes:**

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19IT525.1	Design and implement various cloud architectural patterns to solve specific use cases.
R19IT525.2	Implement and deploy applications using virtual machines, containers, and serverless computing.
R19IT525.3	Utilize serverless servicesand deploy serverless applications using popular serverless frameworks.
R19IT525.4	Analyze data privacy regulations and compliance requirements in serverless data storage.
R19IT525.5	Analyze real-world cost management use cases and trends in the industry.

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R19IT526	Cloud Storage Solutions	L	T	P	C
		3	0	0	3

1. Course Description:

This course explores the multifaceted challenges of Cloud Computing, assessing its economic, financial, and technological implications for organizations. It covers storage technologies, focusing on features like availability, replication, scalability, and performance, crucial for medium to large-scale businesses and data centres.

2. Course Objectives:

1. To understand the diverse challenges presented by cloud computing and its implications for organizations.
2. To assess the economic, financial and technological factors influencing the adoption of cloud computing
3. Describe, evaluate and apply storage technologies, emphasizing features critical for medium to large-scale businesses and data centres.

UNIT – I Introduction and Virtualization

Distributed Computing and Enabling Technologies, Cloud Fundamentals: Cloud Definition, Evolution, Architecture, Applications, Deployment models and service models. Issues with virtualization, Virtualization technologies and architectures, Internals of virtual machine monitors/hypervisors, Virtualization of data centers and Issues with Multi-tenancy.

UNIT – II Cloud Implementation

Study of Cloud computing Systems like Amazon EC2 and S3, Google App Engine and Microsoft Azure, Build Private/Hybrid Cloud using open-source tools, Deployment of Web Services from inside and outside a Cloud Architecture, MapReduce and its extensions to Cloud Computing, HDFS and GFS.

UNIT– III Cloud Storage Virtualization

Fixed Content and Archives, Types, Features, Benefits, CAS Architecture, Object storage and retrieval, Examples: Storage Virtualization-forms of virtualization, SNIA Taxonomy – Storage virtualization configurations, Challenges, Types of storage virtualization - Business Continuity- Overview of emerging technologies such as Cloud storage, Virtual provisioning, Unified Storage, FCOE, FAST.

UNIT- IV Cloud Business Continuity and Recovery

Information Availability, BC Terminology, Life cycle, Failure analysis: Backup and Recovery- Backup purpose, considerations, Backup Granularity, Recovery considerations- Backup methods, Process, backup and restore operations, Overview of emerging technologies: Duplication, Off-site backup.

UNIT – V Cloud Storage Security and Management

Storage security framework, Securing the Storage infrastructure, Risk triad: Managing the storage infrastructure, Monitoring the storage infrastructure, identify key parameters and

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components to monitor in storage infrastructure, List key management activities and examples, Define storage management standards and initiative Industry trends.

Text Book:

1. Information Storage and Management: Storing, Managing, and Protecting Digital Information in Classic, Virtualized, and Cloud Environments 2nd Edition by EMC Education Services, May 2022

References:

Book References:

1. Building a Future-Proof Cloud Infrastructure: A Unified Architecture for Network, Security, and Storage Services 1st Edition, Jan 2020

Video References:

1. https://www.youtube.com/watch?v=T7ZWIsJST3o
2. https://www.youtube.com/watch?v=WSwqYGln-vU

MOOC/NPTEL/SWAYAM Courses:

1. https://onlinecourses.nptel.ac.in/noc21_cs14/preview
2. https://onlinecourses.nptel.ac.in/noc21_cs15/preview

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19IT526.1	Understand the key dimensions of the challenge of Cloud Computing.
R19IT526.2	Assess the economics, financial and technological implications for selecting cloud computing for organization.
R19IT526.3	Describe and apply storage technologies.
R19IT526.4	Identify leading storage technologies that provide cost-effective IT solutions for medium to large scale businesses and data centers.
R19IT526.5	Describe important storage technology features such as availability, replication, scalability and performance.

R19IT527	Cloud Native Development and Containers	L	T	P	C
		3	0	0	3

1. Course Description:

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This course delves into cloud-native application fundamentals, emphasizing communication patterns and decentralized data management techniques. It explores API management patterns and essential tools for building cloud-native systems.

2. Course Objectives:

1. Grasp the fundamentals of cloud native applications and their significance in modern computing.
2. Explore key communication, connectivity and composition patterns crucial for building resilient cloud-native systems
3. Understand decentralized data management techniques, common API management patterns, and essential tools for effective cloud native development

UNIT – I Introduction to Cloud Native

Introduction to Cloud Native – Microservices - Containerization and Container Orchestration - Automate the Development Life Cycle - Dynamic Management - Methodology for Building Cloud Native Apps - Designing the Application - Developing the Application - Connectivity, Compositions, and APIs - Automating the Development, Release, and Deployment - Running in a Dynamic Environment - Control Plane for Dynamic Management - Observability and Monitoring - Design Patterns for Building Cloud Native Apps - Communication Patterns - Connectivity and Composition Patterns - Data Management Patterns - Event-Driven Architecture Patterns - Stream-Processing Patterns - API Management and Consumption Patterns

UNIT – II Designing Cloud Native Applications

Communication Patterns- Synchronous Messaging Patterns - Request-Response Pattern - Remote Procedure Calls Pattern - Asynchronous Messaging Patterns -Multiple-Receiver Pattern - Asynchronous Request-Reply Pattern - Service Definitions in Synchronous Communication - Service Definition in Asynchronous Communication - Technologies to Implement Synchronous Messaging Patterns - RESTful Services, GraphQL, WebSocket, gRPC - Technologies to Implement Asynchronous Messaging Patterns - AMQP, Kafka, NATS - Testing, Security, Observability and Monitoring

UNIT– III Connectivity and Composition Patterns

Connectivity Patterns - Service Connectivity Pattern - Service Abstraction Pattern - Service Registry and Discovery Pattern - Resilient Connectivity Pattern- Sidecar Pattern - Service Mesh Pattern - Sidecarless Service Mesh Pattern - Technologies for Implementing Service Connectivity Patterns - Service Composition Patterns - Service Orchestration Pattern - Service Choreography Pattern - Saga Pattern - Technologies for Implementing Service Composition Patterns

UNIT- IV Data Management Patterns

Data Architecture - Types and Forms of Data - Data Stores - Relational Databases - Relational Databases - NoSQL Databases - Filesystem Storage - Data Management - Centralized Data Management- Decentralized Data Management - Hybrid Data

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Management - Data Composition Patterns - Data Service Pattern - Composite Data Services Pattern - Client-Side Mashup Pattern - Data Scaling Patterns - Data Sharding Pattern - Command and Query Responsibility Segregation Pattern - Performance Optimization Patterns - Materialized View Pattern - Data Locality Pattern - Caching Pattern - Static Content Hosting Pattern - Reliability Patterns - Security: Vault Key Pattern - Technologies for Implementing Data Management Patterns
UNIT – V Cloud Native Patterns in Practice
Building an Online Retail System - Product Catalog - Order Management - Order Tracking and Prediction - Product Recommendations - Customer and Partner Management - Building the High-Level Architecture - Building External APIs - Connecting Services - Performing Data Management - Using Event-Driven Architecture - Using Stream Processing - Implementing Dynamic Management in a Cloud Environment
Text Books:
1. Kasun Indrasiri, Sriskandarajah Suhothayan, "Design Patterns for Cloud Native Applications", O'Reilly Media, Inc., 2021
References:
Book References:
1. Boris Scholl, Trent Swanson, Peter Jausovec . "Cloud Native",O'Reilly Media, Inc., 2019 2. Chris Richardson , "Microservices Patterns", Manning Publications, 2018

4. **Course Outcomes:**

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19IT527.1	To understand the fundamentals of cloud native applications
R19IT527.2	Explore key cloud native communication, connectivity, and composition patterns
R19IT527.3	To understand the decentralized data management techniques
R19IT527.4	Explore the most commonly used patterns for API management and consumption
R19IT527.5	Examine some of the tools and technologies you'll need for building cloud native systems

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R19IT528	Data Analytics on Cloud	L	T	P	C
		3	0	0	3

1. Course Description:

This course equips learners to effectively utilize cloud-based storage and databases for efficient data management. It covers application design with MapReduce and Hadoop, cloud virtualization technologies, real-time data pipelines, and cost optimization techniques.

2. Course Objectives:

1. Master the use of cloud based storage and database for efficient data management
2. To identify and apply appropriate functions for designing applications using MapReduce and Hadoop
3. To analyze cloud virtualization technologies, real time data pipelines and cost optimization techniques to enhance productivity, efficiency and responsiveness.

UNIT – I Data Storage and Management on The Cloud

Overview of cloud data storage and management concepts, Key characteristics of cloud data management solutions, cloud object storage, Data archival and backup strategies in cloud storage, Data privacy and compliance requirements.

UNIT – II Map Reduce and Hadoop

MapReduce workflows, Module tests with MRModule, Test data and local tests, Anatomy of MapReduce job run, Classic Map-reduce, MapReduce types, Data format, Analysing data with Hadoop, Design of Hadoop distributed file system (HDFS), HDFS concepts, Hadoop I/O, Hadoop integration

UNIT– III Cloud Virtualization Infrastructure

Desktop Virtualization, Network Virtualization, Storage Virtualization, System-level ofOperating Virtualization, Application Virtualization, Virtual clusters and Resource Management, Containers vs. Virtual Machines, Introduction to Docker, Docker Components, DockerContainer, Docker Images and Repositories

UNIT- IV Real-Time Data Analytics on The Cloud

Overview of real-time data analytics concepts and use cases, Key characteristics of real-time data analytics solutions, Building real-time data pipelines with cloud services, Real-time data visualization tools and techniques, Performance considerations for real-time data processing, Security considerations for real-time data analytics on the cloud.

UNIT – V Cost Optimization and Performance Tuning

Overview, Key cost and performance challenges in cloud computing, Strategies for cost optimization and efficient resource utilization, Analyzing performance metrics for cloud applications and services, Implementing cost-effective performance improvements, Budgeting and forecasting cloud expenses.

Text Books:

Chairman – Board of Studies
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1. Balusamy, B., Abirami R, N., Kadry, S., Gandomi, A. H. (2021). Big Data: Concepts, Technology, and Architecture. United States: Wiley.

References:

Book References:

1. Applications of Machine Learning in Big-Data Analytics and Cloud Computing. (2022). Denmark: River Publishers.
2. Dr. Venkatachalam K, L. S. (2021). Building Cloud and Virtualization Infrastructure: A Hands-on Approach to Virtualization and Implementation of a Private Cloud Using Real-time Use-cases (English Edition). India: Bpb Publications.

Video References:

1. https://www.youtube.com/watch?v=DvR-DmYrReI&list=PLBgogxgQVM9uZ-lK7fCi61SIVCDKBid2K
2. https://youtu.be/8_9XBJC4kRw?si=r7LlxSgba6fE5Tl_

MOOC/ NPTEL/ SWAYAM Course:

1. https://archive.nptel.ac.in/courses/106/104/106104189/

4. **Course Outcomes:**

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19IT528.1	To Effectively use cloud-based storage and databases for data management.
R19IT528.2	Identify the appropriate function to design the applications using Map Reduce and Hadoop.
R19IT528.3	Apply the various cloud virtualization technologies to increase the productivity, efficiency and responsiveness.
R19IT528.4	Analyze real-time data pipelines and streaming applications on the cloud.
R19IT528.5	Examine cost optimization techniques to minimize cloud expenses and maximize resource efficiency.

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8.2 Open Elective Syllabus

R19AD651	Data Science Essentials	L	T	P	C
		2	0	2	3

1. Course Description:

The course aims to provide students with a comprehensive understanding of data science, covering key concepts, methodologies, and tools essential for data analysis, interpretation, and decision-making. Students will learn to collect, preprocess, and analyze data from various sources using statistical techniques and machine learning algorithms. Students will gain practical experience in applying data science methods to real-world problems. By the end of the course, students will be equipped with the knowledge and proficiency needed to extract valuable insights from data, make informed decisions, and contribute effectively to the rapidly evolving field of data science.

2. Course Objectives:

1. Gain a foundational understanding of data science concepts and methods.
2. Develop the ability to collect, clean, and manage data.
3. Learn how to analyse data using statistical and machine learning techniques.
4. Develop the ability to solve real-world problems using data science.
5. Develop an understanding of the ethical implications of data science

3. Syllabus:

Unit-I: Introduction to Data Science and Data Acquisition

Data science: definition, scope, importance of data-driven decision making, interdisciplinary nature of data science, stages of data science life cycle; overview of data science tools and techniques, applications of data science; Data acquisition: Sources of data, data collection and API, web scraping: extracting data from websites, accessing different sources of data.

Unit-II: Data Exploration and Feature Engineering

Data analytics: descriptive analysis, diagnostic analytics, predictive analytics, predictive analytics; Data pre-processing: handling missing values – imputation techniques, dealing with outliers; Exploratory Data Analysis(EDA); Feature Engineering: One-hot encoding, label encoding, creating new features, dimensionality reduction techniques.

Unit-III: Data Visualization

Tableau: Introduction, Overview of Tableau interface and workspace; Features and advantages, connecting to data sources, importing data from local files and cloud storage services, creating basic visualizations in Tableau: Bar charts, line charts, scatter plots, pie charts, histograms, heatmaps, advanced visualization techniques in Tableau:Treemaps, bubble charts, box plots, dual-axis charts, combination charts, adding filters and parameters, building interactive dashboards in Tableau.

Power BI: Overview, connecting to data Sources in Power BI, Importing data from local files, databases, and web sources; creating basic visualizations in Power BI: Bar charts, line charts, scatter plots, pie charts, histograms, heatmaps; advanced visualization techniques in Power BI: Treemaps, bubble charts, box plots, dual-axis charts, combination charts, building interactive dashboards in Power BI.

Unit-IV: Statistical Concepts for Data Science

Role of Statistics in Data Science; Population vs. Sample; Descriptive vs. Inferential statistics; Probability distributions: Poisson, Normal, Binomial, Uniform; Bayes' theorem and conditional probability; Descriptive statistics: Measures of central tendency: Mean, median, mode; Measures of dispersion: Variance, standard deviation; Inferential statistics:

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Hypothesis testing: Null and alternative hypotheses, p-values; Confidence intervals, ANOVA, Chi-square test, T-test; Correlation and Covariance.

Unit-V: Tools for Data Science

Microsoft Excel for data analysis: Introduction to Excel for basic data manipulation and analysis, data cleaning and formatting techniques in Excel, creating charts and graphs, pivot tables and pivot charts for summarizing and analyzing data, advanced Excel features for statistical analysis; Python packages for data science: NumPy for statistical analysis, data manipulation with Pandas data frames, data visualization using Matplotlib and Seaborn library.

List of Experiments:

1. Web Scrapping
   Use Case: Perform Web-Scrapping, create DataFrame by collecting the data from the website.
2. Exploratory Data Analysis: Perform Data Preprocessing & Data Wrangling on Netflix International Dataset
3. Exploratory Data Analysis: Perform EDA on Netflix International Dataset.
4. Fraud Detection in Financial Transactions
   Use Case: A banking institution aims to detect fraudulent transactions by analyzing historical transaction data.
   Experiment: Explore the dataset to identify patterns and anomalies indicative of fraudulent behavior. Develop new features such as transaction frequency, transaction amount, and geographical location. Apply anomaly detection techniques to flag suspicious transactions for further investigation.
5. Predictive Maintenance for Industrial Equipment
   Use Case: A manufacturing plant wants to implement predictive maintenance strategies to minimize downtime and optimize equipment performance.
   Experiment: Explore sensor data collected from industrial equipment to identify patterns associated with equipment failures. Engineer features such as equipment usage, temperature, and vibration levels. Train machine learning models to predict equipment failures before they occur based on historical sensor data.
6. Market Segmentation Analysis- Tableau
   Use Case: A beverage company is planning to launch a new health drink targeted towards health-conscious consumers. However, they recognize that the health-conscious market is diverse, with varying preferences and needs. To ensure the success of their product, they decide to conduct a market segmentation analysis..
7. Covid-19 Trends- Power BI
   Use Case: During the COVID-19 pandemic, public health authorities and policymakers need accurate and timely information to respond effectively to the evolving situation. Market segmentation analysis can be a valuable tool to understand how different population segments are affected by the virus, which can inform targeted interventions and resource allocation.
8. Exploring COVID-19 Data Trends
   Use Case: Health authorities want to visualize and analyze trends in COVID-19 cases to inform public health policies.
   Experiment: Collect COVID-19 data from reliable sources such as government health departments. Use data visualization tools to create interactive dashboards displaying trends in case counts, testing rates, and vaccination coverage. Analyze the data to identify hotspots and patterns over time.
9. Visualizing Stock Market Volatility

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Use Case: Financial analysts want to visualize and analyze stock market volatility to make informed investment decisions.
Experiment: Gather historical stock market data from financial databases. Use data visualization techniques to create candlestick charts and volatility plots showing price fluctuations and trading volumes. Apply technical analysis indicators such as moving averages and Bollinger Bands to identify potential trading opportunities.

10. Sales Performance Analysis
Use Case: Analyze sales data to identify top-performing products and regions for strategic decision-making.
Experiment: Analyze sales data using Microsoft Excel to uncover insights into sales performance and trends. Utilize Excel's data manipulation, visualization, and analysis tools to examine total sales revenue, product performance, regional sales distribution, and sales trends over time.

Text Books:

1. Avrim Blum, John Hop croft, and Ravindran Kannan," Foundations of Data Science", Springer-2018
2. Suresh Kumar Mukhiya, Usman Ahmed, "Hands-On Exploratory Data Analysis with Python", O'Reilly, 2013.
3. Cathy O' Neil, Rachel Schutt, "Doing Data Science, Straight Talk from The Frontline", O'Reilly, 2013.
4. Chandraish Sinha, "Tableau 10 for Beginners: Step by Step Guide to Developing Visualizations in Tableau 10", Create space Independent Pub, 2017.

References:

Reference Books:

1. Dean J, "Big Data, Data Mining and Machine learning", Wiley Publications, 2014.
2. Provost F and Fawcett T, "Data Science for Business" ,O'Reilly Media Inc, 2013.

Journals References:

1. https://jds-online.org/journal/JDS
2. https://link.springer.com/journal/41060
3. https://epjdatascience.springeropen.com/

Video References:

1. https://www.youtube.com/watch?v=-ETQ97mXXF0
2. https://www.youtube.com/watch?v=dcXqhMqhZUo&t=2s

MOOC/NPTEL/SWAYAM Courses:

1. https://onlinecourses.nptel.ac.in/noc21_cs69/preview
2. https://onlinecourses.nptel.ac.in/noc22_cs32/preview

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19AD651.1	Apply the fundamentals of data science for effective contribution to real-world.
R19AD651.2	Apply the various data collection and exploration techniques to analyze the data
R19AD651.3	Design interactive dashboards using suitable data science tools to reveal the insights of data.

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R19AD651.4	Analyze the distribution of data using various statistical techniques.
R19AD651.5	Analyze datasets using Python packages and Microsoft Excel to derive actionable.

R19AD652	Exploratory Data Analysis and Visualization	L	T	P	C
		2	0	2	3

1. Course Description:

This course covers principles and tools for creating impactful visualizations, using software like Tableau, Power BI, and Python libraries. Students learn to analyze and communicate data effectively, developing interactive dashboards and compelling visual narratives for decision-making across industries.

2. Course Objectives:

1. To learn the essential exploratory techniques for analyzing and visualizing data.
2. To gain hands-on experience of using software tools for data preparation, analytics, and visualization.
3. To utilize visualization for exploratory data analysis, identifying patterns and trends.
4. To apply visualization techniques to practical, real-world datasets.
5. To develop compelling visual narratives to communicate insights effectively.

3. Syllabus:

Unit-I: Data Exploration

Data: Aesthetics, Types of Data, Coordinate systems and axes, Colour Scales; Data Cleanup Basics: Normalizing and standardizing the data; Exploring the data: Importing the data, exploring table functions, identifying correlation and outliers; Introduction to Single variable: Distribution Variables, Numerical Summaries of Level and Spread, Scaling and Standardizing, Inequality, Smoothing Time Series.

Unit-II: Data Analysis

Data collection and management: Introduction, Sources of data, Data collection, APIs; Data Pre- processing Techniques; Data Analysis and Data Analytics: Descriptive Analysis, Diagnostic Analytics, Predictive Analytics, Prescriptive Analytics, Exploratory Analysis, Mechanistic Analysis; Analysis Method: Quantitative Methods, Qualitative Methods; Evaluation: Comparing Models, Cross Validation; Data storage and management, using multiple data sources.

Unit-III: Data Visualization

e Seven Stages of Visualizing Data, Univariate Plots: Histogram, Single and multiple distributions, Probability Distribution plots, Run Sequence Plots; Bivariate Plots: Bar graphs, Heat maps; Density Plots, Pair plots, Contour plots; Empirical cumulative distribution functions and q-q plots; Time series Data: Individual time series, Multiple time series and dose–response curves; Geo-spatial Data: Cartograms.

Unit-IV: Introduction to Tableau

Overview of Tableau and its applications, Installation and setup, connecting to data sources (Excel, CSV, databases), Understanding Tableau's interface; Data Preparation in Tableau, Maps and geographical data visualization, Intermediate Visualization Techniques, Storytelling with Tableau, Real-time data connections and live dashboards.

Unit-V: Power BI for Data Visualization and Analysis

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Data Preparation and Transformation, Basic Visualization Techniques, Advanced DAX functions and calculations, Power BI Data Modelling; Case Study: Wildfire Activity in the Western United States, Single Family Residential Home and Rental Values.	
List of Experiments:	
1.	You are a data analyst working for an insurance company and you have been tasked with generating a comprehensive data quality report for the company's customer data. The data is intended to be used for risk assessment and policy pricing. The dataset contains information about policyholders, their coverage details, and claim history. Your goal is to identify and report on missing values, irregular cardinality, and outliers in the dataset.
2.	You are a data analyst working for a winery, and your team has provided you with a dataset containing information about various attributes related to wine quality. The dataset includes features such as acidity levels, residual sugar, alcohol content, and the quality rating assigned by experts. Your task is to perform Exploratory Data Analysis (EDA) to gain insights into the characteristics of the wines and understand the factors influencing wine quality.
3.	You are a data scientist working for an e-commerce company, and your team has provided you with a dataset containing information about customer purchases. The dataset includes features such as purchase amount, product category, customer age, and the time of purchase. Your goal is to prepare the data for exploratory analysis, employing normalization, binning, and sampling methods.
4.	You are a data scientist working for a telecommunications company, and your team is interested in predicting customer churn. The dataset includes various features such as customer tenure, monthly charges, usage patterns, and customer satisfaction scores. Your task is to identify a descriptive feature that shows a clear relationship with the target feature, which is whether a customer churns or not. You will use visualization techniques to explore these relationships effectively.
5.	You are a data scientist working for a retail company, and your team has provided you with a time series dataset containing daily sales data for various products over the past few years. Your task is to perform time series analysis to understand sales patterns, trends, and seasonality. Additionally, you need to forecast future sales using appropriate visualization techniques.
6.	You work for a travel and tourism company, and your team has tasked you with analyzing and visualizing data related to popular tourist destinations. The dataset includes information such as location coordinates, tourist attractions, and ratings. Your goal is to perform data analysis and represent the information on a map with interactive features, including mouse rollover effects and user interaction.
7.	You work for a global non-profit organization that focuses on socio-economic development, and your team has tasked you with creating cartographic visualizations for multiple datasets involving various countries worldwide and specific states and districts within India. The datasets cover diverse indicators such as education, health, and economic factors. Your goal is to create insightful visualizations that allow stakeholders to compare socio-economic conditions across different regions.
8.	Assume you have a sample COVID-19 dataset named covid_data with variables like Date, Country, Confirmed_Cases, Deaths, and Recovered. How can you filter rows and variables in Tableau? Use the ggplot2 package for data visualization to understand the trend of confirmed cases, deaths, and recoveries over time. Consider a real- time problem: "Visualizing the spike in confirmed cases for a specific country, e.g., USA."

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9. **Case Study 1: Retail Sales Analysis**

Objective: You are a data analyst for a retail company, and the management wants you to analyze the sales data to identify trends, customer preferences, and potential areas for improvement.

Dataset: The dataset includes the following columns: Order_ID: Unique identifier for each order.

Order_Date: Date of the order placement. Product_ID: Unique identifier for each product. Product_Name: Name of the product.

Category: Product category (e.g., Electronics, Clothing, Home Appliances). Unit_Price: Price of one unit of the product.

Quantity: Number of units ordered.

Total_Sales: Total sales amount for the order.

Insights and Recommendations:

a. Monthly Sales Trend: Sales have been consistently increasing, with a noticeable spike in [specific month]. Management could investigate the factors contributing to this increase for potential replication in other months.

b. Product Category Analysis: [Category A] is the highest-selling category, indicating a strong demand. The company might consider expanding or promoting products within this category.

c. Top Selling Products: [Top Product 1] and [Top Product 2] are the highest-selling products. Marketing efforts can be focused on these products to capitalize on their popularity.

d. Customer Segmentation: Further analysis is needed to understand customer segments based on demographics. Targeted marketing strategies can be developed for each segment.

e. Correlation Analysis: Positive correlations between [Variable X] and [Variable Y] suggest that changes in [Variable X] may impact [Variable Y]. Further investigation is recommended.

Case Study 2: Ridesharing Platform Analysis

Objective: You are a data analyst for a ridesharing company, and the management wants you to analyze the rides data to gain insights into user behavior, trip patterns, and areas for service improvement.

Dataset: The dataset includes the following columns:

Ride_ID: Unique identifier for each ride. User_ID: Unique identifier for each user. Timestamp: Date and time of the ride. Pickup_Location: Pickup location of the ride. Dropoff_Location: Dropoff location of the ride. Distance: Distance of the ride in miles.

Duration: Duration of the ride in minutes. Fare: Fare amount for the ride.

Rider_Rating: Rating given by the rider to the driver (out of 5). Insights and Recommendations:

a. User Activity Over Time:

There is a noticeable increase in rides during peak hours, suggesting high demand during specific times. Consider adjusting service capacity or introducing dynamic pricing during peak hours.

b. Trip Duration Distribution:

Most trips have a duration of between 10-30 minutes. Investigate and optimize routes for shorter trips to enhance efficiency.

c. User Ratings Analysis:

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	The median rider rating is high, indicating overall satisfaction. Identify factors contributing to low ratings and address them to maintain service quality. d. Geographical Analysis: Analyze popular pickup and dropoff locations to optimize driver allocation and potentially identify areas for promotional campaigns. Further Analysis: a. User Segmentation: Explore user segments based on frequency, distance traveled, and rider ratings. Tailor marketing strategies for each segment. b. Price Sensitivity Analysis: Investigate the relationship between fare amounts and rider ratings. Understand if there is a correlation and adjust pricing strategies accordingly. c. Weather Impact: If available, incorporate weather data to analyze how weather conditions influence ride demand and duration.
10.	**Mini project:** **Scenario 1: E-commerce Sales Analysis** Objective: You are working for an e-commerce company, and the management wants to understand the sales performance of their products over the past year. They have provided you with a dataset containing information about the sales transactions. Dataset: The dataset includes the following columns: Transaction_ID: Unique identifier for each transaction. Product_ID: Unique identifier for each product. Product_Name: Name of the product. Transaction_Date: Date of the transaction. Transaction_Amount: The amount of money spent on the transaction. Perform the following tasks and subtasks: 1. Data Exploration a. Load the data b. Explore the data c. Check for missing values 2. Data Visualization a. Time series analysis b. Product sales distribution c. Transaction amount distribution d. Monthly sales trend **Scenario 2: Fitness App User Engagement Analysis** Objective: You are working for a fitness app company, and the management wants to understand the user engagement patterns and activity levels of their users. They have provided you with a dataset containing information about user activities. Dataset: The dataset includes the following columns: User_ID: Unique identifier for each user. Date: Date of the activity. Steps: Number of steps taken by the user on that day. Calories Burned: Calories burned by the user on that day. Active Minutes: The total number of active minutes (e.g., exercise, workout) by the user. Perform the following tasks and subtasks: 1. Data Exploration

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	a. Load the data b. Explore the data c. Check for missing values 2. Data Visualization a. Daily Steps Trend b. Calories Burned vs. Active Minutes c. Weekly Aggregation of Steps d. Histogram of Active Minutes e. User Engagement by Day of the Week
Text Books: 3. Claus O Wilke, "Fundamentals of Data Visualization A Primer on Making Informative and Compelling Figures", O'Reilly Media, Inc., First Edition, 2019. 4. David Baldwin," Mastering Tableau: Smart Business Intelligence techniques to get maximum insights from your data", Packt, First Edition, 2016.	
References:	
Reference Books: 5. Catherine Marsh, Jane Elliott, Exploring Data: An Introduction to Data Analysis for Social Scientists, Wiley Publications, 2nd Edition, 2008. 6. Alberto Cairo, "The Functional Art: An Introduction to Information Graphics and Visualization", New Riders, 2012. 7. Nathan Yau, "Visualize This: The Flowing Data Guide to Design, Visualization and Statistics", John Wiley & Sons, 3rd Edition, 2011. 8. Ben Fry, "Visualizing Data", O" Reilly Media, Inc., 2007.	
Journals References: 3. Deepmala Srivastava, "An Introduction to Data Visualization Tools and Techniques in Various Domains," International Journal of Computer Trends and Technology, vol. 71, no. 4, pp. 125-130, 2023. Crossref, https://doi.org/10.14445/22312803/IJCTT-V71I4P116 4. Diamond, Michael and Angela Mattia. "Data Visualization: An Exploratory Study into the Software Tools Used by Businesses." Journal of Instructional Pedagogies 17 (2015).	
Video References: 3. https://www.youtube.com/watch?v=TPMlZxRRaBQ 4. https://youtu.be/64-eK-tdTPc	
MOOC/NPTEL/SWAYAM Courses: 3. https://www.udemy.com/course/data-exploration-data-analysis-data-visualization/ 4. https://www.coursera.org/courses?query=data%20visualization	

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19AD652.1	Apply the key techniques and theory behind Data Exploration.
R19AD652.2	Apply the statistical techniques and methods for Data visualization

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R19AD652.3	Apply various data visualization techniques for a variety of tasks
R19AD652.4	Implement data visualization techniques using Tableau and Power BI
R19AD652.5	Create story telling Dashboards using Tableau and Power BI

R19AD653	Machine Learning Techniques	L	T	P	C
		3	0	0	3

1. Course Description:

This course provides an in-depth introduction to the fundamental concepts and techniques of machine learning, a field at the intersection of computer science and statistics that focuses on the development of algorithms capable of learning from data. Students will gain a comprehensive understanding of the principles and applications of machine learning, along with hands-on experience in implementing and evaluating machine learning models.

2. Course Objectives:

1. To explain the different types of Machine learning techniques and mathematical concepts
2. To use natural language processing techniques using large language models
3. To apply the different machine learning tools to solve the real-time problems
4. To make decisions using reinforcement learning and Markov Decision process.

3. Syllabus:

Unit-I: Introduction

Review of Linear Algebra for Machine Learning. Introduction and motivation for machine learning; Types of Machine Learning: Supervised Learning, Unsupervised Learning and Reinforcement learning. Statistical Decision theory: Classification and Regression, Bias and Variance.

Case Study: Stock Price Prediction

Unit-II: Classification and Regression

Linear Regression, Multivariate Regression, Subset Selection, Shrinkage methods, Principal Components Regression, Partial Least Squares. Ridge and LASSO Regression. Logistic Regression. Linear Discriminant Analysis. Decision Tree, K Nearest Neighbor, Separating hyperplane – Perceptron learning Support Vector Machines and kernels. Artificial Neural Networks: Backpropagation Algorithm, Maximum Likelihood estimate.

Case Study: House Price Prediction using Linear Regression and spam email classification usingsupport vector machine algorithm.

Unit-III: Evaluation Measures and Ensemble Techniques

Evaluation Measures: Bootstrapping and cross validation ROC Curve, Minimum Description length and exploratory analysis. Ensemble Methods: Bagging, Committee machines, Stacking, Boosting, Gradient Boosting, Random Forest

Case Study: Random Forest for Credit Scoring and Stacking for Image Classification.

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Unit-IV: Bayesian Networks and Clustering

Naïve Bayes, Bayesian Networks, Undirected Graphical models, Hidden Markov models, Variable Elimination, Belief Propagation; Partitional Clustering, Hierarchical Clustering, BIRCH and CURE algorithms, Density based Clustering, Spectral Clustering.

Case Study: Analyze customer reviews to determine the sentiment (positive, negative, or neutral) associated with a product or service.

Unit-V: Reinforcement Learning

Introduction to Reinforcement Learning, Framework, Elements of Reinforcement learning, MarkovDecision Process, Q – Learning in Python, Deep Q- learning.

Case Study: Game Playing

Text Books:

1. Ethem Alpaydin, "Introduction to Machine Learning", Third Edition, Prentice Hall of India, 2015.
2. Tom Mitchell, "Machine Learning", McGraw-Hill, 2017.
3. Christopher Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
4. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.
5. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", Second Edition, CRC Press,2014.

References:

Reference Books:

1. Fabio Nelli, "Python Data Analytics with Pandas, Numpy, and Matplotlib", Second Edition, Apress,2018. Educational Publishers Inc., 2015.

2. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", FirstEdition, Cambridge University Press, 2012.

Video References:

1. https://www.youtube.com/c/3blue1brown
2. https://www.youtube.com/channel/UCfzlCWGWYyIQ0aLC5w48gBQ

Web Resources:

1. https://www.youtube.com/channel/UCWN3xxRkmTPmbKwht9FuE5A
2. Machine Learning by Andrew Ng on Coursera

MOOC/SWAYAM/NPTEL Courses:

1. Introduction to Deep Learning - MIT Open Courseware
2. Essential Mathematics for Artificial Intelligence on edX

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19AD653.1	Apply the mathematical concepts of Machine learning to solve real-time problems.

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R19AD653.2	Apply the different types of Machine learningand graphical modelling for data analysis andvisualization.
R19AD653.3	Implement boosting algorithms using appropriate libraries and tune hyperparametersfor optimal performance.
R19AD653.4	Interpret and communicate the results obtained from Bayesian network analysis and clusteringalgorithms in the context of specific applications.
R19AD653.5	Examine the Markov Decision Process and Reinforcement learning algorithms in a simulated environment.

R19AD654	Foundations of Artificial Intelligence	L	T	P	C
		3	0	0	3

1. Course Description:

This course offers a comprehensive exploration of the foundational principles and core concepts in Artificial Intelligence (AI). Beginning with an introduction to the history and applications of AI, the course progressively delves into intelligent agents, problem-solving, search algorithms, and extends to encompass knowledge representation and planning. Through a structured journey, students will delve into the origin of Artificial Intelligence (AI), covering a spectrum of topics crucial for understanding and equipping them with the problem-solving skills essential for the broader field of AI.

2. Course Objectives:

1. To study about structure of agents and the nature of environments
2. To learn the search algorithms of AI in different environments
3. To Learn and apply adversarial search techniques to solve problems in dynamic environments.
4. To study and infer the logical and probabilistic inference mechanisms.
5. To study the knowledge representation and planning algorithms.

3. Syllabus:

Unit-I: Intelligent Agents

Introduction to artificial intelligence; Intelligent agents: agents & environment, concept of rationality, nature of environments, structure of agents.

Case Study: Autonomous Delivery Robots which interact with their surroundings and navigate through dynamic environments to deliver packages.

Unit-II: Problem Solving Agents

Uninformed search strategies, Heuristic search strategies, heuristic functions; Local search and optimization problems, local search in continuous space, search with nondeterministic actions, search in partially observable environments, online search agents and unknown environments.

Case Study: Autonomous vehicle Navigation in Unknown Environments

Unit-III: Game Playing and CSP

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Adversarial search: Games, optimal decisions in games, alpha - beta pruning, stochastic games, partially observable games; Constraint satisfaction problems; constraint propagation, backtracking search for CSP, local search for CSP, structure of CSP

Case Study: Artificial intelligence system plays chess to make optimal moves in a partially observable and dynamic environment.

Unit-IV: Logical Agents

Knowledge-based agents, propositional logic, propositional theorem proving, propositional model checking, agents based on propositional logic; First-order logic: syntax and semantics, knowledge representation and engineering; Inferences in first-order logic: forward chaining, backward chaining, resolution

Case Study: Automated personal assistant to assist users in managing their daily tasks, scheduling, and information retrieval.

Unit-V: Knowledge Representation and Planning

Ontological engineering, categories and objects, events, mental objects and modal logic, reasoning systems for categories, reasoning with default information; Classical planning, algorithms for classical planning; time, schedule, and resources analysis, hierarchical planning, planning and acting in non-deterministic domains

Case Study: Autonomous Warehouse Management System (WMS) for efficient planning, scheduling, and resource allocation within a warehouse environment.

Text Books:

1. Stuart Russel and Peter Norvig, "Artificial Intelligence: A Modern Approach", Fourth Edition, Pearson Education, 2020.
2. Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw Hill Publishing Company, New Delhi, 2014.

References:

Reference Books:

1. I. Bratko, "Prolog: Programming for Artificial Intelligence", Fourth edition, Addison-Wesley Educational Publishers Inc., 2015.
2. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw Hill Education, New Delhi, 2017

Video References:

1. https://www.youtube.com/watch?v=R3nqhDIEyMg&list=PLaatXkJEXKyJjYYOrWrmVPNbWvs_sRgm
2. https://www.youtube.com/watch?v=WfdwKUuiLNo&list=PLbhdEzRraaeGjIhuP96wB3L2BTBhaOeWe

Web References:

1. https://www.geeksforgeeks.org/optimal-decision-making-in-games/
2. https://www.javatpoint.com/ai-informed-search-algorithms

MOOC/SWAYAM/NPTEL Courses:

1. https://onlinecourses.nptel.ac.in/noc20_cs81/preview
2. https://www.udemy.com/course/searching-algorithms-in-ai/

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4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19AD654.1	Implement a study of agents' structures and diverse environments in AI.
R19AD654.2	Apply various AI search algorithms for different environmental scenarios using the knowledge and skills acquired.
R19AD654.3	Implement a comprehensive study of adversarial search techniques and resolving constraint satisfaction problems in AI.
R19AD654.4	Apply logical and probabilistic inference mechanisms to improve decision-making in AI systems.
R19AD654.5	Analyse knowledge representation techniques and planning algorithms vital for Artificial Intelligence

R19CC651	Network Protocols	L	T	P	C
		2	0	2	3

1. Course Description:

This course is designed to equip students with a solid understanding of network protocols, addressing, and their functions in computer networks. Topics covered include the various types of IP addressing, the functionalities of Internet Protocol (IP), and the basics of TCP protocol design and operations. Additionally, students will learn to identify different types of TCP/IP family network protocols crucial for effective network management and communication.

2. Course Objectives:

1. To examine network protocols, addressing, and functions for foundational comprehension.
2. To make students understand diverse IP addressing types for efficient network management.
3. To summarize Internet Protocol functionalities for communication understanding.
4. To gain knowledge of TCP protocol basics for reliable data transmission comprehension.
5. To identify TCP/IP family protocols for specific network functionality comprehension.

3. Syllabus:

Unit-I: Protocols and Standards

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Protocols and Standards- Internet Standards-Protocol Layers-OSI Reference Model-TCP/IP Protocol Suite-Addressing: Physical, Logical, Application and Port Addressing.

Unit-II: IP Addressing

Address Space- Notation- Range of Addresses-Classful Addressing: Classes And Blocks-Two-Level Addressing- Subnetting and Supernetting-Classless Addressing: Variable-Length Blocks- Two-Level Addressing- Block Allocation.

Unit-III: Internet Protocol

TCP/IP Protocol Suite -Datagram-Fragmentation-Options- Checksum-Security: Packet Sniffing, Packet Modification, IP Spoofing-IP Packaging-Internet Control Message Protocol: Messages and Formats- Error Reporting-Query- Checksum- Internet Control Message Protocol Design

Unit-IV: Transmission Control Protocol

Process To Process Communication -TCP Services –Segment -Options- Checksum-Flow Control- Error Control- TCP Timers-Connection-State Transition Diagram-Congestion Control-TCP Operation- TCP Design

Unit-V: TCP/IP Family Protocols

User Datagram Protocol: UDP Services-UDP Applications-File Transfer Protocol: Connections Communication-Command Processing-File Transfer-Anonymous FTP-Security For FTP- Hypertext Transfer Protocol: HTTP Overview-Message Formats- HTTP Connections-Security

List of Experiments:

1. Simulate and compare the OSI and TCP/IP protocol layers using a network simulator
2. Configure a small network using Classful and Classless (CIDR) IP addressing schemes. Perform subnetting and supernetting to manage IP addresses efficiently in Cisco Packet Tracer.
3. Analyze IP packets, focusing on packet fragmentation, reassembly, and identifying spoofed packets.
4. Simulate a TCP connection establishment and analyse its flow control mechanism
5. Set up an FTP server and client, transfer files between them, and monitor the communication

Text Books:

1. Behrouz A. Forouzan, —TCP/IP Protocol Suite‖, Tata McGraw Hill Publishing Company, New Delhi, 2010.
2. DOUGLAS E. COMER, —Internetworking With TCPI/IP Principles, Protocols, and Architecture‖, Pearson, 2015.

References:

1. Achyut S. Godbole, Atul Kahate —Data Communications and Networks, Tata McGraw Hill Publishing Company, New Delhi, 2011.
2. William Stallings —Data and Computer Communications‖, Pearson Prentice-Hall, New Delhi, 2011.
3. W. Richard Stevens, —TCP/IP Illustrated: The Protocols‖, Addison-Wesley

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Professional, 2011.

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CC651.1	Implement the basics of protocols, addressing, and their functions in computer networks.
R19CC651.2	Classify the different types of IP addressing and their functions in networks.
R19CC651.3	Demonstrate the functionalities of Internet Protocol and its elements.
R19CC651.4	Analyze the basics of TCP protocol design and operations.
R19CC651.5	Differentiate the types of TCP/IP family of network protocols within the network.

R19CC601	High Speed Networks	L	T	P	C
		3	0	0	3

1. Course Description:

This course is designed to provide a comprehensive understanding of high-speed networks, focusing on the architecture of ATM and high-speed LANs. Students will analyze congestion control within packet-switching networks, describe various traffic management techniques in ATM, and explore the basic taxonomy and architecture implementation of high-speed wireless LANs. Additionally, they will learn to compare and select appropriate modes in wireless ATM networks, preparing them for effective network design and management in high-speed environments.

2. Course Objectives:

1. To examine ATM and high-speed LAN architectures for foundational comprehension.
2. To make students understand congestion control in packet-switching networks for effective management.
3. To impart knowledge on traffic management techniques in ATM to optimize performance.
4. To examine high-speed wireless LAN taxonomy and architecture for comprehension.
5. To compare and select modes in wireless ATM networks for efficient transmission.

3. Syllabus:

Unit-I: High Speed Networks

Asynchronous Transfer Mode – ATM Protocol Architecture, ATM Logical Connection – ATM Cell – ATM Service Categories – AAL. High Speed LANs – Fast Ethernet – Gigabit Ethernet – Fibre Channel – Wireless LAN's Applications, Requirements – Architecture of IEEE 802.11.

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Unit-II: Queuing Analysis and Congestion Control
Single Server Queues – Multiserver Queues – Queues with Priorities – Networks of Queues –Effects of Congestion – Congestion Control – Traffic Management – Congestion Control in Packet Switching Networks – Frame Relay Congestion Control
Unit-III: ATM Congestion Control
Traffic and Congestion Control in ATM – Requirements – Attributes – Traffic Management Frame Work – Traffic Control – ABR Traffic Management – ABR Rate Control – RM Cell Formats – ABR Capacity Allocations – GFR Traffic Management.
Unit-IV: High Speed Wireless Lan
Classification Of Wireless LANs: Radio LANs-Direct Sequence Spread Spectrum-Frequency Hopping Spread Spectrum-Comparison-Infrared LANs-Wireless LAN Implementation-Components-Protocol Architecture-LAN Topologies-Deployment-Performance of Wireless LANs.
Unit-V: Wireless ATM Networks
ATM Technology: Comparison of Transfer Modes, ATM vs IP- Need for Wireless ATM-Wireless Communication using ATM-Multimedia Communications using Wireless ATM.
Text Books:
1. William Stallings, —High-speed Networks and Internet, Pearson Education, 2nd Edition, 2002. 2. Benny Bing, —High-Speed Wireless ATM and LANs, Artech House Publishers, 2000
References:
1. Jean Warland, Pravin Varaiya—High-performance Communication Networks‖, Jean Harcourt Asia Private Limited, 2nd Edition, 2000. 2. Abhijit S. Pandya, ErcanSen —ATM Technology for Broadband Telecommunications Networks, CRC Press, 2004. 3. William Stallings —High-speed Networks: TCP/IP and ATM Design Principles‖, PHI, 2nd Edition, 2008

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CC601.1	Implement the basics of architecture of ATM and high-speed LANs.
R19CC601.2	Analyze and manage congestion control in various scenarios within packet switching networks.
R19CC601.3	Demonstrate a range of traffic management strategies in ATM.
R19CC601.4	Evaluate the basic taxonomy in high-speed wireless LANs and their architectural implementation.
R19CC601.5	Select and apply appropriate modes in wireless ATM networks.

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R19CC602	Introduction to Industrial Networking	L	T	P	C
		3	0	0	3

1. Course Description:

This course is designed to provide an introduction to industrial networking, covering fundamental concepts such as data networks and internetworking. Students will familiarize themselves with serial communications, delve into specifics like HART and Field buses, and understand communication protocols like MODBUS and PROFIBUS. Additionally, the course explores industrial Ethernet and wireless communication, equipping students with essential knowledge for navigating the complexities of industrial networking.

2. Course Objectives:

1. To examine data network basics to establish foundational understanding.
2. To understand internetworking and serial communications fundamentals for application.
3. To explore HART and Field buses to grasp their industrial significance.
4. To make students understand MODBUS, PROFIBUS, and other protocols for effective communication.
5. To impart knowledge on industrial Ethernet and wireless communication for modern networking.

3. Syllabus:

Unit-I: Data Network Fundamentals

Networks hierarchy and switching – Open System Interconnection model of ISO - Data link control protocol - Media access protocol - Command/response - Token passing - CSMA/CD, TCP/IP

Unit-II: Internet Working and RS 232, RS 485

Bridges - Routers - Gateways - Standard ETHERNET and ARCNET configuration special requirement for networks used for control - RS 232, RS 485 configuration Actuator Sensor (AS) – interface, Device net.

Unit-III: HART and Fieldbus

Introduction - Evolution of signal standard - HART communication protocol - HART networks – HART commands - HART applications - Field bus - Introduction - General Field bus architecture – Basic requirements of Field bus standard - Field bus topology - Interoperability - Interchangeability - Introduction to OLE for process control (OPC).

Unit-IV: Modbus and Profibus PA/DP/FMS and FF

MODBUS protocol structure - function codes – troubleshooting Profibus, Introduction, Profibus protocol stack, Profibus communication model - communication objects - system operation - troubleshooting - review of foundation field bus - Data Highway

Unit-V: Industrial Ethernet and Wireless Communication

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Industrial Ethernet, Introduction, 10 Mbps Ethernet, 100 Mbps Ethernet - Radio and wireless communication, Introduction, components of radio link - radio spectrum and frequency allocation – radio MODEMs-Introduction to wireless HART and ISA100.
Text Books:
1. Steve Mackay, Edwin Wrijut, Deon Reynders, John Park, Practical Industrial Data Networks 2. 'Design, Installation and Troubleshooting' Newnes Publication, Elsevier First Edition, 2004 3. A. Behrouz Forouzan, Data Communications & Networking,3RD edition, Tata Mc Graw hill, 2006.
References:
1. Andrew S. Tanenbaum, David J. Wetherall, Computer Networks, Prentice Hall of India Pvt. Ltd., 5th Edition. 2011. 2. Theodore S Rappaport, Wireless Communication: Principles and Practice, Prentice Hall of India 2nd Edition, 2001. 3. William Stallings, Wireless Communication & Networks, Prentice Hall of India, 2nd Edition, 2005.

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CC602.1	Apply the basic concepts of data networks.
R19CC602.2	Implement the basics of internetworking and serial communications.
R19CC602.3	Utilize the details of HART and Field buses.
R19CC602.4	Implement MODBUS, PROFIBUS, and other communication protocols.
R19CC602.5	Apply industrial Ethernet and wireless communication concepts.

R19CC603	Basics of Mobile Communication	L	T	P	C
		3	0	0	3

1. Course Description:

This course is designed to provide a comprehensive understanding of the basics of mobile communication. Students will explore wireless communication mediums used in cellular systems, understand the architecture and fundamentals of mobile telecommunication systems, and delve into the architecture of Wireless LAN technologies. Additionally, they will determine the functionalities of network and transport layers, illustrate the generations of wireless networks, and acquire knowledge of application layer functionalities and associated languages and operating systems in mobile communication.

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2. Course Objectives:

1. To impart knowledge on wireless communication mediums for cellular systems, establishing a foundational understanding.
2. To equip students with a practical understanding of mobile telecommunication system architecture.
3. To provide comprehensive insights into the architecture of Wireless LAN technologies.
4. To enhance the understanding of network and transport layer functionalities, along with the evolution of wireless network generations.
5. To develop expertise in application layer functionalities, associated programming languages, and operating systems relevant to mobile communications.

3. Syllabus:

Unit-I: Wireless Transmission and Channel

Introduction: Applications, History of wireless communication. Wireless Transmission: Frequencies for radio transmission, Signal Propagation, Cellular Systems. Medium Access Control: Motivation for a specialized MAC, SDMA, FDMA, TDMA and CDMA.

Unit-II: Mobile Communication Systems

Mobile Communication systems: GSM Mobile services, System Architecture, Radio Interface, Protocols, Localization and calling, Handover, Security, New Data services. Satellite systems: Overview and applications. Broadcast systems: Overview, DAB and DVB, Convergence of Broadcasting and Mobile communication

Unit-III: Wireless LAN

Wireless LAN: Infra-red vs. radio transmission, Infrastructure and ad-hoc network, IEEE 802.11, HIPERLAN, Bluetooth

Unit-IV: Mobile Network Layer and Transport Layer

Mobile Network Layer and Transport Layer: Mobile IP, Dynamic Host Configuration Protocol, Mobile adhoc networks, Traditional and classical TCP and TCP over 2.5/3G wireless networks.

Unit-V: Application Layer

Application Layer: Wireless Application Protocol, Architecture, Wireless datagram protocol, wireless transport layer security, wireless transaction protocol, wireless session protocol, wireless application environment, wireless mark-up language, WMLScript, I-mode, SuncML, WAP2.0, Mobile Application Languages: Mobile application Development, XML, JAVA, Java 2 Micro Edition, Java card, Mobile Operating system: Window Mobile and CE, Android.

Text Books:

1. Jochen Schiller, —Mobile communications‖ Pearson, 2nd edition 2009
2. Clint Smith, Daniel Collins, —Wireless Networks, Third Edition, McGraw Hill Publications, 2014.

References:

1. Raj Kamal, —Mobile Computing Oxford University Press 2nd Edition
2. Prasanth Kumar Patnaik, Rajib Mall, — Fundamentals of Mobile Computing‖, PHI

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Learning Pvt. Ltd., New Delhi, 2012

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CC603.1	Apply the concepts of wireless communication and mediums used for cellular systems.
R19CC603.2	Implement the basics of mobile telecommunication systems and their architectures.
R19CC603.3	Utilize the architecture of Wireless LAN technologies.
R19CC603.4	Determine the functionality of the network layer and transport layer, and illustrate the generations of wireless networks.
R19CC603.5	Apply the functionalities of application layer and associated languages and operating systems in mobile communications.

R19CC604	Introduction to Wireless Communication Networks	L	T	P	C
		3	0	0	3

1. Course Description:

This course is designed to provide an introduction to wireless communication networks, covering fundamental concepts and technologies. Students will understand the basics of wireless communication systems, explore cellular system concepts based on resource availability, and analyze the performance of various modulation schemes. Additionally, they will delve into the concepts of multiple input multiple output (MIMO) systems and grasp basic wireless networking concepts, preparing them for navigating the complexities of wireless communication networks.

2. Course Objectives:

1. To impart knowledge on wireless communication systems for foundational understanding.
2. To develop an understanding of cellular system concepts with a focus on resource availability.
3. To explore and analyze the performance of various modulation schemes.
4. To provide insights into the concepts of different MIMO systems for deeper comprehension.
5. To foster a comprehensive understanding of basic wireless networking concepts.

3. Syllabus:

Unit-I: Services and Technical Challenges

Types of Services, Requirements for the services and Technical Challenges of wireless communication-Multipath propagation, Spectrum Limitations, Noise and Interference

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Unit-II: Cellular Communication Concepts
Introduction - frequency reuse - channel assignment - handoff - coverage and capacity improvement, Multiple Access techniques – TDMA, FDMA, CDMA, SDMA.
Unit-III: Wireless Transceivers
Structure of a wireless communication link, Modulation and demodulation – Quadrature Phase Shift Keying, pi/4-Differential Quadrature Phase Shift Keying, Offset-Quadrature Phase Shift Keying, Binary Frequency Shift Keying, Minimum Shift Keying, Gaussian Minimum Shift Keying, OFDM Principles.
Unit-IV: Multipath Mitigation and MIMO Systems
Equalization – Adaptive equalization, Linear and Non-Linear equalization. Diversity – Micro and Macro diversity, Diversity combining techniques, Error probability in fading channels with diversity reception, Rake receiver. MIMO systems – spatial multiplexing - System model -Pre-coding – Beamforming.
Unit-V: Wireless Networks
Introduction-IEEE 802.11 project – Bluetooth – WiMAX- IEEE project 802.16 – Cellular Telephony – Generations, satellite communication Networks- GEO satellite, MEO Satellites, LEO Satellites.
Text Book:
1. Andreas.F. Molisch, —Wireless Communications‖, John Wiley – India, 2nd Edition.
Reference Books:
1. Rappaport,T.S., —Wireless communications‖, Second Edition, Pearson Education, 2010. 2. Behrouz A. Forouzan —Data communication and Networking‖, Fourth Edition, Tata McGraw – Hill, 2011. 3. Simon Haykin & Michael Moher—Modern Wireless Communications‖, Pearson Education, 2007. 4. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2007.

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CC604.1	Demonstrate an understanding of the basics of wireless communication systems.
R19CC604.2	Analyze cellular system concepts based on resource availability.
R19CC604.3	Evaluate the performance of various modulation schemes.
R19CC604.4	Apply the concepts of various MIMO systems.
R19CC604.5	Apply basic wireless networking concepts.

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R19CB601	Algorithmic Trading Strategies	L	T	P	C
		3	0	0	3

1. Course Description:

The aim of the Algorithmic Trading Strategies course is to investigate various methods implemented in trading strategies with emphasis on automated trading. The course also provides a broad view of the algorithmic trading strategies, system architecture, and its risk management. The course content includes methods implemented in multiple quantitative trading strategies on quantitative finance-based approaches to enhance the trade decision making mechanism. Students will learn to quantify liquidity risk, market risk, operational and real economy risks; as well as how to manage those risks.

2. Course Objectives:

1. To understand some basic theories of quantitative trading.
2. To implement spectrum of modelling skills to investigate and summarize stylized features of the market data.
3. To acquire skills in designing and implementing systematic investment trading strategies.
4. To learn regulations and risk management aspects of the business of quantitative trading.
5. Gain a comprehensive understanding of the importance of audit and compliance processes.

3. Syllabus:

Unit-I: Introduction to Algorithmic Trading

Overview: Evolution of Algorithmic Trading, Meaning of Algorithmic Trading, Different Trading Methodologies; Trends in Algorithmic Trading: Global and India, Benefits of Algorithmic Trading.

Unit-II: Trading Strategies

Order Types: Different Order Types, Execution of Trading Strategies; Trading Strategies: Calendar Spread, Cash Future Arbitrage Strategy, Index Arbitrage, Pair Trading, News Based Trading Strategies, Conversion, Reversal.

Unit-III: Algorithmic Trading: System Architecture

Market Data: CEP Engine, Order Routing / Order Manager, Colocation, Smart Order Routing (SOR), Connectivity Options.

Unit-IV: Risk management in Algorithmic Trading

Different Stages involved in Risk Management, Risk Management Specific to High Frequency & Algorithmic Trading.

Unit-V: Audit and Compliance Process

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International Organization of Securities Commissions, Auditing Process and Requirements (As defined by NSE for member-broker); SEBI Recommendations on Algorithmic Trading: Software Testing and Empanelment, Exchange Audits, Technology and System Audit, Compliance Requirements.

Text Books:

1. Raja Velu, Maxence Hardy and Daniel Nehren, "Algorithmic Trading and Quantitative Strategies", CRC Press Taylor and Francis Group, Florid, 2020.
2. Sebastien Donadio, Sourav Ghosh, "Learn Algorithmic Trading: Build and Deploy Algorithmic Trading Systems and Strategies Using Python and Advanced Data Analysis", United Kingdom: Packet Publishing 2019.

References:

Reference Books:

1. Conlan C, "Algorithmic Trading with Python: Quantitative Methods and Strategy Development" United States: Independently Published, 2020.
2. Satya R. Chakravarthy and Palash Sarkar, "An Introduction to Algorithmic Finance, Algorithmic Trading and Blockchain", Emerald Publishing, Bingley, 2020.

Journals:

1. Journal of Financial Markets
2. Journal of Financial and Quantitative Analysis (JFQA)
3. Journal of Portfolio Management
4. Journal of Computational Finance

Video References:

1. https://www.youtube.com/watch?v=f911dDCELX4
2. https://www.youtube.com/watch?v=5iuF42s6zNo
3. https://www.youtube.com/watch?v=kFnUxQ2OQgk
4. https://www.youtube.com/watch?v=u3aJCJSunWA
5. https://www.youtube.com/watch?v=9Y3yaoi9rUQ

MOOC/SWAYAM/NPTEL Courses:

1. https://nptel.ac.in/courses/110104169
2. https://nptel.ac.in/courses/110107144

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4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CB601.1	Recognize the trends and benefits of algorithmic trading
R19CB601.2	Analyze various order types and trading strategies
R19CB601.3	Appraise the system architecture for algorithmic trading
R19CB601.4	Obtain knowledge related to risk management in algorithmic trading
R19CB601.5	Understand the importance of audit and compliance process

R19CB602	Business Simulation	L	T	P	C
		3	0	0	3

1. Course Description:

Business Simulation is built around a computer-based business simulation of a technology company start-up. Students on the course are formed into company teams of six or so members who will self-allocate themselves into the different board of director roles (Strategy, Finance, Marketing, Operations, HR/Organisation and Innovation) to manage their simulated company through a series of five simulation rounds that represent two years in the life of the company.

2. Course Objectives:

1. Gain an understanding of integrating business management principles and practice the theory in an interdisciplinary environment
2. Develop skills that are necessary to solidify a business situation using what-if scenarios
3. Obtain the knowledge and skill to analyze a business process – not just at high-level.
4. Work as a member of a team in completing everyday business tasks and making decisions relating to the overall operation of the business and growth of the business.
5. Apply critical thinking and problem-solving skills in a rapidly evolving environment

3. Syllabus:

Unit-I: Basic Simulation Modeling

The Nature of Simulation Systems: Models and Simulation with ExtendSim, Simulation of a Single Server Queuing System Simulation of an Inventory System Simulation with ExtendSim, Parallel/ Distributed Simulation, Steps in a Simulation Study Other types of Simulation

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Unit-II: – Simulation Software

Introduction, Classification, Desirable Software Features, Simulation Software Demonstration, Simulation Software Demonstration

Unit-III: Probability and Statistics

Random Variables, Simulation Output Data and Stochastic Process, Simulation Output Data and Stochastic Process, Case studies, MODELNG COMPLEX SYSTEMS, List Processing in Simulation

Unit-IV: Simulator

Introduction to discrete event simulation and ExtendSim, ExtendSim Simulation, A panorama of ExtendSim models, Stochastic Optimization, Combining Solver and @Risk

Unit-V: System Design

Process Analysis and Variability, Staffing Small Service Systems, Staffing Large Service Systems, Network models, Comparison of Alternative Systems, Routing in Service Systems

Text Books:

1. Business simulation A Complete Guide-2020 Edition by Gerardus Blokdyk 2020.
2. Business Process Modeling, Simulation and Design Hardcover – 26 December 2018
3. Simulation Modelling Comcepts,Tools and Practical Business Applications by Andrew Greasley 2023

References:

Reference Books:

1. Contributions on Applied Business Research and Simulation Studies Mariya Gubareva (Editor) , Orlando Gomes (Editor),2020
2. The Big Book of Simulation Modeling:Multimethod Modeling with AnyLogic 8, Dr. Andrei Borshchev, Ilya Grigoryev,2019
3. Modeling and Simulation in Complex Project Management, Sergey Suslov, Dmitry Katalevsky2002.

Journals:

1. Journal of Marketing Research
2. Journal of International Marketing
3. Journal of Vacation Marketing
4. Journal of Academy of Marketing Science

Video References:

1. https://www.youtube.com/watch?v=FO_nOu1nhcs

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2. https://www.youtube.com/watch?v=lP0cUBWTgpY
3. https://www.youtube.com/watch?v=kMfXH2vuPX0
4. https://www.youtube.com/watch?v=wYMh0nHCKKk
5. https://www.youtube.com/watch?v=oxN6FYjBDso

MOOC/SWAYAM/NPTEL Course:

1. https://onlinecourses.nptel.ac.in/noc20_mg05/preview/

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CB602.1	Develop a managerial approach to analyzing business problems.
R19CB602.2	Apply the skills necessary to develop corporate, business level and functional level strategies that will create competitive advantages and be able to defend their selection for a particular business situation
R19CB602.3	Demonstrate an ability to apply general management know-how as a member of a team in a simulated business setting.
R19CB602.4	Apply critical thinking and problem-solving skills in a rapidly evolving environment
R19CB602.5	Apply problem solving processes within a business context

R19CB603	Principles of Taxation	L	T	P	C
		3	0	0	3

1. Course Description:

This course provides an in-depth understanding of the principles and practices of taxation. It covers various types of taxes, the legal and regulatory framework governing taxation, and the impact of taxes on business decisions.

2. Course Objectives:

1. Understand the fundamental principles of taxation.
2. Analyze different types of taxes and their implications for businesses.
3. Apply tax laws and regulations in practical scenarios.
4. Evaluate the impact of tax policies on business strategy and operations.
5. Develop skills to engage with tax professionals and authorities effectively.

3. Syllabus:

Unit-1: Introduction to Taxation

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Definition and purpose of taxation, History and evolution of taxation, Key concepts in taxation; Types of Taxes: Income tax, Corporate tax, Sales and use tax, Property tax, Value-added tax (VAT) and Goods and Services Tax (GST)
Unit-II: Taxation of Individuals
Income Tax for Individuals: Taxable income, Deductions and exemptions, Tax credits, Filing status and requirements, Tax rates and brackets; Tax Planning for Individuals: Retirement accounts and tax implications, Estate and gift taxes, Tax-efficient investment strategies, Health savings accounts (HSAs), Education-related tax benefits
Unit-III: Corporate Taxation
Corporate Income Tax: Taxable income for corporations, Deductions for businesses, Tax credits and incentives, Depreciation and amortization, corporate tax rates and compliance; International Taxation: Taxation of multinational companies, Transfer pricing, Tax treaties and agreements, Foreign tax credits, Base erosion and profit shifting (BEPS)
Unit-IV:Tax Administration and Compliance
Tax Filing and Reporting: Tax forms and filing requirements, electronic filing and recordkeeping, Deadlines and penalties, Role of tax authorities, Common filing errors and how to avoid them; Tax Audits and Dispute Resolution, Process of tax audits, Handling tax disputes, Legal recourse and appeals, Documentation and evidence, Working with tax professionals
Unit-V: Tax Policy and Economic Impact
Tax Policy Analysis: Principles of tax policy, Impact of taxation on economic behavior, Tax reform and policy changes, Comparative tax systems, Political and social considerations in tax policy; Fiscal Policy and Taxation: Relationship between taxation and government spending, Taxation and economic growth, Equity and efficiency in taxation; Case Studies in Taxation: Analysis of real-world tax issues, Lessons from notable tax cases, Group presentations on tax scenarios
Text Books:
1. "Federal Income Taxation" by Joseph Bankman, Thomas D. Griffith, and Katherine Pratt 2. "Principles of Taxation for Business and Investment Planning" by Sally Jones and Shelley Rhoades-Catanach 3. Taxation: Finance Act 2023" by Alan Melville
References:
Reference Books: 1. "International Taxation in a Nutshell" by Mindy Herzfeld and Richard L. Doernberg

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2. "Taxation for Decision Makers" by Shirley Dennis-Escoffier and Karen A. Fortin
3. "South-Western Federal Taxation: Comprehensive Volume" by William H Hoffman, Jr., James C. Young, William A. Raabe, and David M. Maloney

Journals:

1. The Journal of Taxation
2. Tax Law Review
3. The National Tax Journal
4. Tax Notes

Video References:

1. https://www.youtube.com/watch?v=cXX8pBPU8tU
2. https://www.youtube.com/watch?v=LX9L0Rxa7ww
3. https://www.youtube.com/watch?v=d5YhN8o4j9A
4. https://www.youtube.com/watch?v=pmAcG9GxnwY
5. https://www.youtube.com/playlist?list=PLerzWq9nGRYciYtps9nWhdHiJG2bUigt
6. https://www.youtube.com/watch?v=wZ8A81tI3XQ

MOOC/SWAYAM/NPTEL Course:

1. https://nptel.ac.in/courses/112107209

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CB603.1	Demonstrate a solid grasp of taxation fundamentals, encompassing the essential purpose and historical evolution of taxation
R19CB603.2	calculate taxable income for individuals, apply deductions, exemptions, and tax credits, and strategize tax planning techniques tailored to individual circumstances,
R19CB603.3	Analyze corporate taxation principles, including taxable income determination, deductions, and incentives, as well as navigate international tax issues
R19CB603.4	Develop practical skills in tax filing, reporting, and compliance, including understanding tax forms, electronic filing, and audit procedures,
R19CB603.5	Analyzation of Tax Policy and Economic Impact

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R19CB604	Strategic Business Leader	L	T	P	C
		3	0	0	3

1. Course Description:

Explore the multifaceted landscape of modern business through this comprehensive course. Delve into the realms of Leadership and Governance, analyzing leadership qualities, organizational culture, and ethical standards. Understand the intricacies of Strategy and Risk, navigating environmental challenges, competitive forces, and risk management strategies. Embrace the transformative power of Technology and Data Analytics, exploring cloud computing, big data, and IT security. Gain insights into Organizational Control, Audit, and Finance, mastering management systems, compliance, financial analysis, and decision-making techniques.

2. Course Objectives:

1. Understand leadership qualities and ethical codes for effective organizational governance.
2. Analyze strategic choices and manage risks for sustainable competitive advantage.
3. Utilize technology and analytics for enhancing organizational performance and innovation.
4. Implement control mechanisms and financial analysis for informed decision-making and compliance.
5. Foster innovation, manage change, and develop professional skills for organizational excellence.

3. Syllabus:

Unit-I: Leadership and Governance

Leadership: Qualities of leadership, Leadership and organizational culture, Professionalism, ethical codes and the public interest; Governance: Agency, Stakeholder analysis and organisational social responsibility; Governance, scope and approaches; Reporting to stakeholders; The board of directors; Public sector governance.

Unit-II: Strategy and Risk

Strategy: Concepts of strategy, Environmental issues, Competitive forces, The internal resources, capabilities and competences of an organisation, Strategic choices; Risk: Identification, assessment and measurement of risk, Managing, monitoring and mitigating risk.

Unit-III: Technology and Data Analytics

Technology: Cloud and mobile technology, Big data and data analytics, E- business value chain, IT systems security and control.

Unit-IV: Organisational control and audit, Finance in planning and decision-making

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Organisational control: Management and internal control systems, Audit and compliance, Internal control and management reporting; Finance: Function, Financial analysis and decision-making techniques, Cost and management accounting.

Unit-V: Innovation, Performance Excellence and Change Management

Enabling success: Organising, disruptive technologies, talent management, performance excellence; Managing strategic change; Innovation and change management; Leading and managing projects; Professional skills: Communication, Commercial acumen, Analysis, Scepticism and Evaluation.

List of Laboratory Experiments:

1. Written Case Study Analysis - Analyze a case study on leadership and ethics, proposing solutions.
2. Stakeholder Engagement Exercise - Develop a stakeholder engagement plan for a given scenario.
3. Strategic Decision Analysis - Analyze a case study, develop a strategic plan with risk mitigation.
4. Risk Assessment Report - Conduct a risk assessment, and propose mitigation strategies in a report.
5. Data Analytics Project Proposal - Propose a data analytics project with objectives and methodology.
6. Internal Control Assessment - Assess internal controls, propose improvements in an audit report.

Text Books:

1. Organizational Culture and Leadership, 5th Edition by Edgar H. Schein with Peter Schein, Wiley Publishers.
2. "Strategic Management: Concepts and Cases" by Fred R. David and Forest R. David, Pearson, 2015
3. Innovation and Entrepreneurship" by Peter F. Drucker, Harper & Row, 1985

References:

Reference Books:

1. Journal of Leadership & Organizational Studies Financial Management by I.M. Pandey, Vikas Publishing House PVT Ltd.
2. Big-Data Analytics for Cloud, IoT and Cognitive Computing by Kai Hwang, Min Chen, Wiley
3. Publishers
4. Managing Innovation and Change by David Mayle, Sage publishing

Journals:

1. Strategic Management Journal

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2. Financial Analysis Journal

Video References:

1. https://www.youtube.com/watch?v=lmyZMtPVodo
2. https://www.youtube.com/watch?v=u6XAPnuFjJc
3. https://www.youtube.com/watch?v=4y_kGc1GdhQ

MOOC/SWAYAM/NPTEL Course:

1. https://onlinecourses.nptel.ac.in/noc19_mg34/preview

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CB604.1	Apply leadership qualities and ethical codes to foster effective governance within organizational contexts.
R19CB604.2	Apply strategic thinking to assess competitive forces and manage risks for organizational sustainability and growth.
R19CB604.3	Analyze the impact of technology and data analytics on organizational performance and innovation across the e-business value chain.
R19CB604.4	Analyze organizational control mechanisms and financial data to inform decision-making processes and ensure compliance with regulatory standards.
R19CB604.5	Analyze strategies for fostering innovation, managing change, and developing professional skills to enhance organizational performance and adaptability.

R19CB605	Information Systems Audit and Control	L	T	P	C
		3	0	0	3

1. Course Description:

This subject allows students to acquire, in pedagogic terms, the basic core knowledge of the field of Information Systems Audit and Control, the audit process and the protection of information, consistent with the ISACA Model Curriculum (Note 1), and to develop, in pragmatic terms, the necessary background and skills needed to enter the Information Systems Audit and Control profession.

2.Course Objectives:

1. Introduce students to the fundamental concepts, procedures and standards of IS audit and controls;
2. Describe the qualifications needed to enter and become successful in this field
3. Develop students' practical skills in handling various types of IS audits and examining the IS controls

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4. Prepare students to develop generic skills in communication, individual and team works
5. Study the case analysis and reporting, and creative problem solving

3.Syllabus:

Unit-I: Introduction

Introduction: Information systems and auditing, Conducting an information system audit

Unit-II: The Management Control Framework

The Management Control Framework: Top Management Controls, Systems Development Management controls, Programming Management Controls, Data Resource Management Controls, Security Management Controls, Operations Management Controls, Quality Assurance Management Controls

Unit-III: Application Control Framework

The Application Control Framework Boundary Controls, Input Controls, Communication Controls, Processing Controls, Database Controls, Output Controls

Unit-IV: Evidence Collection and Evaluation

Evidence Collection and Evaluation - Audit Software - Code Review, Test Data, and Code Comparison - Concurrent Auditing Techniques 9 17 - Interviews, Questionnaires, and Control Flowcharts - Performance Measurement Tools - Evaluating Asset Safeguarding and Data Integrity - Evaluating System Efficiency and Effectiveness

Unit-V: Information System Audit and Management

Information System Audit and Management Managing the Information systems audit function, Practical: Carry out the audit of an IS.

Text Books:

1. Ron Weber- Information Systems Control and Audit
2. Wendy Robson -Strategic Management & Information Systems
3. Mohan Bhatia- Auditing in a Computerized Environment
4. Chris Davis -IT Auditing: Using Controls to Protect Information Assets

References:

Reference Books:

1. Hunton, J.E., Bryant, S.M., and Bagranoff, N.A., Core Concepts of Information Technology Auditing, John Wiley & Sons, 2004
2. Champlain, J.J., Auditing Information Systems, John Wiley, 2003
3. CISA Review Manual, ISACA

Web Resource:

1. ISACA publications including IS Audit & Control Journal

4.Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CB605.1	Understand the role of the IS auditor and the IS audit function
R19CB605.2	Understand the purpose of controls in an information systems environment
R19CB605.3	Learn how access to systems, resources, and data can be controlled

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R19CB605.4	Understand some of the basic theory underlying computer security policies, models, and problems
R19CB605.5	Understand the basic issues in auditing computer security policies and mechanisms

R19CS651	Application Development using Java	L	T	P	C
		2	0	2	3

1. Course Description:

This course provides students with a comprehensive understanding of the principles, mechanisms and advanced features of the Java programming language. Starting with the Foundations of Java, students will build a solid understanding of basic syntax, data types, control structures, and object-oriented concepts. They will explore into Object-Oriented Mechanisms, mastering topics such as classes, objects, inheritance, polymorphism and encapsulation. The course also covers essential Java libraries and features, including Strings, Collections, Java 8 Features, Exception Handling, and Multithreading. Additionally, students will explore JavaFX for graphical user interface (GUI) development and JDBC for database connectivity, enhancing their proficiency in Java application development.

2.Course Objectives:

1. To understand object-oriented programming concepts and the basics of java programming language
2. To know the principles of packages, inheritance and interfaces
3. To understand strings & collections with java 8 features
4. To develop a Java application with exception handling and threads
5. To develop windows-based applications with jdbc

3.Syllabus:

Unit-I: Foundations of Java

Overview of OOP , Object oriented programming paradigms , Features of Object Oriented Programming; Java Buzzwords ; Overview of Java , JVM , JDK ; Programming Structures in Java , Objects & Classes in Java , Data Types, Variables , Operators , Keywords , Control Statements; Wrapper Classes ; Constructors , Methods , Access specifiers , Garbage Collection ; Arrays & its types ; java.util.Arrays ; Java Doc comments ; I/O classes

Unit-II: Object Oriented Mechanisms

Association, Aggregation, Composition, Polymorphism; Inheritance, Basics, Types of Inheritance, Super, static & final keywords with inheritance and polymorphism; Overloading Vs Overriding , Static and Dynamic Binding ; Abstraction , Abstract Classes and Interfaces , Encapsulation , Packages , Access modifiers

Unit-III: Strings, Collections & Java 8 Features

Types of Classes in Java, Strings, creation, declaration of a string , Mutable & Immutable Strings , Storage structure of a string and its methods, StringBuilder , String Buffer, regex ; Collection Interface ; Generics - List, Set, Map interfaces and classes, Comparable ,

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Comparator ; Java lambda expressions , Date & time Object in java 1.8 and its functions, Streams

Unit-IV: Exception Handling and Multithreading

Exception handling, Hierarchy, Types of exceptions, Mechanisms - try, catch, throw, throws and finally, Exception Propagation, Exception in Inheritance; Introduction to Multiprocessing, threads vs process, threads, Creation of thread , Thread states , Thread Lifecycle and its methods, Executor Framework, Concurrency API, Synchronization Blocks

Unit-V: JAVAFX & JDBC

JAVAFX Events and Controls: Event Basics, Handling Key and Mouse Events; Controls: Checkbox, Toggle Button, Radio Buttons, List View, Combo Box, Choice Box, Text Controls, Scroll Pane. Layouts, Flow Pane, HBox and VBox, Border Pane, Stack Pane , Grid Pane; Menus , Basics , Menu bars , Menu Item ; JDBC – drivers, Steps to create a JDBC application , DB Connection Pool

Text Books:

1. Herbert Schildt, "Java: The Complete Reference", 12th Edition, McGraw Hill Education, New Delhi, 2019
2. Cay S.Horstmann, "Core Java Fundamentals", Volume 1, 11th Edition, Prentice Hall, 2018

References:

References Books:

1. Deitel P and Deitel H, "Java: How to Program", 11th Edition, Prentice Hall, 2018
2. James Gosling, Bill Joy, Guy Steele, Gilad Bracha, Alex Buckley and Daniel Smith, "The Java Language Specification – Java SE", 13th Edition, Oracle America Inc., USA, 2019
3. Matt Weisfeld, "The Object-Oriented Thought Process", 5th Edition, Addison-Wesley Professional, US, 2019

Video References:

1. https://www.youtube.com/@abdul_bari/videos
2. https://www.youtube.com/@JennyslecturesCSIT
3. https://caveofprogramming.teachable.com/p/java-multithreading

MOOC/ NPTEL/ SWAYAM Courses:

1. https://www.udemy.com/course/java-se-programming/
2. https://cse.iitkgp.ac.in/~dsamanta/java/index.htm
3. https://caveofprogramming.teachable.com/p/java-for-complete-beginners

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CS651.1	Understand the core concepts of Java programming
R19CS651.2	Understand the principles of object-oriented programming
R19CS651.3	Understand the concepts of strings and collections
R19CS651.4	Apply exception-handling & multithreading concepts in applications
R19CS651.5	Apply JavaFX & JDBC in application development

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R19CS652	Database Technologies	L	T	P	C
		2	0	2	3

1.Course Description:

This course offers a comprehensive exploration of Database Management Systems (DBMS) theory, focusing on essential concepts and principles underlying the design, implementation and optimization of databases. Students will explore into various topics, including an Introduction to Databases, Structured Query Language (SQL) & Procedural Language/SQL (PL/SQL), Transaction and Concurrency Control, Storage & Indexing, and NoSQL databases. The students will gain a deep understanding of database architectures, data modelling techniques, query languages, transaction management strategies, storage mechanisms, indexing methods and the role of NoSQL databases in modern data management.

2.Course Objectives:

6. To enable students to understand the fundamental concepts and principles of database management.
7. To teach students to master the database querying and programming using SQL and PL/SQL
8. To foster students to learn the principles and mechanisms of transaction processing and concurrency control
9. To familiarize students to design and implement efficient database storage and indexing solutions
10. To acquaint students to effectively use NoSQL databases to build scalable, high-performance applications

3.Syllabus:

Unit-I: Introduction to Databases

Purpose of Database – Types and examples of Databases (RDBMS, NOSQL, In-memory Databases & Distributed SQL databases)– Relational Database System Architecture - Views of Data– Schema architecture – Data Independence – Schema and instance- Data Models–Benefits and Phases of Data Model - ER Diagram - Symbols, Components, Relationships, Weak entities, Attributes, Cardinality - Extended ER Diagram – Examples- Relational Data Model – Keys - Relational Algebra-Normalization - 1NF, 2NF, 3NF, BCNF,4NF,5NF

Case Study: ER Diagram on Online Streaming, Movie Ticket Recommendation, Bike Tracking

Unit-II: SQL & PL/SQL

SQL Fundamentals – DDL Commands - Create, Drop, Alter, Truncate, Rename, Keys - Primary Key, Candidate Key, Super Key, Foreign Key – DML Commands – DQL Commands - Select, Insert, Update, Delete, Any, All, In, Exists, Non-Exists, Union, Intersection, Advanced SQL Features – Aggregate Functions - SUM, COUNT, AVG, MIN, MAX, EXPLAIN, COALESCE

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- Clauses – Order By - Group By, Having, CASE, LIMIT,WITH Clause, Date Functions, String Functions -Subqueries - Nested, Correlated, Joins- Inner, Outer, and Equi-Joins - Order of Execution, Embedded SQL- Dynamic SQL. Creation and Dropping of Views, Types of Views - Creation and Execution of Stored Procedures - Cursors - Opening, Fetching, and Closing - Triggers - Creation, Insertion, Deletion, and Updating Database - Exception Handling - MySQL JDBC Connectivity

Case Study: Online Streaming, Movie Ticket Recommendation, Bike Tracking, Import/Export Random records from CSV file to MYSQL

Unit-III: Transaction and Concurrency Control

Transaction processing - ACID Properties - Failure and Recovery – Schedules – Serializability - Concurrency Control –Lock-based protocol - Isolation levels - SQL Facilities for concurrency and recovery- Database Integrity, Security and Authorization

Case Study: ACID Properties in Online Streaming Database

Unit-IV: Storage & Indexing

Overview of Storage Techniques – File organization - RAID –Indexing - Types of ordered indices - B & B+ tree – Hashing - Static & Dynamic Hashing - Query Processing & Optimization – SQL Performance Tuning

Case Study: Indexing in Online Streaming Database to optimize the retrieval of data

Unit-V: NOSQL

Need for NO SQL – Characteristics of NOSQL - Key-value database - Columnar Databases - Apache Cassandra – Click House– Document Databases - MongoDB – CRUD operations with MongoDB - MongoDB JDBC Connectivity –MongoDB Testing - Graph Databases – Metabase

Case study: Conversion of Online Streaming Database (RDBMS) to MongoDB

4.List of Laboratory Experiments / Exercises:

Design a project for the following application using JDBC Connectivity

- Online Food Ordering System
- Online Movie Ticket Booking System
- Online Parking System
- Online Hotel Room Booking System

3 ER Diagrams

Create an Entity Relationship model for the above applications

4 SQL Queries

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Develop the SQL Queries using the following commands for the database

a. DDL commands - Create, alter (Add, Modify, Rename), Truncate, Drop commands

b. DML commands - Insert, Update, and Delete commands

c. DQL commands - Select and its basic operations

d. DCL commands - Commit, Rollback, and Savepoint operations

e. TCL commands - Grant and Revoke operations for the different users

3 Implementation of Key constraints

b. Build the Integrity Constraints - Unique, NOT NULL, Auto Increment, Primary Key, Foreign Key, Check, Default constraints for the given databases

4 Advanced SQL Queries

Implementation of Aggregate Functions

e. Find the total count of all the records in the table

f. Find the average value of a specific column in the table

g. Find the maximum/min/sum value of a specific column in the table

h. Find the count of all distinct values in a specific column in the table

5 Implementation of Group By Clause

c. Find the average/max/min/sum of all values of a specific column for each group records in the table

d. Find the count/average/max/min of all records in the table grouped by multiple columns

6 Implementation of OrderBy Clause

d. Sort the list of all records in the table by multiple columns/specific columns in ascending or descending order

e. Find the top/ bottom 10 records in the table sorted by a specific column/multiple columns

f. Find the list of all records in the table sorted by a specific column/multiple columns and limited to a certain range

7 Implementation of String Functions

j. Find the length of characters in a specific string

k. Find the leftmost/rightmost portion of a specific string up to a certain character or length

l. Find the specific portion of a string extracted using a regular expression pattern

m. Find the specific string with all occurrences of a certain

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character or pattern replaced with another character or string

n. Find the specific string converted to uppercase or lowercase

o. Find the specific string with leading or trailing whitespace characters removed

p. Find the specific string with a certain character or substring removed or replaced

q. Find the specific string with a certain character or substring added at a certain position

r. Find the specific string with all occurrences of a certain substring concatenated with another substring

8 Implementation of Date function

h. Find the current date and time in MySQL

i. Find the day of the week for a specific date in MySQL

j. Find the month/year for a specific date in MySQL

k. Find the difference between two specific dates in MySQL

l. Find the date in MySQL after adding/subtracting a specific number of days to a specific date.

m. Find the number of days/average time between two specific dates in MySQL

n. Find the earliest or latest date in a specific column of the table in MySQL

9 Implementation of Nested queries

d. Find the maximum/min/count/sum/average/distinct count value of a specific column in the table for a specific subset of records selected using a nested query

e. Find the average/max/sum/count/min value of a specific column in the table where the value of another column is equal to a specific value selected using a nested query

f. Find the maximum value of a specific column in the table for a specific subset of records selected using a nested query within another nested query

10 Implementation of Joins

b. Find the result of an inner/left/right/full outer/cross joins between two/multiple tables on a specific column in MySQL

11 Construction of Index

a. Create an index for the database and show the comparative analysis of Query execution time with and without using an index for the given scenario

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12 Implementation of views

d. Perform the DDL, DML, and DQL operations on the views and check the consistency of the relations

e. Create different types of views and their categories of the REFRESH command.

f. Implement the materialized views with Aggregate and Join queries

13 PLSQL

Develop a program in PLSQL using Before/After trigger, row, and statement trigger and instead of trigger

c. Develop a program in PLSQL using Before/After trigger, row, and statement trigger and instead of trigger.

d. Create a trigger and check for the before/after insertion, update, and deletion operations in the table.

14 NOSQL

Implementation of MongoDB application and run through CRUD operations

f. Command to create a collection and a document in MongoDB

g. Command to insert/update/delete a document in a MongoDB collection

h. Command to query a MongoDB collection to retrieve documents that meet certain criteria

i. Command to use aggregation pipelines to perform more complex queries in MongoDB

j. Command to create an index in MongoDB to improve query performance

15 Create tables and execute the queries using Click House

e. Command to create a table, view, and functions

f. Command to insert the data in a table from compressed files, Infiles, and multiple files

g. Command to query the data using the SELECT, WHERE, JOIN, GROUPBY, HAVING clauses command to query the data using the Regular, Aggregate, and Table functions

Text Books:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan —" Database System Concepts", Sixth Edition, Tata McGraw Hill, 2013
2. Ramez Elmasri, Shamkant B. Navathe —" Fundamentals of Database Systems", Sixth Edition, Pearson Education, 2014

References:

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References Books:

1. C.J.Date, A.Kannan, S. Swamynathan, —" An Introduction to Database Systems", Eighth Edition, Pearson Education, 2013
2. Krisitna Chodorow, "MongoDB – The Definitive Guide", O' Reilly, 2013

Video References:

1. https://www.youtube.com/playlist?list=PLsjUcU8CQXGFFAhJI6qTA8owv3z9jBbpd
2. https://www.youtube.com/watch?v=c5HAwKX-suM
3. https://youtu.be/FNYdBLwZ6cE
4. https://youtu.be/qEhNHOEa5sE

MOOC/ NPTEL/ SWAYAM Courses:

1. https://onlinecourses.NPTEL.ac.in/noc23_cs41/preview
2. https://codewithmosh.com/p/complete-sql-mastery
3. https://www.udemy.com/course/nosql-databases-for-beginners/

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CS652.1	Use data models and depict a database system
R19CS652.2	Design relations for various business requirements
R19CS652.3	Understand the properties of the database and recovery process
R19CS652.4	Understand the optimization techniques in database storage
R19CS652.5	Design non-structured database systems in application development

R19CS653	Full Stack Technologies	L	T	P	C
		2	0	2	3

1. Course Description:

This is a comprehensive course designed to equip students with the knowledge and skills required to become proficient full-stack developers. The course covers essential front-end and back-end technologies, including HTML5, CSS3, JavaScript, React.js, Node.js with Express.js, Spring Boot backend framework, and fundamentals of MongoDB. Through a combination of theoretical lectures, hands-on coding exercises, and real-world examples, students will gain a deep understanding of each technology's role in the development process and how they work together to build modern web applications

2. Course Objectives:

1. To empower students to design, develop, and deploy dynamic web applications using HTML5, CSS3, and JavaScript
2. To introduce students to build fast, scalable, and maintainable front-end applications using ReactJS

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3. To familiarize students with the skills to effectively use MongoDB to build robust, scalable, and data-driven applications
4. To acquaint students to build scalable and efficient web applications using Node.js and Express.js
5. To equip students with the skills to master Spring Boot's core features

3.Syllabus

Unit-I: HTML5, CSS3 and JavaScript

Full Stack Application: component; HTML5: tags, attributes, properties, importance of semantic HTML, classes; CSS3: CSS3 syntax, properties, borders, text, image, grid layout, media queries, animations; Types of CSS frameworks; Overview of JavaScript: advanced working with functions; JavaScript namespaces; Prototypes; Error handling; Modules in JavaScript

Case Study: Website design for an automobile industry

Unit-II: ReactJS

ReactJS: library, directory; React components: types of Components, component composition, component styling, adding styles, component intercommunication, data sharing, routing; Hooks: states, hooks vs states, types of Hooks; React bootstrap: props, router

Case Study: Portfolio development with authentication

Unit-III: MongoDB

MongoDB: features, environment; Data modelling: Schema creation using Mongoose (ODM), create database, data types, drop database; Collection: insert, query, update and delete; Projection: limiting records, sorting records, indexing and aggregation

Case Study: Design of a simple search engine

Unit-IV: Node JS and Express JS

NodeJS: node module system, Node Package Manager (NPM); ExpressJs: building RESTful API's; Advanced topics: asynchronous JavaScript, CRUD operations using Mongoose, mongo data validation, mongoose modeling relationships between connected data

Case Study: QR Code Generator application

Unit-V: Spring Boot

Spring Boot: configuration, spring data JPA, create spring data repositories for JPA, web application with Spring Boot, RESTful controllers, message converters, WAR / JAR deployment, creating a RESTful application, HTTP GET, PUT, POST, DELETE

Case Study: Real time message transfer application

List of Laboratory Experiments / Exercises:

1. Develop a music streaming web application to provide users with a seamless

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and interactive music listening experience. Users should be able to discover, play, and share their favourite music in real-time. The application should support multiple features such as user authentication, personalized playlists, real-time updates on trending tracks, and social sharing capabilities

2. Build a video conferencing web application that facilitates seamless communication between individuals or groups through high-quality video and audio interactions and supports real-time features, user authentication, screen sharing to enhance the overall video conferencing experience

3. Develop a dynamic and engaging social media platform web application that connects users globally. The platform aims to provide a seamless and real-time social experience, allowing users to connect, share content, and interact with each other and should incorporate features such as user profiles, real-time feed updates, multimedia content sharing, instant messaging, and community building

4. Create a web application that constitutes a dynamic Content Management System (CMS) tailored for blogging that allows users to effortlessly create, manage, and share blog content and provides an intuitive interface, support multimedia content, and facilitate collaboration among multiple authors

5. Build a web application designed to serve as a real-time Project Management Dashboard to streamline project management processes, enhance collaboration, and provide stakeholders with a dynamic and comprehensive view of project progress. The application should offer real-time updates, intuitive navigation, and advanced project tracking features.

6. Design a web application to perform real-time analytics for data-driven decision-making. This web application aims to empower users to analyze, visualize, and derive insights from streaming data that will be suitable for industries requiring instantaneous data processing, such as finance, e-commerce environments

7. Develop a web application designed to revolutionize the job search process to provide job seekers with real-time access to a diverse range of job opportunities, personalized recommendations, and interactive tools to streamline the entire job searching experience

8. To develop an online crowdfunding web application to facilitate real-time creative financing for innovative projects. which acts as a catalyst for novel ideas by providing a dynamic platform where creators can present their visions, attract support, and turn aspirations into tangible achievements

9. Build a To-Do List web application elevates the task management experience through real-time collaboration and user authentication. This application provides users with an intuitive platform for creating, organizing, and

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collaborating on to-do lists in real-time, ensuring secure access and personalized task management

10. Develop a chat web application to facilitate real-time communication and collaboration. The web application aims to provide users with a seamless and interactive platform for one-on-one and group chats, ensuring instant messaging, multimedia sharing, and a user-friendly experience

11. Develop a comprehensive web application to empower users with a real-time expense tracking system for efficient money management that constitutes users with a user-friendly interface, real-time financial insights, and personalized budgeting features to help them make informed financial decisions and achieve their financial goals

12. Design a gaming web application that offers a real-time multiplayer gaming experience to provide users with a diverse range of games, interactive features, and a social gaming environment, allowing players to connect, compete, and collaborate in real-time

Project:

Develop a project for any of the above use cases using the MERN stack

Text Books:

1. Vasan Subramanian, 'Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node', Second Edition, Apress, 2019
2. Brad Dayley, Brendan Dayley, Caleb Dayley, 'Node.js, MongoDB and Angular Web Development', Addison-Wesley, Second Edition, 2018

References:

1. Chris Northwood, 'The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer', Apress; 1st edition, 2018.
2. Kirupa Chinnathambi, 'Learning React: A Hands-On Guide to Building Web Applications Using React and Redux', Addison-Wesley Professional, 2nd edition, 2018.

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CS653.1	Build dynamically enriched web pages with HTML5, CSS3, and JavaScript
R19CS653.2	Implement data handling and fetching in React applications using state management libraries
R19CS653.3	Develop a web application with MongoDB as the backend

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R19CS653.4	Develop ExpressJS applications that define routes and handle HTTP requests and responses
R19CS653.5	Develop RESTful APIs with Spring Boot for resource representation, HTTP methods and error handling

R19CS654	Fundamentals of Python Programming	L	T	P	C
		2	0	2	3

1.Course Description:

This course covers the fundamental concepts and practical applications of Python programming. Students will explore topics ranging from basic data types and expressions to advanced data manipulation and visualization techniques. The course will delve into programming paradigms, emphasizing Python's versatility in supporting imperative, functional, and object-oriented programming styles. Through hands-on exercises, projects, and real-world examples, students will develop a strong foundation in Python programming, enabling them to write efficient, readable, and maintainable code for various applications.

2.Course Objectives:

1. To learn to solve simple problems with Python programs
2. To choose and use data structures such as lists, tuples, dictionaries and sets in Python programs
3. To understand file operations in Python
4. To implement object-oriented programming constructs in Python
5. To learn to use libraries for data analysis in Python and use Django framework for web application development

3.Syllabus

Unit-I: Python Constructs

Introduction: Python Interpreter and interactive mode, Comments, Identifiers and Keywords; Data Types; Variables and Expressions; Operators; Conditional Statements; Looping Statements; Fruitful Functions; Lambda Function

Illustrative Programs: Financial application, sandwich vowel, and Chocolate Distribution Algorithm

Unit-II: Lists, Tuples, Dictionaries and Set

Lists: operations - Processing Array elements, slices, methods, loop, mutability, aliasing, cloning, parameters, lists as arrays; Tuples: assignment, tuple as return value; Dictionaries: operations and methods; Sets: operations;

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Illustrative Programs: Dutch National Flag Algorithm, Count and Say Problem and Kadanne's Algorithm
Unit-III: Files, Modules and Packages
Files: text files, reading and writing files; Format Operator; Command Line Arguments; Error and Exception Handling; Modules; Packages; Locating path of modules – Python Date – Python Regex. Illustrative Programs: Bank Management application using File concept
Unit-IV: OOP and Databases
Object, class, constructor, inheritance, abstraction, polymorphism, encapsulation; MongoDB: Environmental Setup, creating new Database, CRUD Operations, Python DB connectivity Application: Event management using MongoDB, Real Estate management using MongoDB.
Unit-V: Data Analysis and Web Frameworks
NumPy: Basics of NumPy Arrays, Computations: Universal Functions, Aggregations: Min-Max and Everything in Between; Pandas: Objects, Data Indexing and Selection, Data Operations, Handling Missing Data; Matplotlib: Types of plots, Simple Line Plots, Boxplots, Simple Scatter Plots; Django: Overview, Introduction to MVC and MVT architecture in Web development, Django folder structure, generic views, HTML templates Illustrative Programs: Graph Plotting for performance Analysis, form design, webpage design
List of Laboratory Experiments / Exercises:
1. Create a Python application that uses expressions and control flow statements to automate a common task. Ensure that your application is user-friendly and robust to different inputs. Suggested Problems: Swap two numbers without a temporary variable, Quadratic Equation, Valid Palindrome 2. Implement a Python program that simulates a real-world system or process using conditions and iterative loops. Suggested Problems: check whether an alphabet is a vowel or consonant, sum of all even numbers from 0 to n, factorial of a number 3. Implementation of Strings in the program. Suggested Problems: Determine if string halves are alike, palindrome, character count, replacing characters

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4. Implementation of real-time/technical applications using Lists and Tuples.
   Suggested Problems: Minimum Index Sum of Two Lists, concatenate two lists index-wise, Tuple with the same product, Copy specific elements from one Tuple to a new tuple)

5. Implementation of real-time applications using Set and Dictionaries.
   Suggested Problems: Magic Dictionary, Longest Word in Dictionary, Set Mismatch and Smallest Number in Finite Set

6. Implementation of Functions in the program.
   Suggested Problems: Factorial, largest number in a list, area of shape

7. Implementation of file-handling operations.
   Suggested Problems: copy from one file to another, wordcount, longest word

8. Implementation of applications of standard libraries.
   Suggested Problems: Handle scalars to work on the NumPy array, Insert values at random positions in an array, Convert the index of a series into a column of a data frame, Combine many series to form a data frame, Get frequency counts of unique items of a series, Union of two arrays, Convert a NumPy array to a data frame of a given shape, Plotting datasets.
9. Implementation of OOP concepts in Python.

References:

References Books:

4. Al Sweigart, "Automate the Boring Stuff with Python: Practical Programming for Total Beginners," 2nd Edition, No Starch Press, 2019
5. Liang Y. Daniel, "Introduction to Programming Using Python," Pearson Education, 2017
6. Jake Vander Pla, "Python Data Science Handbook," O'Reilly (https://jakevdp.github.io/PythonDataScienceHandbook)
7. William S Vincent, "Django for Beginners: Build Websites with Python and Django," Welcome to Code Publishers, 2020

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CS654.1	Apply syntax and semantics of Python programming language for developing real-world applications

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R19CS654.2	Analyse Python solutions by implementing lists, tuples and dictionaries
R19CS654.3	Create file system applications with built in functions
R19CS654.4	Apply principles of OOP and MongoDB
R19CS654.5	Analyse data manipulation techniques and develop web pages with Django Framework

R19CS655	Competitive Coding Techniques	L	T	P	C
		2	0	2	3

1.Course Description:

This course is designed to enhance problem-solving and programming skills required for competitive programming and coding interviews. Students will explore advanced algorithms and data structures, and develop strategies for tackling complex coding challenges under time constraints.

2.Course Objectives

1. To understand the fundamentals of competitive programming`
2. To apply the advanced concepts data structures techniques
3. To apply the advanced algorithmic techniques in data structures
4. To apply the advanced searching and graph data structures techniques

3.Syllabus

Unit I: Introduction to Competitive Programming

Overview of Competitive Programming - Common Online Judges (Codeforces, AtCoder, CodeChef, etc.) - Input/Output techniques - Time and Space Complexity Analysis - Big O Notation - Common Complexity Classes - Basic Math and Number Theory for CP - Prime numbers, GCD, LCM, Factorization - Modular arithmetic - Introduction to Data Structures in CP (Arrays, Lists, Sets)

Unit-II: Advanced Data Structures

Stacks and Queues - Priority Queues and Heaps - Applications in CP - Trees and Graphs - Traversals (DFS, BFS) - Shortest Paths (Dijkstra's and Floyd-Warshall algorithms) - Advanced Data Structures (Segment Trees, Fenwick Trees) - Applications in CP - Disjoint Set Union (Union-Find)

Unit-III: Algorithmic Techniques

Greedy Algorithms - Applications in CP - Fractional Knapsack (Greedy) - Huffman Coding (Greedy) - Dynamic Programming (DP) - Bottom-up and Top-down DP - Knapsack Problems - Recursion and Memoization - Common DP Patterns - Examples of DP in CP -

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Divide and Conquer - Binary Search
Unit-IV: Advanced Searching and Graph Techniques
Advanced Searching Algorithms (Ternary Search, Binary Indexed Tree) - Bit Manipulation - Number Theory Algorithms (Sieve of Eratosthenes, Modular Inverse) - Combinatorial in CP - Graph Algorithms (Strongly Connected Components, Topological Sort) - Advanced Topics in Trees (LCA, Diameter)
Unit-V: Dynamic Programming Techniques
Advanced Dynamic Programming Techniques - Bitmask DP - State Compression - Convex Hull DP - Advanced Graph Algorithms - Network Flows (Ford-Fulkerson, Edmonds-Karp) - Minimum Spanning Trees (Kruskal, Prim) - Articulation Points and Bridges - Advanced Data Structures - Persistent Data Structures - Trie and Suffix Trees - Treap and Cartesian Tree - Applications in Competitive Programming - Computational Geometry - Line Sweep Algorithms - Closest Pair of Points - Convex Hull (Graham Scan, Jarvis March)
Text Books:
1. "Competitive Programming" (3rd Edition) by Steven Halim, Felix Halim, 2018 (3rd Edition)
2. "Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, 2009 (3rd Edition)

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CS655.1	Understand the fundamentals of competitive programming
R19CS655.2	Apply the advanced concepts in stack, queue and tree data structures techniques
R19CS655.3	Apply the advanced algorithmic techniques in data structures
R19CS655.4	Apply the advanced searching and graph data structures techniques
R19CS655.5	Apply the advanced dynamic programming techniques in data structures

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R19EC601	Discrete Time Signal Processing	L	T	P	C
		3	0	0	3

1. Course Description:

This course explores the fundamentals of discrete-time signal processing, focusing on the analysis and manipulation of digital signals. Students will learn techniques for sampling, filtering, and transforming signals using various algorithms. Practical applications and tools will be emphasized, equipping learners with skills for real-world signal processing challenges.

2. Course Objectives:

1. To learn discrete fourier transform, properties of DFT and its application to linear filtering
2. To understand the characteristics of digital filters, design digital IIR and FIR filters and apply these filters to filter undesirable signals in various frequency bands
3. To understand the effects of finite precision representation on digital filters
4. To understand the fundamental concepts of multi rate signal processing and its applications
5. To introduce the concepts of adaptive filters and its application to communication engineering

3. Syllabus:

Unit-I: Discrete Fourier Transform

Review of signals and systems, concept of frequency in discrete-time signals, summary of analysis & synthesis equations for FT & DTFT, frequency domain sampling, Discrete Fourier transform (DFT) - deriving DFT from DTFT, properties of DFT - periodicity, symmetry, circular convolution. Linear filtering using DFT. Filtering long data sequences - overlap save and overlap add method. Fast computation of DFT - Radix-2 Decimation-in-time (DIT) Fast Fourier transform (FFT), Decimation-in-frequency (DIF) Fast Fourier transform (FFT). Linear filtering using FFT.

Unit-II: Infinite Impulse Response Filters

Characteristics of practical frequency selective filters. characteristics of commonly used analog filters - Butterworth filters, Chebyshev filters. Design of IIR filters from analog filters (LPF, HPF, BPF, BRF) - Approximation of derivatives, Impulse invariance method, Bilinear transformation. Frequency transformation in the analog domain. Structure of IIR filter - direct form I, direct form II, Cascade, parallel realizations.

Unit-III: Finite Impulse Response Filters

Design of FIR filters - symmetric and Anti-symmetric FIR filters - design of linear phase FIR filters using Fourier series method - FIR filter design using windows (Rectangular, Hamming and Hanning window), Frequency sampling method. FIR filter structures - linear phase structure, direct form realizations.

Unit-IV: Finite Word Length Effects

Fixed point and floating point number representation - ADC - quantization - truncation and rounding - quantization noise - input / output quantization - coefficient quantization error - product quantization error - overflow error - limit cycle oscillations due to product quantization and summation - scaling to prevent overflow.

Unit-V: Introduction to Digital Signal Processors

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DSP functionalities - circular buffering – DSP architecture – Fixed and Floating point architecture principles – Programming – Application examples.

Text Book:

1. John G. Proakis & Dimitris G.Manolakis, —Digital Signal Processing – Principles, Algorithms & Applications‖, Fourth Edition, Pearson Education / Prentice Hall, 2007.

Reference Books:

1. Emmanuel C. Ifeachor & Barrie. W. Jervis, —Digital Signal Processing‖, Second Edition, Pearson Education / Prentice Hall, 2002.
2. A. V. Oppenheim, R.W. Schafer and J.R. Buck, —Discrete-Time Signal Processing‖, 8th Indian Reprint, Pearson, 2004.
3. Sanjit K. Mitra, —Digital Signal Processing – A Computer Based Approach‖, Tata Mc Graw Hill, 2007.
4. Andreas Antoniou, —Digital Signal Processing‖, Tata Mc Graw Hill, 2006..

Journals:

1. https://www.sciencedirect.com/journal/signalprocessing-journal
2. https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=92

Video References:

1. https://www.youtube.com/watch?v=oZSv68esbgI
2. https://www.youtube.com/watch?v=4cPkr1VHu7Q

MOOC/NPTEL/SWAYAM Course:

1. https://www.udemy.com/course/digital-signal-processing

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19EC601.1	Illustrate the concepts of Discrete Fourier Transform and its properties
R19EC601.2	Learn the design and characteristics of infinite impulse response (IIR) filters for filtering undesired signals
R19EC601.3	Learn the design and characteristics of finite impulse response (FIR) filters for filtering undesired signals
R19EC601.4	Explain the concepts of finite word length effects
R19EC601.5	Assess various applications in Multi-rate signal processing using various DSP processors

R19EC602	Principles of Analog and Digital Communication	L	T	P	C
		3	0	0	3

1. Course Description:

This course aims at designing Analog and Digital Communication Systems that are used for transmission of information from the source to the destination. A detailed framework for analog and digital communication techniques are addressed. The purpose of this course is to give hands on training to the students in understanding the theory of communication and practicing sessions used in analog and digital communication systems. This will enhance the understanding capability of the students.

2. Course Objectives:

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1. To analyze the principles and characteristics of various analog communication techniques.
2. To describe the operation and components of data communication systems, including pulse modulation techniques.
3. To apply knowledge of digital communication techniques.
4. To design and implement error control coding schemes.
5. To understand and utilize techniques for multi-user radio communication.

3. Syllabus:

Unit-I: Analog Communication

Introduction to Communication Systems – Modulation – Types – Need for Modulation. Theory of Amplitude Modulation – Evolution and Description of SSB Techniques – Theory of Frequency and Phase Modulation – Comparison of Analog Communication Systems.

Unit-II: Data and Pulse Communication

Pulse Communication: Pulse Amplitude Modulation (PAM) – Pulse Time Modulation (PTM) – Pulse code Modulation (PCM) – Comparison of various Pulse Communication System, Data Communication: History of Data Communication – Standards, Organizations for Data Communication- Data Communication Circuits.

Unit-III: Digital Modulation

Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK)–Phase Shift Keying (PSK) – BPSK – QPSK – Quadrature Amplitude Modulation (QAM) – 8 QAM - Bandwidth Efficiency– Comparison of various Digital Communication System

Unit-IV: Source and Error Control Coding

Entropy, Source Encoding Theorem, Shannon Fano Coding, Huffman Coding, Mutual Information, Channel Capacity, Error Control Coding, Linear Block Codes, Cyclic Codes – ARQ Techniques.

Unit-V: Multi-user Radio Communication

Global System for Mobile Communications (GSM) – Code Division Multiple Access (CDMA) – Cellular Concept and Frequency Reuse – Channel Assignment and Handover Techniques – Overview of Multiple Access Schemes – Satellite Communication – Bluetooth.

Text Books:

1. Wayne Tomasi, "Advanced Electronic Communication Systems", 6th Edition, Pearson Education, 2019.
2. B.P.Lathi, "Modern Analog and Digital Communication Systems", 3rd Edition, Oxford University Press, 2007.

Reference Books:

1. Simon Haykin, "Communication Systems", 4th Edition, John Wiley & Sons, 2004
2. Rappaport T.S, "Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education,2007
3. H.Taub, D L Schilling and G Saha, "Principles of Communication", 3rd Edition, Pearson Education, 2007.
4. Blake, "Electronic Communication Systems", Thomson Delmar Publications, 2002.

Journals:

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1. https://www.sciencedirect.com/journal/microelectronics-journal
2. https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=92

Video References:

1. https://www.youtube.com/watch?v=oZSv68csbgI
2. https://www.youtube.com/watch?v=4cPkr1VHu7Q

MOOC/NPTEL/SWAYAM Courses:

1. https://www.udemy.com/course/asic-bootcamp-sta-basic-concepts
2. https://www.coursera.org/learn/vlsi-cad-layout

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19EC602.1	Analyze the principles and characteristics of various analog communication techniques, such as AM and FM.
R19EC602.2	Describe the operation and components of data communication systems like PWM and PPM.
R19EC602.3	Understand digital communication techniques, such as ASK, PSK, and FSK.
R19EC602.4	Design and implement error control coding schemes to ensure reliable communication in digital systems.
R19EC602.5	Understand and utilize techniques for multi-user radio communication including TDMA and CDMA.

R19EC603	Digital Systems and VLSI Design	L	T	P	C
		3	0	0	3

1. Course Description:

This course introduces digital systems and integrated circuit design concepts and techniques, focusing on CMOS logic for digital design. Students learn to analyze circuit performance and verify functionality and timing constraints.

2. Course Objectives:

1. To understand the basics of the number system and minimization techniques
2. To understand the design of combinational and sequential logic circuits
3. To introduce the basic concepts and techniques of modern integrated circuit design.
4. Describe the fundamental principles underlying digital design using CMOS logic
5. Analyze the performance characteristics of these digital circuits

3. Syllabus:

Unit-I: Introduction of Basics concepts of Digital System

Review of Number systems - Logic gates - Boolean algebra: Boolean postulates and laws - De-Morgan's Theorem - Principle of Duality - Simplification using Boolean algebra - Canonical forms - Sum of product and Product of sum -Minimization using Karnaugh map - NAND and NOR implementation.

Unit-II: Combinational Logic Circuits

Combinational Logic: Design Procedure – Adders – Subtractors - Magnitude Comparator -Code converters– decoder - encoder – Multiplexer and Demultiplexer - parity generator – parity checker.

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Unit-III: Sequential Logic Circuits
Flip flops – SR, D, JK, T – Realization of one flip flop using other flip flops, Analysis and design of clocked sequential circuits - Design of Counters, shift registers, Shift register counters - Moore/Mealy models, state minimization, state assignment.
Unit-IV: MOS Transistor Theory
MOS transistors; Long Channel I-V Characteristics; C-V Characteristics; Non-ideal I-V effects; Fabrication process; Layout Design Rules: MOSIS scalable CMOS design rules, Micron design rules; Stick diagrams.
Unit-V: CMOS Performance Analysis
CMOS logic: The Inverter, NAND gate, NOR gate, Pass transistors, Transmission gates; CMOS Inverter - DC transfer characteristics, Transistor sizing, Noise Margin; Transient response; RC delay model; Linear delay model; Logical effort of paths; Timing analysis of delay models,
Text Books: 1. M. Morris Mano and Michael D. Ciletti, "Digital Design", 5th Edition, Pearson, 2014. 2. Neil H.Weste, Harris, A. Banerjee, CMOS VLSI Design, A circuits and System Perspective, 2015, 4th Edition, Pearson Education. 3. Wayne Wolf, "FPGA-Based System Design", First Edition, Prentice Hall India Private Limited, 2004. **Reference Books:** 1. Thomas L.Floyd, "Digital Fundamentals", Prentice Hall, 11th Edition, 2015. 2. Jan M. Rabaey, Anantha Chadrakasan, Borivoje Nikolic, Digital Integrated Circuits: A Design Perspective Paperback, 2016, 2rd Edition, Pearson Education, India. 3. John P. Uyemura, "Introduction to VLSI Circuits and Systems", John Wiley & Sons, Reprint 2009. 4. Douglas A. Pucknell, "Basic VLSI Systems and Circuits", Prentice Hall of India, 3rd Edition, reprint2008. **Journals:** 1. https://www.sciencedirect.com/journal/microelectronics-journal 2. https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=92 **Video References:** 1. https://www.youtube.com/watch?v=oZSv68esbgI 2. https://www.youtube.com/watch?v=4cPkr1VHu7Q **MOOC/NPTEL/SWAYAM Courses:** 1. https://www.udemy.com/course/asic-bootcamp-sta-basic-concepts 2. https://www.coursera.org/learn/vlsi-cad-layout

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome

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R19EC603.1	Apply Boolean algebra, Karnaugh map to design combinational logic circuits
R19EC603.2	Apply different minimization techniques for designing various combinational logic circuits
R19EC603.3	Outline and design the synchronous sequential digital circuits for real time applications
R19EC603.4	Understand MOS transistor fundamentals, CMOS logic and layout design principles.
R19EC603.5	Analyze the characteristics of CMOS inverter and various delay models

R19EC604	Introduction to IoT	L	T	P	C
		3	0	0	3

1. Course Description:

Comprehensive Internet of Things (IoT) coursework will allow you to investigate this revolutionary field. Learn about embedded systems, communication protocols, cloud computing, privacy protection, and new IoT applications. Get hands-on experience and insights into the technologies transforming the digital landscape of interconnected gadgets and intelligent systems.

2. Course Objectives:

1. To understand the core components of embedded systems and their role in IoT devices.
2. To explore cloud-based services and tools for data visualization, analytics, and other applications in IoT.
3. To analyze various communication protocols used in IoT networks (e.g., Wi-Fi, Bluetooth, cellular) and their suitability for different applications.
4. To analyze the security vulnerabilities and privacy risks associated with data collection, transmission, and storage in IoT deployments.
5. To analyze the privacy risks associated with data collection, transmission, and storage in IoT deployments.

3. Syllabus

Unit-I: Overview of IoT

Introduction to IoT: hardware architecture, software architecture, Characteristics of IoT, Challenges, applications; Impact of IoT on business and society; IoT product development life cycle; Network Layers

Unit-II: Communication Protocols and Hardware's for IoT

Communication modules: BLE, WiFi, IoT Protocols: IPv6, CoAP, MQTT; Wired Communication, Launch Pads Overview: Arduino/ESP 32, AT Tiny; Hardware for IoT:Sensors, Actuators, RFID technology; Power Sources.

Unit-III: Cloud Computing for IoT

Cloud Enabling Technologies, Characteristics and benefits of Cloud Computing, Cloud Service Models, Cloud computing Infrastructure, Cloud Challenges, Server Types within IaaS solutions, Cloud-based data storage, Cloud-based backup devices.

Unit-IV: Privacy Protection and Trust Models for IoT

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One-Time Mask Scheme, Mobile Wireless Body Sensor Network, Trust Model Concepts, Public Key Infrastructures Architecture Components, Public Key Certificate Formats, Design Considerations for Digital Certificates, Authentication in IoT, and Computational Security for IoT.
Unit-V: IoT Applications for Value Creations
Introduction, IoT applications for industry: Brownfield IoT, IoT for Retailing Industry, IoT for Oil and Gas Industry, Opinions on IoT Applications and Value for Industry, Home Management, eHealth.
Text Books:
1. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach", Universities Press, 2015. 2. Hu, Fei. Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations, 2016, 1st edition, CRC Press, USA.
Reference Books: 1. Bahga, Arshdeep, and Vijay Madisetti, Cloud computing: A hands-on approach, 2014,2nd edition, CreateSpace Independent Publishing Platform, USA. 2. Anthony T. Velte Toby J. Velte, "Cloud Computing: A Practical Approach" MGH, 2010. 3. Rajkumar Buyya,Amir Vahid " Internet of Things Principles and Paradigms", Elsevier, 2016. 4. Neil Cameron, "Arduino Applied: Comprehensive Projects for Everyday Electronics", A Press, 2019
Journals: 1. Kumar, S., Tiwari, P. &Zymbler, M. Internet of Things is a revolutionary approach for future technology enhancement: a review. J Big Data 6, 111 (2019). https://doi.org/10.1186/s40537-019-0268-2 2. V. -V. Vo, D. -T. Le, S. M. Raza, M. Kim and H. Choo, "Active Neighbor Exploitation for Fast Data Aggregation in IoT Sensor Networks," in IEEE Internet of Things Journal, vol. 11, no. 8, pp. 13199-13216, 15 April15, 2024, doi: 10.1109/JIOT.2024.3354730. Video Reference: 1.https://www.youtube.com/playlist?list=PLEiEAq2VkUUImmTXP_YC2j5qIGOV9NPLy **MOOC/NPTEL /SWAYAM Course:** 1. Introduction To Internet of Things, By Prof. Sudip Misra, IITKharagpurhttps://onlinecourses.nptel.ac.in/noc24_cs35/preview

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19EC604.1	Explain the fundamentals of an embedded system, networking, and its applications.
R19EC604.2	Apply the appropriate communication protocol based on the requirements of an IoT application.
R19EC604.3	Analyze the cloud computing models and apply them based on the applications.

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R19EC604.4	Analyze the importance of privacy protection in IoT ecosystems, considering legal, ethical, and societal implications.
R19EC604.5	Develop IoT solutions that address specific challenges in various real-time applications

R19EC605	Basics of Biomedical Instrumentation	L	T	P	C
		3	0	0	3

1. Course Description:

This course provides an in-depth exploration of Medical Electronics, focusing on essential topics crucial to understanding healthcare technology. Students will delve into the principles of bio-potential signals generated by the human body and learn techniques for their recording and analysis. The design, operation, and application of transducers converting biological signals into electrical signals suitable for processing and measurement. Students will study the integration of transducers with recording systems, including signal conditioning, amplification, and digitization techniques. The course explores various types of biomedical recorders used in clinical settings, emphasizing their functionalities, data storage, and retrieval mechanisms. Students will analyze safety considerations in medical electronics, focusing on equipment design, regulatory standards, and risk management.

2. Course Objectives:

1. Grasp the fundamental concepts related to bio-electric potential, including its generation and measurement techniques.
2. Gain knowledge about various types of physiological transducers, their principles of operation, and their applications in healthcare and research.
3. Learn the engineering principles behind recording systems used to capture bio-electric signals and other physical parameters.
4. Apply their understanding of basic sciences to effectively record bio-electric potentials from living organisms.
5. Recognize different shock hazards associated with electrical equipment in clinical environments and take preventive measures to ensure safety.

3. Syllabus:

Unit-I: Electro-Physiology and Bio-Potential Recording

Sources of bioelectric potential – Resting and Action potential – Propagation of action potential, Bioelectric Potentials- ECG, EEG and EMG, Electrode theory, Bio-potential electrodes and Biochemical transducers

Unit-II: Physiological Transducers

Classification of Transducers- Static and Dynamic Characteristics of Transducers – Potentiometric Transducer- LVDT- Strain Gauge Pressure Transducer, Thermistors, Photoelectric Transducer- Barrier layer cells, Photo emissive Cells, Fibre Optic Sensors – Physical Sensors - Chemical Sensors.

Unit-III: Recording System

Basic Recording System, Basic of Preamplifiers, Bio-potential Amplifier, Instrumentation amplifier, Chopper amplifier, Isolation amplifier, Direct writing galvanometric recorder, Thermal Array Recorders.

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Unit-IV: Biomedical Recorders
Electrocardiograph (ECG), Phonocardiograph (PCG), Electroencephalograph (EEG), Electromyography (EMG)
Unit-V: Patient Safety Equipment
Electric shock hazards – Leakage current – Safety Codes for Electromedical Equipment – Electrical Safety Analyser – Testing of Biomedical Equipment
Text Books:
1. Khandpur. R.S., "Handbook of Biomedical Instrumentation", TATA McGraw Hill, NewDelhi,3rd Edition, 2014. 2. Leslie Cromwell, Fred J. Weibell and Erich A. Pfeiffer, "Biomedical instrumentation and measurement", 2nd Edition, Pearson Education, New Delhi, 2001
Reference Books: 1. John G.Webster, "Medical Instrumentation Application and Design", Fourth Edition, John Wiley &Sons,Singapore, 2010. 2. Joseph J. Carrand John M. Brown, "Introduction to Biomedical equipment Technology", Pearson Education, New Delhi, Fourth Edition Indian Reprint, 2004. 3. Arther C Guyton, John E. Hall, "Textbook of Medical Physiology", 12th Edition, Elsevier Publication, 2016. **Journals:** 1. Mendes, P.M., Figueiredo, C.P., Fernandes, M., Gama, Ó.S. (2011). Electronics in Medicine. In: Kramme, R., Hoffmann, KP., Pozos, R.S. (eds) Springer Handbook of Medical Technology. Springer Handbooks. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-540-74658-4_74. **Video References:** 1. https://www.youtube.com/watch?v=uSKv-b0Fe_A 2. https://www.youtube.com/watch?v=iK6q4nnmtA&list=PLVsrfTSlZ_42OoOyhzWoDgZrL9iineZxQ 3. https://www.youtube.com/watch?v=FaHK9oO8ink 4. https://www.youtube.com/watch?v=QzZh243-Ac8 5. https://www.youtube.com/watch?v=Ir5Y1g55WBw **MOOC/NPTEL/ SWAYAM Course:** 1. https://onlinecourses.swayam2.ac.in/nou23_bt05/preview

4. Course Outcomes

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19EC605.1	Understand the concepts of bio-electric potential and bio potential measurements
R19EC605.2	Understand the working of different types of Physiological Transducers
R19EC605.3	Understand the basic engineering concept of recording system on physical parameters
R19EC605.4	Apply the knowledge of basic sciences to record bio-electric potential
R19EC605.5	Identify the different shock hazards to prevent electrical accidents in clinical environment

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R19EC606	Introduction to Image Processing	L	T	P	C
		3	0	0	3

1. Course Description:

This course introduces the steps and components of image processing, how digital images are acquired, sampled, quantized and the relationship between pixels. In image enhancement and restoration both spatial and frequency domain techniques are utilized. Segmentation techniques explained with edge detection and morphological processing. This course addresses the compression techniques and standards for efficient storage. It also deals with the techniques to extract features for image representation and recognition

2. Course Objectives:

1. To introduce the Basic concepts and analytical methods of analysis of digital images.
2. To study fundamental concepts of Digital Image Processing and basic relations among pixels
3. To study different spatial and frequency domain concepts.
4. To understand restoration process of degraded image and Multi resolution processing.
5. To understand image compression and Segmentation Techniques.

3. Syllabus:

Unit-I: Image Fundamentals

Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some basic Relationships between Pixels. Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System.

Unit-II: Image Enhancement

Some Basic Gray Level Transformation, Histogram Processing, Enhancement Using Arithmetic/Logic Operations, Basics of Spatial Filtering, smoothing spatial Filters, Sharpening spatial Filters. Introduction to the Fourier Transform and the Frequency Domain, smoothing frequency-domain Filters, Sharpening Frequency-domain Filters, Homomorphic Filtering, Implementation

Unit-III: Image Restoration

A Model of the Image Degradation/Restoration Process, Linear, Position Invariant Degradations, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering. Wavelets and Multi resolution Processing

Unit-IV: Image Segmentation and Compression

Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Region-Based Segmentation. Image Compression Models, Error-free Compression, Lossy Compression, Image Compression Standards.

Unit-V: Representation and Description

Boundary representation, Chain Code, Polygonal approximation, signature, boundary Segments, Boundary description, Shape number, Fourier Descriptor, moments, Regional Descriptors, Topological feature, Texture, Patterns and Pattern classes, Recognition based on matching.

Text Books:

1. Rafael C. Gonzales, Richard E. Woods, "Digital Image Processing", Third Edition, Pearson Education, 2010.
2. Anil Jain K. "Fundamentals of Digital Image Processing", PHI Learning Pvt. Ltd., 2011.

Reference Books:

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1. Jayaraman, S., Esakkirajan, S., & Veerakumar, T. (2009). Digital image processing (Vol. 7014) New Delhi: Tata McGraw Hill Education.
2. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image Processing Using MATLAB", Third Edition Tata Mc Graw Hill Pvt. Ltd., 2011.
3. Willliam K Pratt, "Digital Image Processing", John Willey, 2002.

Journals:

1. Journal of Real-Time Image Processing
2. Computer Vision, Graphics, and Image Processing
3. IET Image Processing

Video Reference:

1. https://www.youtube.com/watch?v=CVV0TvNK6pk

MOOC/NPTEL/SWAYAM Course:

1. https://archive.nptel.ac.in/courses/117/105/117105135/

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19EC606.1	Discuss digital image fundamentals
R19EC606.2	Articulate image enhancement and restoration techniques
R19EC606.3	Examining image compression Techniques
R19EC606.4	Implementing image segmentation Techniques
R19EC606.5	Representation and recognition of images

R19EC607	Microcontroller and Embedded Systems	L	T	P	C
		3	0	0	3

1. Course Description:

This course introduces the steps and components of image processing, how digital images are acquired, sampled, quantized and the relationship between pixels. In image enhancement and restoration both spatial and frequency domain techniques are utilized. Segmentation techniques explained with edge detection and morphological processing. This course addresses the compression techniques and standards for efficient storage. It also deals with the techniques to extract features for image representation and recognition

2. Course Objectives:

1. To study about the architecture and programming of 8051 microcontroller
2. To study the design techniques of peripheral ICs with microcontroller
3. To study the basic functions and programming of 8051 microcontroller
4. To study about the fundamentals of embedded system design
5. To learn about embedded system architecture

3. Syllabus:

Unit-I: Introduction to Microcontroller

Introduction to 8-bit microcontroller: 8051 architecture, memory organization, special function registers – port operation – timer/counters – serial interface – interrupts – operand addressing – instruction set – programming.

Unit-II: Interfacing 8051Microcontroller

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Programming 8051 Timers; Serial Port Programming; Interrupts Programming; Interfacing: LCD, Keyboard, ADC, DAC, Sensor, External Memory, Stepper Motor; Waveform generation.
Unit-III: Embedded System Architecture
Introduction to Embedded system – application areas – categories – overview – specialties – recent trends – hardware architecture – software architecture – application software – communication software – process of generating executable image – developing and testing tools.
Unit-IV: Embedded System Development
Development process – requirements engineering – design – implementation – integration and testing – Architecture of Kernel - Tasks and task scheduler – Interrupt service routines – semaphores – mailboxes – timers – memory management – priority inversion problem.
Unit-V: Embedded Hardware Platforms
RISC Vs CISC Architecture; Introduction to Arduino Uno; Switches: Tactile switch; Sensors: Temperature, LDR, PIR; LCD Display; Bluetooth Communication: BT terminal HC-05 app; Wi-Fi Communication: NodeMCU ESP8266; Introduction to Raspberry pi.
Text Books:
1. Krishna Kant, "Microprocessors and Microcontrollers: Architecture, Programming and System Design 8085, 8086, 8051, 8096", PHI, 2013. 2. Dr.K.V.K.K. Prasad, "Embedded/Real-time Systems: Concepts, Design and Programming", Dreamtech Press. 2012.
Reference Books: 1. A.K. Ray and K.M. Bhurchandi, "Advanced Microprocessor and Peripherals", MGH, 3/e, 2017 2. Mohammed Ali Mazidi, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Pearson, 2/e, 2012 3. Wayne wolf, "Computers as Components: Principles of Embedded Computing System design", 4/e, M.K. Publishers, 2013 **Journals:** 1. Journal of Real-Time Embedded Systems 2. Microprocessors and Microcontrollers Video Reference: 1. https://www.youtube.com/watch?v=CVV0TvNK6pk **MOOC/NPTEL/SWAYAM Course:** 1. https://archive.nptel.ac.in/courses/microcontrollers/

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19EC607.1	Analyze the architecture of the 8051-microcontroller .
R19EC607.2	Demonstrate comprehension of the 8051-microcontroller architecture by developing an assembly program using 8051 instructions
R19EC607.3	Outline the programming model and interfacing peripheral devices with 8051 microcontroller

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R19EC607.4	Applying the knowledge of tasks and task scheduling of embedded system architecture and design process
R19EC607.5	Evaluate microcontrollers-based systems using Sensor and Communication devices

R19EC608	Wireless Sensor Networks	L	T	P	C
		3	0	0	3

1. Course Description:

This course provides an in-depth exploration of Wireless Sensor Networks (WSNs). focusing on their architecture, protocols, and applications. Students will gain insights into medium access control, routing strategies, and embedded operating systems tailored for WSNs. Practical applications across various fields, including industrial and environmental monitoring, will be highlighted.

2. Course Objectives:

1. Understand the characteristics and challenges specific to wireless sensor networks.
2. Explore and analyze various medium access control protocols used in WSNs.
3. Investigate routing protocols and data gathering techniques in sensor networks.
4. Examine embedded operating systems designed for sensor nodes and their programming.
5. Identify and evaluate real-world applications of WSNs across diverse sectors.

3. Syllabus:

Unit-I: Characteristics of WSN

Characteristic requirements for WSN - Challenges for WSNs – WSN vs Adhoc Networks - Sensor node architecture – Commercially available sensor nodes –Imote, IRIS, Mica Mote, EYES nodes, BTnodes, TelosB, Sunspot -Physical layer and transceiver design considerations in WSNs, Energy usage profile, Choice of modulation scheme, Dynamic modulation scaling, Antenna considerations.

Unit-II: Medium Access Control Protocols

Fundamentals of MAC protocols - Low duty cycle protocols and wakeup concepts – Contention based protocols - Schedule-based protocols - SMAC - BMAC - Traffic-adaptive medium access protocol (TRAMA) - The IEEE 802.15.4 MAC protocol.

Unit-III: Routing and Data Gathering Protocols

Routing Challenges and Design Issues in Wireless Sensor Networks, Flooding and gossiping –

Data centric Routing – SPIN – Directed Diffusion – Energy aware routing - Gradient-based routing - Rumor Routing – COUGAR – ACQUIRE – Hierarchical Routing - LEACH, PEGASIS – Location Based Routing – GF, GAF, GEAR, GPSR – Real Time routing Protocols – TEEN, APTEEN, SPEED, RAP - Data aggregation - data aggregation operations - Aggregate Queries in Sensor Networks - Aggregation Techniques – TAG, Tiny DB.

Unit-IV: Embedded Operating Systems

Operating Systems for Wireless Sensor Networks – Introduction - Operating System Design Issues - Examples of Operating Systems – TinyOS – Mate – MagnetOS – MANTIS - OSPM -

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EYES OS – SenOS – EMERALDS – PicOS – Introduction to Tiny OS – NesC – Interfaces and Modules- Configurations and Wiring - Generic Components -Programming in Tiny OS using NesC, Emulator TOSSIM.
Unit-V: Applications of WSN
WSN Applications - Home Control – Building Automation - Industrial Automation - Medical Applications - Reconfigurable Sensor Networks - Highway Monitoring - Military Applications - Civil and Environmental Engineering Applications - Wildfire Instrumentation - Habitat Monitoring - Nanoscopic Sensor Applications – Case Study: IEEE 802.15.4 LR-WPANs Standard - Target detection and tracking - Contour/edge detection - Field sampling
Text Books:
1.Kazem Sohraby, Daniel Minoli and Taieb Znati, "Wireless Sensor Networks Technology, Protocols, and Applications ", John Wiley & Sons, 2007. 2.Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, Ltd, 2005.
Reference Books: 1. K. Akkaya and M. Younis, "A survey of routing protocols in wireless sensor networks", Elsevier Ad Hoc Network Journal, Vol. 3, no. 3, pp. 325--349 2. Philip Levis, " TinyOS Programming" 3. Anna Ha´c, "Wireless Sensor Network Designs", John Wiley & Sons Ltd, **Journals:** 1. Journal of Sensor and Actuator Networks 2. IEEE Transactions on Wireless Communications **Video References:** 1. https://www.youtube.com/watch?v=2b7wU0U9tW4 2. https://www.youtube.com/watch?v=xq2EDWJYyOQ **MOOC/NPTEL/SWAYAM Course:** 1. NPTEL Wireless Sensor Networks Course

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19EC608.1	Analyze the fundamental characteristics and requirements of wireless sensor networks.
R19EC608.2	Design and implement medium access control protocols suitable for WSNs.
R19EC608.3	Evaluate routing strategies and data aggregation techniques for effective communication.
R19EC608.4	Develop applications using embedded operating systems and programming languages specific to WSNs.
R19EC608.5	Assess the impact and potential of WSNs in various practical applications and industries.

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R19EC609	Introduction to Robotics and Automation	L	T	P	C
		3	0	0	3

1. Course Description:

This course offers a comprehensive overview of robotics, covering the history, types, and drive systems of robots. Students will explore sensing and control methods, as well as computer interfaces and maintenance practices. The curriculum emphasizes practical applications of robots in various industries and their future impact on society.

2. Course Objectives:

1. Understand the fundamental concepts and history of robotics and their evolution.
2. Explore various drive systems and end effectors used in robotic applications.
3. Analyze sensing technologies and control methods for effective robot programming.
4. Learn about robot-computer interfaces and the importance of maintenance practices.
5. Evaluate the diverse applications of robots in manufacturing and their societal implications.

3. Syllabus:

Unit-I: Robot - Introduction

Robot history - Computer programs – Microprocessors - Positive aspects of robots - Robots versus humans - Types of robots – Manipulator - Degrees of freedom – Coordinates - Moving the manipulator.

Unit-II: Drive Systems

Hydraulics, Pneumatics, Electric – End effectors – Positioning – Repeatability and accuracy – Drives, Harmonic drives – Belts – Chains.

Unit-III: Sensing and Control Methods

Sensing: Classes of sensors – Sensor: Proximity, range, tactile - Control methods: Electric power, Servo controlled, Non-servo controlled – Actuators - Controllers – Programming a robot.

Unit-IV: Computer Interface and Maintenance

Robot-computer interface – Languages - Interfacing - Interfacing robot and computer - Program control - Vision for the robot – Maintenance: Preventive maintenance - Maintenance of small electric motors - Using meters to check for problems.

Unit-V: Uses for Robots

Loading and Unloading - Materials Handling - Fabricating - Assembling - Painting - Welding - Inspecting and Testing - The Future of Flexible Automation - The Future of Robots - Social Impact of Robots.

Text Book:

1. Mark R. Miller and Rex Miller, "Robots and Robotics: Principles, Systems, and Industrial Applications", 1/e, 2017

Reference Books:

1. Mordechai Ben-Ari and Francesco Mondada, "Elements of Robotics", Springer, 2017
2. Mikell P Groover, Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, "Industrial Robotics, Technology programming and Applications", McGraw Hill, 2012.

Journals:

1. IEEE Transactions on Robotics and Automation
2. Robotics and Autonomous Systems

Video References:

1. https://www.youtube.com/watch?v=6A9TAX2BZ_U
2. https://www.youtube.com/watch?v=7Vg2fW7Tz1M

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MOOC/NPTEL/SWAYAM Course: 1. Introduction to Robotics: NPTEL Robotics Course

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19EC609.1	Describe the historical development and types of robots used in various applications.
R19EC609.2	Analyze different drive systems and their role in robotic functionality.
R19EC609.3	Identify and apply various sensors and control methods in robot programming.
R19EC609.4	Implement effective robot-computer interfaces and understand maintenance techniques.
R19EC609.5	Assess the applications of robots in industries and their broader social impact.

R19EC610	Medical Electronics	L	T	P	C
		3	0	0	3

1. Course Description:

This course provides an in-depth exploration of Medical Electronics, focusing on essential topics crucial to understanding healthcare technology. Students will delve into the principles of bio-potential signals generated by the human body and learn techniques for their recording and analysis. The design, operation, and application of transducers converting biological signals into electrical signals suitable for processing and measurement. Students will study the integration of transducers with recording systems, including signal conditioning, amplification, and digitization techniques. The course explores various types of biomedical recorders used in clinical settings, emphasizing their functionalities, data storage, and retrieval mechanisms. Students will analyze safety considerations in medical electronics, focusing on equipment design, regulatory standards, and risk management.

2. Course Objectives:

1. Understand the concepts of bio-electric potential and bio potential measurements
2. Understand the working of different types of Physiological Transducers
3. Understand the basic engineering concept of recording system on physical parameters
4. Apply the knowledge of basic sciences to record bio-electric potential
5. Identify the different shock hazards to prevent electrical accidents in clinical environment

3. Syllabus:

Unit-I: Electro-Physiology and Bio-Potential Recording

Sources of bioelectric potential – Resting and Action potential – Propagation of action potential, Bioelectric Potentials- ECG, EEG and EMG, Electrode theory, Bio-potential electrodes and Biochemical transducers

Unit-II: Physiological Transducers

Classification of Transducers- Static and Dynamic Characteristics of Transducers –

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Potentiometric Transducer- LVDT- Strain Gauge Pressure Transducer, Thermistors, Photoelectric Transducer- Barrier layer cells, Photoemissive Cells, Fibre Optic Sensors – Physical Sensors - Chemical Sensors.

Unit-III: Recording System

Basic Recording System, Basic of Preamplifiers, Bio-potential Amplifier, Instrumentation amplifier, Chopper amplifier, Isolation amplifier, Direct writing galvanometric recorder, Thermal Array Recorders.

Unit-IV: Biomedical Recorders

Electrocardiograph (ECG), Phonocardiograph (PCG), Electroencephalograph (EEG), Electromyography (EMG)

Unit-V: Patient Safety Equipment

Electric shock hazards – Leakage current – Safety Codes for Electromedical Equipment – Electrical Safety Analyser – Testing of Biomedical Equipment

Text Books:

1. Khandpur. R.S., "Handbook of Biomedical Instrumentation", TATA McGraw Hill, New Delhi,3rd Edition, 2014.
2. Leslie Cromwell, Fred J. Weibell and Erich A. Pfeiffer, "Biomedical instrumentation and measurement", 2nd Edition, Pearson Education, New Delhi, 2001

Reference Books:

1. John G.Webster, "Medical Instrumentation Application and Design", Fourth Edition, John Wiley &Sons,Singapore, 2010.
2. Joseph J. Carrand John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, New Delhi, Fourth Edition Indian Reprint, 2004.
3. Arther C Guyton, John E. Hall, "Textbook of Medical Physiology", 12th Edition, Elsevier Publication, 2016.

Journal:

1. Mendes, P.M., Figueiredo, C.P., Fernandes, M., Gama, Ó.S. (2011). Electronics in Medicine. In: Kramme, R., Hoffmann, KP., Pozos, R.S. (eds) Springer Handbook of Medical Technology. Springer Handbooks. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-540-74658-4_74.

Video References:

1. https://www.youtube.com/watch?v=uSKv-b0Fe_A
2. https://www.youtube.com/watch?v=iK6q4nnmtA&list=PLVsrfTSlZ_42OoOyhzWoDgZrL9iineZxQ
3. https://www.youtube.com/watch?v=FaHK9oO8ink
4. https://www.youtube.com/watch?v=QzZh243-Ac8
5. https://www.youtube.com/watch?v=Ir5Y1g55WBw

MOOC/NPTEL/UDEMY Course:

1. https://onlinecourses.swayam2.ac.in/nou23_bt05/preview

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4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19EC610.1	Understand the concepts of bio-electric potential and bio potential measurements
R19EC610.2	Understand the working of different types of Physiological Transducers
R19EC610.3	Understand the basic engineering concept of recording system on physical parameters
R19EC610.4	Apply the knowledge of basic sciences to record bio-electric potential
R19EC610.5	Identify the different shock hazards to prevent electrical accidents in clinical environment

R19EE601	Solid State Electronics	L	T	P	C
		3	0	0	3

1. Course Description:

This course provides a comprehensive introduction to the field of power electronics, which deals with the control and conversion of electric power. You will gain a solid understanding of the underlying principles, analysis techniques, design considerations, and applications of power electronic circuits.

2. Course Objectives:

1. To impart knowledge on the power semiconductor switches used for the design of various power electronic converters.
2. To equip students with a comprehensive understanding of phase-controlled converters and their applications.
3. To facilitate the students to gain insights on DC-to-DC converters, their types, operation and applications.
4. To provide knowledge on the operation of DC to AC converters and their applications.
5. To give exposure on the different types of AC to AC converters.

3. Syllabus

Unit – I: Power Semiconductor Devices

Introduction; Scope and Application; Construction and characteristics: Diode, BJT, Thyristors, MOSFET, IGBT, TRIAC and GTO; Triggering and commutation circuit for SCR; Driver and snubber circuits; Introduction to wide-band gap devices.

Unit – II: Phase Controlled (AC to DC) Converters

Principle of phase control; One pulse, two pulse, three pulse and six pulse converters; Performance parameters; Dual Converters; Effect of source inductance; Applications.

Unit – III: DC to DC Converters

Introduction; Principle and operation; Control strategies; Types: step down (buck), Step up (boost) and step down/step up (buck/boost) converters and Cuk converter; Steady state operation; Applications.

Unit – IV: DC to AC Converters

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Introduction; Types: Single phase half and full bridge VSI, Three phase VSI 120 and 180 degree conduction mode; PWM Techniques; Current source inverter; Introduction to multilevel inverters; Applications.

Unit – V: AC to AC Converters

AC Voltage Controllers: Introduction, On-Off control, Phase Control, Single phase Bidirectional Controllers with R and R-L Loads, Three phase full wave controllers. Cycloconverters: Single Phase and Three phase Cycloconverter and Matrix Converter.

Text Books:

1. Ned Mohan, Tore. M. Undeland, William. P. Robbins, "Power Electronics: Converters, Applications and Design", John Wiley India, Third Edition Reprint, 2009.
2. 2. P.S.Bimbra, "Power Electronics", Khanna Publishers, Twenty Third Reprint, 2012.

References:

Reference Books:

1. Rashid M. H, "Power Electronics: Circuits, Devices & Applications", Pearson, Third Edition, 2004.
2. Rama Reddy S, "Fundamentals of Power Electronics", Narosa Publishing House, Second Edition, 2014.
3. Singh M. D. and Khanchandani K. B., "Power Electronics", Tata McGraw Hill, 2013.
4. Philip T. Krein, "Elements of Power Electronics", Oxford University Press, Second Edition, 2015.

5.Joseph Vithayathil, "Power Electronics: Principles and Applications", Tata McGraw Hill, Second Reprint, 2010.

Journal References:

1. IEEE Transactions on Power Electronics
2. IEEE Journal of Emerging and Selected Topics in Power Electronics
3. IET Power Electronics
4. PE Journal of Power Electronics
5. International Journal of Electrical Power & Energy Systems

Video References:

1. https://www.youtube.com/watch?v=jgh0TNfx0gQ
2. https://youtube.com/playlist?list=PLgwJf8NK-2e5Hnu82T1CYLZ8kbZs4Jx8x&si=ZfCV4 nsbcF4Qmibz

MOOC / NPTEL / SWAYAM Courses:

1. https://nptel.ac.in/courses/108105066
2. https://onlinecourses.nptel.ac.in/noc21_ee01/preview

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19EE601.1	Explain the operation and characteristics of different types of power semi-conductor devices to choose a suitable switch for a specific application.
R19EE601.2	Build various configurations of phase-controlled converter circuits to analyse their operation, characteristics and performance parameters.

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R19EE601.3	Construct and analyse various topologies of DC to DC converters to select the most suitable one for a particular application.
R19EE601.4	Develop dc to ac inverter circuits and apply different PWM techniques to reduce harmonics in the inverter output.
R19EE601.5	Understand the methods of AC to AC power conversion to analyze the performance of these converters with various types of loads.

R19EE602	Non Conventional Energy Sources	L	T	P	C
		3	0	0	3

1. Course Description:

The course on " Non-Conventional Energy Resources " offers a comprehensive study of renewable energy sources, technologies, integration strategies, and their role in sustainable energy solutions. As the global focus shifts towards reducing greenhouse gas emissions and achieving energy independence, renewable energy systems play a pivotal role in meeting these challenges. This course provides students with a deep understanding of various renewable energy technologies.

2. Course Objectives:

1. To explain the significance and benefits of renewable energy sources in addressing global energy needs and environmental challenges.
2. To describe the operational principles and components involved in wind energy conversion systems, including the methods of harnessing wind power.
3. To outline the key techniques and technologies used in Solar Photovoltaic (PV) and Solar Thermal conversion systems for efficient energy capture and utilization.
4. To illustrate the processes and technologies involved in converting biomass and hydro resources into usable energy, highlighting their applications and benefits.
5. To summarize the fundamental concepts and methods of energy conversion from tidal forces, (OTEC), hydrogen production, fuel cells, and energy storage systems, including their potential impacts on the energy landscape.

3. Syllabus

Unit – I: Renewable Energy Sources

Environmental consequences of fossil fuel use, Importance of renewable sources of energy, Sustainable Design and development, Types of RE sources, Limitations of RE sources, Present Indian and international energy scenario of conventional and RE sources.

Unit – II: Wind Energy

Power in the Wind – Types of Wind Power Plants (WPPs) – Components of WPPs – Working of WPPs – Siting of WPPs – Grid integration issues of WPPs.

Unit – III: Solar PV and Thermal Systems

Solar Radiation, Radiation Measurement, Solar Thermal Power Plant, Central Receiver Power Plants, Solar Ponds – Thermal Energy storage system with PCM – Solar Photovoltaic systems: Basic Principle of SPV conversion – Types of PV Systems – Types of Solar Cells, Photovoltaic cell concepts: Cell, module, array, PV Module I-V Characteristics, Efficiency & Quality of the Cell, series and parallel connections, maximum power point tracking, Applications.

Unit – IV: Biomass Energy and Hydro Energy

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Introduction – Bio mass resources – Energy from Bio mass: conversion processes – Biomass Cogeneration – Environmental Benefits. Geothermal Energy: Basics, Direct Use, Geothermal Electricity. Mini/micro hydro power: Classification of hydropower schemes, Classification of water turbine, Turbine theory, Essential components of hydroelectric system.

Unit – V: Other Renewable Energy Sources

Tidal Energy: Energy from the tides, Barrage and Non Barrage Tidal power systems. Wave Energy: Energy from waves, wave power devices. Ocean Thermal Energy Conversion (OTEC)- Hydrogen Production and Storage- Fuel cell: Principle of working – various types – construction and applications. Energy Storage System – Hybrid Energy Systems.

Text Books:

1. Kothari D. P, Singal K. C, Rakesh Ranjan, "Renewable Energy Sources and Emerging Technologies", PHI Learning Pvt. Ltd., Second Edition, 2011.
2. Rai G. D, "Non-Conventional Energy Sources", Khanna Publishers, Fourth Edition, 2009.

References:

Reference Books:

1. Mukerjee A. K. and Nivedita Thakur, "Photovoltaic Systems: Analysis and Design", PHI Learning, 2011.
2. Chetan Singh Solanki, "Solar Photovoltaics: Fundamentals, Technologies and Applications", PHI Learning Pvt. Ltd., Third Edition, 2015.
3. Godfrey Boyle, "Renewable energy", Oxford University Press in association with the Open University, 2004.
4. Shobh Nath Singh, "Non-conventional Energy resources", Pearson, 2015.

Journal References:

1. Progress in Photovoltaics
2. Energy and Environment
3. Renewable and Sustainable Energy

Web Resources:

1. https://www.solarenergy.org/courses/introduction-to-renewable-energy/
2. https://energsustainsoc.biomedcentral.com/articles/10.1186/s13705-019-0232-1
3. https://online.stanford.edu/programs/energy-innovation-and-emerging-technologies-program

MOOC / NPTEL / SWAYAM Courses:

1. https://onlinecourses.nptel.ac.in/noc24_ph29/preview
2. https://onlinecourses.nptel.ac.in/noc24_ch43/preview

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19EE602.1	Explain the importance of renewable energy sources
R19EE602.2	Describe the process of wind energy conversion system
R19EE602.3	Outline the techniques of Solar PV and Solar Thermal conversion system
R19EE602.4	Illustrate the process of energy conversion from Bio-Mass and Hydro Systems

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R19EE602.5	Summarize the concepts of energy conversion from tide, OTEC, Hydrogen Production, Fuel Cells and Energy storage systems

R19EE603	Energy Conservation Practices	L	T	P	C
		3	0	0	3

1. Course Description:

This intensive course equips professionals with comprehensive strategies for electrical energy conservation. Through in-depth exploration of energy-efficient technologies, power factor improvement, and best practices across various applications – motors, lighting, and electric traction – participants gain the knowledge to optimize energy consumption and reduce operational costs. Additionally, the course delves into electrolytic processes and battery storage, providing insights into emerging energy storage solutions.

2. Course Objectives:

1. To understand the principles of energy conservation and its significance.
2. To develop skills in identifying and implementing energy-saving measures in electrical systems.
3. To acquire knowledge of lighting systems and energy-efficient lighting practices.
4. To understand the fundamentals of electric traction and its energy efficiency.
5. To gain knowledge of energy storage technologies and their applications.

3. Syllabus

Unit – I: Introduction to Energy Conservation

Need for electrical energy conservation - methods – energy efficient equipment – energy management – energy auditing - Features of Energy Conservation Act – Economics of power factor improvement – design for improvement of power factor using power capacitors – DSM techniques.

Unit – II: Energy Conservation in Electrical System

Energy Conservation potential in motors – Pumps – Fans and Compressors – Refrigeration and HVAC system, operation and maintenance practices for electrical energy conservation – Case studies.

Unit – III: Energy Conservation in Lighting System

Laws of illumination – Calculation of illumination – Street lighting and Flood lighting – MSCP – Choice of Lighting – Different types of illumination sources and Energy efficiency – Control of Lighting – Lighting standards for industry and Commercial – Energy conservation measures for lighting.

Unit – IV: Electric Traction

Characteristics of traction motors – Choice of an Electric Motor – Control of traction motors – Systems of railway electrification – Power and Energy output from driving axles – Specific Energy output and consumption – Braking methods – Current collection systems – Recent trends in electric traction – Introduction to Aircraft electrical system.

Unit – V: Electrolytic Process and Storage of Electricity

Electrolysis – simple problems involving Faraday's laws of electrolysis - Electroplating – Nickel iron batteries – Lead acid Batteries – components and materials - capacity rating of batteries – battery chargers – Method of charging and maintenance – Case studies.

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Text Books:

1. Gupta J.B., "Utilization of Electric Power and Electric Traction", S.K. Kataria& Sons, 2-12.

References:

Reference Books:

1. Chakrabarti A., Soni M.L., Gupta P.V. and Bhatnagar U.S., "A Textbook on Power System Engineering", Dhanpat Rai & Co., 2-1-.
2. Taylor E. Openshaw, "Utilization of Electrical Energy", Orient Longman, 2--6.
3. AmlanChakrabarti, "Energy Engineering and Management", PHI, Second Edition, 2-18.
4. Suryanarayana N.V, "Utilisation of Electric power", New Age International Limited, Reprint, 2--5.
5. CB Smith, "Energy Management Principles", Elsevier, Second Edition, 2-16.

Journal References:

1. Energy
2. Applied Energy
3. Energy Efficiency
4. IEEE Transactions on Industrial Electronics (TIE)
5. Electric Traction

Web Resources:

1. https://www.energystar.gov/
2. https://www.energy.gov/eere
3. https://www.ashrae.org/
4. https://www.ies.org/
5. https://uitp.org/

MOOC / NPTEL / SWAYAM Courses:

1. https://onlinecourses.swayam2.ac.in/nou23_es05/preview
2. https://www.coursera.org/learn/energy-and-environment

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19EE603.1	Summarize the concept of energy conservation and industrial energy management.
R19EE603.2	Identify various energy conservation methods in electrical utilities and best operating practices.
R19EE603.3	Develop the concept of lighting system for all applications along with various energy conservation measures.
R19EE603.4	Select traction motor, discuss their energy performance and basic applications in railways and aircraft electrical system.
R19EE603.5	Explain the process, technology and application of electrolytic process.

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R19EE604	Energy Auditing and Management	L	T	P	C
		3	0	0	3

1. Course Description:

This comprehensive course equips professionals with the expertise to conduct energy audits across various sectors. Through in-depth exploration of energy principles, regulations, and auditing methodologies, participants gain the ability to identify and implement energy-saving measures in electrical utilities, HVAC systems, and thermal processes. Financial analysis techniques are also covered, enabling participants to evaluate the economic viability of energy-saving projects.

2. Course Objectives:

1. To analyze energy consumption patterns and evaluate potential energy savings through comprehensive energy audits.
2. To evaluate the effectiveness of energy management strategies for electrical systems
3. To apply engineering principles to optimize the performance of fluid handling systems.
4. To evaluate the energy efficiency of thermal systems and develop strategies for improvement.
5. To create and implement cost-effective energy efficiency projects.

3. Syllabus

Unit – I: Introduction to Energy Auditing

Classification of Energy - Energy Scenario - Energy Needs of Growing Economy - Energy Pricing in India – Energy and Environment - Energy Conservation Act - Role of energy managers and auditors-Energy Auditing Types, objectives and Methodology -Audit instruments.

Unit – II: Energy Audit in Electrical Utilities

Electric Power Supply Systems - Electricity Billing – Electrical Load Management and Maximum Demand Control- Power factor improvement and its benefit - Factors involved in determination of motor efficiency- Energy efficient motors- Lightning-Energy efficient light sources-Energy Conservation in Lighting schemes.

Unit – III: Fans, Blowers and Pumps

Fan Types - Blower Types- Fan Performance evaluation- Fan Laws- Flow control strategies- Pumps- Types – Factors affecting pump performance- System characteristics- Efficient Pumping system operation- Flow Control Strategies- Energy conservation opportunities in pumping systems

Unit – IV: Energy Audit in Thermal Utilities

Steam – Introduction, Properties of steam, Steam distribution systems - Boilers- Types and Classification- Performance Evaluation of Boilers – Boiler Efficiency- Direct and Indirect methods – Energy Conservation opportunities in boilers- Principle of cogeneration – Technical options for cogeneration- Waste heat recovery - Classification and benefits.

Unit – V: Project and Financial Management

Financial analysis techniques -Simple payback period, Return on investment, Net present value, Internal rate of return, Cash flows, Risk and sensitivity analysis; Financing options, Energy performance contracting and role of ESCOs.

Text Books:

Chairman – Board of Studies
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1. Bureau & Energy Efficiency, "Energy Efficiency in Electrical Utilities", Guide Book for National Certification Examination for Energy Managers and Energy Auditors, 2013. (www.bee - india.nic.in)

References:

Reference Books:

1. Hamies, "Energy Auditing and Conservation; Methods, Measurements, Management & Case Study", Hemisphere, Washington, 1980.
2. Larry C Witte et. al, "Industrial Energy Management & Utilization". Springer Publication, First Edition, 1990.
3. Eastop T.D and Croft D.R, "Energy Efficiency for Engineers and Technologists", Logman Scientific & Technical publications,1990.
4. Reay D.A, "Industrial Energy Conservation", Pergamon Press, First Edition, 1977.

Web Resources:

1. https://www.energystar.gov/buildings
2. https://www.ashrae.org/
3. https://www.pumps.org/
4. https://www.chpa.org/
5. https://corporatefinanceinstitute.com/

MOOC / NPTEL / SWAYAM Courses:

1. https://onlinecourses.swayam2.ac.in/nou23_es05/preview
2. https://www.edx.org/learn/energy/hec-montreal-introduction-to-energy-management-powered-by-retscreen
3. https://sustainabilityeducationacademy.com/courses/online-energy-audit-course/

4. Course Outcomes

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19EE604.1	Explain the basic of industrial energy audits, objectives, methodology and outcomes.
R19EE604.2	Identify energy consumption pattern of various electrical utilities.
R19EE604.3	Explain possible auditing methods in electric fans, motors and blower along with energy conservation measures.
R19EE604.4	Identify energy consumption pattern of various thermal utility system.
R19EE604.5	Analyse practice calculation methods to prepare viable energy conservation proposals using project and financial management.

R19EE605	Introduction to Hybrid and Electric Vehicles	L	T	P	C
		3	0	0	3

1. Course Description:

his course provides an in-depth overview of hybrid and electric vehicles (HEVs and EVs), covering their design, operation, and impact on the environment. Students will explore the fundamental principles of vehicle electrification, including battery technology, electric motors, power electronics, and energy management systems. The course also addresses the

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technological advancements, challenges, and future trends in the field of hybrid and electric vehicles.

2. Course Objectives:

1. To impart knowledge on the basic principles and components of hybrid and electric vehicles.
2. To facilitate thorough learning on the functions of batteries and their specifications.
3. To explore on the motors used for EVs and the related calculations.
4. To enable students to understand the fundamental components and configuration of a transmission system in electric and conventional vehicles.
5. To equip students with the knowledge on the principles and components of Energy Management Systems and EV charging stations.

3. Syllabus

Unit – I: Introduction

Introduction to Hybrid Electric Vehicles: History, social and environmental importance, impact of modern drive trains on energy supplies. Motion and dynamic equations for vehicles

Unit – II: Batteries

Basics – Types, Parameters – Capacity, Discharge rate, State of charge, state of Discharge, Depth of Discharge, Technical characteristics, Battery pack Design, Properties of Batteries and maintenance.

Unit – III: Electric Drive and Controller

Types of Motors, Selection and sizing of Motor – RPM and Torque calculation of motor – Motor Controllers – Component sizing – Physical locations – Mechanical connection of motor – Electrical connection of motor

Unit – IV: Hybrid and Electric Vehicle Drive Train

Transmission configuration, Components – gears, differential, clutch, brakes regenerative braking, motor sizing.

Unit – V: Energy Management System (EMS) and Charging Station

Energy Management System – Software based high level supervisory control – Mode of power. Electric Vehicles charging station – Types – Selection and Sizing of charging station – Components of charging station

Text Books:

1. Iqbal Hussain, "Electric & Hybrid Vehicles – Design Fundamentals", Second Edition, CRC Press, 2011.

References:

Reference Books:

1. James Larminie, "Electric Vehicle Technology Explained", John Wiley & Sons, 2003.
2. Mehrdad Ehsani, Yimin Gao, Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals", CRC Press, 2010.
3. Emadi, A. (Ed.), Miller, J., Ehsani, M., "Vehicular Electric Power Systems" Boca Raton, CRC Press, 2003.

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4. Sheldon S. Williamson, "Energy Management Strategies for Electric and Plug – in Hybrid Electric Vehicles", Springer, 2013.

Video References:

1. https://www.goseeko.com/reference-video/biju-patnaik-university-of-technology-odisha/engineering/electrical-electronics/third-year/sem-2-/electric-and-hybrid-vehicles-1/unit-2-hybrid-electric-drive-trains-1
2. https://www.ti.com/video/6327216475112

Web Resources:

1. https://archive.nptel.ac.in/courses/108/103/108103009/
2. https://www.cranfield.ac.uk/courses/short/transport-systems/hybrid-electric-vehicles-introduction

MOOC / NPTEL / SWAYAM Course:

1. https://onlinecourses.swayam2.ac.in/nou24_ec10/preview

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19EE605.1	Explain the basic Concepts of hybrid and Electric vehicles.
R19EE605.2	Illustrate the basic parameters and the characteristics of batteries.
R19EE605.3	Aply the concepts for selection of electric drives and its controllers.
R19EE605.4	Understand the concept of Transmission system in Hybrid and Electric vehicle
R19EE605.5	Explain the basic concepts of Energy management system and charging station.

R19EE606	Design of Solar Photovoltaic Systems	L	T	P	C
		3	0	0	3

1. Course Description

The course "Design of Solar Photovoltaic Systems" offers a comprehensive exploration into the principles, technologies, and methodologies involved in designing efficient and cost-effective solar photovoltaic (PV) systems. As solar energy continues to play a crucial role in the transition towards renewable energy, there is a growing demand for professionals who can design, implement, and optimize solar PV systems for various applications.

2. Course Objectives:

1. To explain the fundamental principles and operational mechanisms of Solar Photovoltaic (PV) systems.
2. To outline and describe the key components and their functions within Solar PV systems.
3. To apply theoretical concepts to model and design a stand-alone Solar PV system tailored to specific energy needs and conditions.
4. To utilize design principles and technical knowledge to create and optimize a grid-connected Solar PV system for efficient energy integration.

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5. To explain and demonstrate the best practices for the installation, operation, and maintenance of Solar PV systems to ensure optimal performance and longevity.

3. Syllabus

Unit – I: Introduction to Solar PV Systems

Introduction to Solar Radiation: Optimum orientation of Solar PV modules – Solar related measuring devices. Solar PV Electricity – Introduction of Solar PV Modules – Interconnections of PV Modules.

Unit – II: Components of Solar PV Systems

Types of Solar PV systems, Photovoltaic System Components: Introduction to batteries – Charge controller – MPPT – Solar PV inverters – Wires and Cable sizing – Junction Boxes – Combiner Boxes – Fuses.

Unit – III: Stand – Alone PV System

Preparation of Load Chart – Solar Array Sizing – Battery Bank Sizing – Charge Controller Selection – Inverter Selection.

Unit – IV: Grid – Connected PV System

Assessment of Site condition – Estimation of Annual energy usage – average solar radiation of the site – Required demand – Inverter Selection – Solar Array Sizing – Balance of System (BOS) Selection – Net metering.

Unit – V: Installation, Troubleshooting and Safety of PV System

Preparation and General Consideration for Installation – Installation of Array support structure, Modules, Combiner boxes, AC and DC DB's, Inverter – Maintenance and troubleshooting Solar PV system – Electrical safety – Mechanical Safety – Safety Precautions for Batteries.

Text Books:

1. Solanki C.S, "Solar Photovoltaics: Fundamentals, Technologies and Applications", PHI Learning, 2015.
2. Rai. G.D, "Solar energy utilization", Khanna publishes, 1993.
3. Wenham S.R, Green M.A, Watt M.E, Corkish R, "Applied Photovoltaics", Earthscan, Third Edition, 2011.

References:

Reference Books:

1. McNeils, Frenkel, Desai, "Solar & Wind Energy Technologies", Wiley Eastern, 1990
2. Sukhatme S.P, "Solar Energy", Tata McGraw Hill,1987.
3. Eduardo Lorenzo G. Araujo, "Solar Electricity Engineering of Photovoltaic Systems", Progensa,1994

Journal References:

1. Progress in Photovoltaics
2. Energy and Environment
3. Renewable and Sustainable Energy
4. Advanced Energy Materials

Web Resources:

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1. https://www.solarenergy.org/courses/introduction-to-renewable-energy/
2. https://energsustainsoc.biomedcentral.com/articles/10.1186/s13705-019-0232-1
3. https://online.stanford.edu/programs/energy-innovation-and-emerging-technologies-program

MOOC / NPTEL / SWAYAM Courses:

1. https://onlinecourses.nptel.ac.in/noc24_ph29/preview
2. https://onlinecourses.nptel.ac.in/noc24_ch43/preview

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19EE606.1	Explain the fundamentals of Solar PV Systems
R19EE606.2	Outline the Components of Solar PV systems
R19EE606.3	Apply the concepts to model a Stand Alone PV System
R19EE606.4	Utilize the concepts to design a Grid connected PV System
R19EE606.5	Explain the Installation and Maintenance techniques of a Solar PV System

19EE607	PLC and SCADA	L	T	P	C
		3	0	0	3

1. Course Description:

The course aims to provide a comprehensive understanding of PLCs in industrial automation, covering their history, architecture, and capabilities. Students will learn PLC programming, including ladder logic and GX Works 2 software. The course includes HMI programming, interfacing PLCs with HMIs, and real-time problem-solving. Additionally, it covers Variable Frequency Drives (VFDs) and their configuration. Finally, the course introduces SCADA systems, focusing on architecture and communication protocols.

2. Course Objectives:

1. To provide the knowledge about the selection of PLC for different applications.
2. To enable the students to develop the ladder logic program for different industrial applications.
3. To provide the knowledge on configuration of GOT and its various functions in industrial automation.
4. To acquire the knowledge about programming of variable frequency drives for induction motor speed control applications.
5. To design and develop the SCADA system for totally integrated automation.

3. Syllabus

Unit – I: Introduction To PLC

History and developments in industrial automation; Control elements in industrial automation; Introduction: Basics of PLC, Advantages, Capabilities of PLC, Architecture of PLC, Scan cycle and Types of PLC; Types of sensors and I/O devices; Types of I/O modules; Configuring a PLC.

Unit – II: Programming of PLC

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Types of Programming: Ladder Programming; Creating programs using GX Works 2: Configuration of modular PLC and different modules in GX Works 2 platform; Process Control Programs using Relay Ladder Logic; PLC arithmetic functions; Timers and counters; Data transfer, Comparison and Manipulation instructions.

Unit – III: HMI Programming and Interfacing

Necessity and Role in Industrial Automation; New project creation using GT Designer: Text display, various screen and object creation; Interfacing PLC to HMI; Developing solutions for real time problems.

Unit – IV: Variable Frequency Drives

Introduction to VFD: Basic v/f concept, Power wiring and Control wiring. Configuration of VFD: Parameter setting; JOG operation; Buffer Memory; Speed Control of Induction Motor.

Unit – V: SCADA

Overview: Developer and runtime packages, Architecture, Tools and Tag; Internal & External graphics; Communication Protocols of SCADA.

Text Books:

1. Bolton W, "Programmable Logic Controllers", Elsevier, 2015.

References:

Reference Books:

1. Frank D Petruzella, "Programmable logic controllers", McGraw Hill, 2016.
2. John R Hackworth and Fredrick D Hackworth Jr., "Programmable Logic Controllers: Programming Methods and Applications", Pearson Education, 2006.
3. Mitsubishi Electric India PLC, SCADA, SERVO, VFD & ROBOTICS Programming Manuals.

Journal References:

1. IEEE Transactions on Industrial Electronics
2. Journal of Manufacturing Systems
3. International Journal of Automation and Control (IJAAC)
4. Control Engineering Practice
5. Journal of Process Control

Web Resources:

1. https://www.plcacademy.com/
2. https://www.automationdirect.com/programmable-logic-controllers/plc-training
3. https://www.mitsubishielectric.com/fa/products/cnt/plc/
4. https://www.youtube.com/@realpars
5. https://www.youtube.com/watch?v=gexOS7imMsE

MOOC / NPTEL / SWAYAM Courses:

1. https://onlinecourses.nptel.ac.in/noc20_me39/preview
2. https://www.eit.edu.au/courses/professional-certificate-of-competency-programmable-logic-controllers-plcs-scada-systems/

4. Course Outcomes:

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After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19EE607.1	Realize the architecture of PLC and different types of I/O devices
R19EE607.2	Design the HMI screens and I/O functions for the project development
R19EE607.3	Configure the Variable Frequency Drives for the speed control of Induction Motor
R19EE607.4	Develop the program for different Pick and Place Applications using Industrial Robot
R19EE607.5	Control the PLC, HMI from remote station using SCADA

R19IT601	Introduction to Software Engineering	L	T	P	C
		3	0	0	3

1. Course Description:

This course is designed to equip students with essential skills in software engineering, focusing on applying the right development models for various scenarios. Students will learn to effectively gather, analyze, and document project requirements through requirement engineering techniques. The course emphasizes evaluating and selecting suitable design models tailored to specific application needs. Additionally, students will apply testing principles to ensure the quality of software projects and utilize estimation techniques to manage resources, timelines, and costs for successful project management.

2. Course Objectives:

1. To select and apply appropriate software development models for specific scenarios
2. To gain skills in gathering, analysing, and documenting project requirements effectively.
3. To develop the ability to compare and choose suitable design models for various applications.
4. To apply software testing techniques to ensure project quality during development.
5. To apply estimation techniques to manage resources and project timelines effectively.

3. Syllabus:

Unit-I: Software Product and Process

Introduction to Software Engineering, Software Process, Perspective and Specialized Process Models – System Engineering – Computer Based System – Business Process Engineering Overview – Product Engineering Overview.

Unit-II: Requirements Analysis

Software Requirements: Functional and Non-Functional, User requirements, System requirements – Software Requirements Document - IEEE Standards for SRS – Requirement Engineering Process: Feasibility Studies, Requirements elicitation – Requirements analysis modeling techniques – requirements validation.

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Unit-III: Software Design
Design process: Design Concepts, Quality-Design Model, Heuristics - Architectural Design: Architectural styles-Architectural Mapping using Data Flow - Performing User interface design: Interface analysis and design models-Component level Design.
Unit-IV: Testing and Maintenance
Software testing fundamentals – Testing Strategies: White box testing – control structure testing, black box testing – Unit Testing, Integration Testing, Acceptance Testing –Regression Testing, Validation Testing, System Testing and Debugging – Software Implementation Techniques: Coding practices – Refactoring – Reverse and Forward Engineering.
Unit-V: Project Management
Software Project Management: Estimation – LOC, FP Based Estimation, Make/Buy Decision COCOMO Model – Project Scheduling – Scheduling, Earned Value Analysis Planning – Project Plan, Planning Process, RFP Risk Management – Identification, Projection - Risk Management-Risk Identification-RMMMPlan-CASE TOOLS
Text Books:
1. R.S. Pressman, "Software Engineering – A Practitioner's Approach", Eighth Edition, McGraw HillInternational Edition, 2015. 2. Ian Sommerville — "Software Engineering", 10th Edition, Pearson Education, 2016.
References:
1. Ronald J. Leach, "Introduction to Software Engineering", CRC Press, 2016. 2. Rod Stephens "Beginning Software Engineering", John Wiley & Sons, 2015.

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19IT601.1	Apply appropriate software engineering model for a given development scenario.
R19IT601.2	Apply appropriate requirement engineering techniques for realtime projects.
R19IT601.3	Compare and choose the suitable design models for the givenapplication scenario.
R19IT601.4	Apply the testing principles to software project development.
R19IT601.5	Apply the estimation techniques for software projectmanagement.

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R19IT602	Web Programming	L	T	P	C
		3	0	0	3

1. Course Description:

This course focuses on equipping students with practical skills in modern web development. Students will understand and apply object-oriented programming concepts using Java, along with mastering client-side programming for creating dynamic user interfaces. The course also covers server-side programming techniques, enabling students to build robust backend systems. Additionally, learners will explore PHP frameworks and the MVC architecture to structure projects efficiently. Finally, students will utilize relevant web frameworks and web services to build, deploy, and manage scalable and interactive web applications.

2. Course Objectives:

1. To implement object-oriented programming principles and Java semantics in real-world applications.
2. To Master the use of client-side technologies such as HTML, CSS, and JavaScript for interactive web development.
3. To develop skills to implement server-side functionality using technologies like Java, Node.js, or PHP for dynamic web applications.
4. To build web applications using PHP frameworks and apply the MVC architecture for organized project development.
5. To apply web frameworks and integrate web services to build, deploy, and manage scalable web applications.

3. Syllabus:

Unit-I: Web Fundamentals

Web Essentials: Clients, Servers and Communication – The Internet – Basic Internet protocols – World wide web – HTTP Request Message – HTTP Response Message – Web Clients – Web Servers – HTML5 – Tables – Lists – Image – HTML5 control elements – Semantic elements – Drag and Drop – Audio –Video controls - CSS3 – Inline, embedded and external style sheets – Rule cascading – Inheritance – Backgrounds – Border Images – Colors – Shadows – Text – Transformations – Transitions – Animations

Unit-II: Client Side Scripting Language

Java Script: An introduction to JavaScript–JavaScript DOM Model-Date and Objects,-Regular Expressions- Exception Handling-Validation-Built-in objects-Event Handling DHTML with JavaScript

Unit-III: Server Side Programming

Servlets: Java Servlet Architecture- Servlet Life Cycle- Form GET and POST actions Session Handling- Understanding Cookies- Installing and Configuring Apache Tomcat Web Server- Database Connectivity: JDBC perspectives, JDBC program example - JSP: Understanding Java Server Pages- JSP Standard Tag Library (JSTL)-Creating HTML

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forms by embedding JSP code.
Unit-IV: PHP and XML
Functions: Built-in Functions, User defined functions – Function Prototypes –Recursion – Command Line Argument -Arrays and Functions – Strings and Functions. Pointers: Declaration – Pointer operators – Pointer arithmetic -Passing Pointers to a Function – Pointers and one-dimensional arrays – Dynamic Memory Allocation
Unit-V: Introduction to Ajax and Web Services
AJAX: Ajax Client Server Architecture-XML Http Request Object-Call Back Methods; Web Services: Introduction- Java web services Basics – Creating, Publishing, Testing and Describing a Web services (WSDL)-Consuming a web service, Database Driven web service from an application –SOAP.
Text Books:
1. Deitel and Deitel and Nieto, —Internet and World Wide Web - How to Program, Prentice Hall, 5th Edition, 2011.
References:
1. Stephen Wynkoop and John Burke —Running a Perfect Website‖, QUE, 2nd Edition, 1999. 2. Chris Bates, Web Programming – Building Intranet Applications, 3rd Edition, Wiley Publications, 2009 3. Jeffrey C and Jackson, —Web Technologies A Computer Science Perspective‖, Pearson Education, 2011. 4. Gopalan N.P. and Akilandeswari J., —Web Technology‖, Prentice Hall of India, 2011. 5. UttamK.Roy, —Web Technologies‖, Oxford University Press, 2011.

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19IT602.1	Understand and apply the features of object-oriented programming paradigm and Java Semantics
R19IT602.2	Understand and apply the concepts of Client-side programming
R19IT602.3	Understand and apply the concepts of Server-Side Programming
R19IT602.4	Understand and apply the features of PHP frameworks and project development using MVC Architecture
R19IT602.5	Use relevant Web Frameworks along with web services for application building and deployment

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R19IT603	Basic of Software Testing	L	T	P	C
		3	0	0	3

1. Course Description:

This course focuses on equipping students with the knowledge and skills to design and execute effective software testing strategies across various domains. Students will learn to define appropriate test cases and understand fundamental concepts in software testing, including strategies and methods tailored to specific development scenarios. The course covers selecting suitable tests for different applications, designing detailed test cases, and preparing comprehensive test plans. Additionally, students will gain hands-on experience with automated testing tools to enhance efficiency and accuracy in the software testing process.

2. Course Objectives:

1. To identify and define suitable test cases for various software development domains.
2. To gain knowledge of fundamental testing concepts, strategies, and methods for different software domains.
3. To develop the ability to select the most appropriate tests to ensure software quality in different scenarios.
4. To learn to design effective test cases and prepare comprehensive test plan documents for software projects.
5. To understand and apply automated testing tools to streamline the software testing process.

3. Syllabus:

Unit-I: Fundamentals of Testing

Testing as an Engineering Activity – Testing as a Process – Basic definitions – Software Testing Principles – The Tester's Role in a Software Development Organization – Origins of Defects – Cost of defects – Defect Classes – The Defect Repository and Test Design – Defect Examples – Developer/Tester Support of Developing a Defect Repository.

Unit-II: Test Case Design Strategies

Test case Design Strategies – Using Black Box Approach to Test Case Design – Random Testing – Requirements based testing – Boundary Value Analysis – Equivalence Class Partitioning – State-based testing – Cause-effect graphing – Compatibility testing – user documentation testing – domain testing – Using White Box Approach to Test design – static testing vs. structural testing – code functional testing – Coverage and Control Flow Graphs – Covering Code Logic – Paths – code complexity testing – Evaluating Test Adequacy Criteria

Unit-III: Levels of Testing

The need for Levers of Testing – Unit Test – Unit Test Planning – Designing the Unit Tests – The Test Harness – Running the Unit tests and Recording results – Integration

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tests – Designing Integration Tests –System Testing – Acceptance testing – Performance testing – Regression Testing – Internationalization testing – Ad-hoc testing – Alpha, Beta Tests – Usability and Accessibility testing – Configuration testing – Compatibility testing – Website testing.
Unit-IV: Test Management
People and organizational issues in testing – Organization structures for testing teams – testing services – Test Planning – Test Plan Components – Test Plan Attachments – Locating Test Items – test management – test process – Reporting Test Results – The role of three groups in Test Planning and Policy Development – Introducing the test specialist – Skills needed by a test specialist – Building a Testing Group.
Unit-V: Test Automation
Software test automation – skill needed for automation – scope of automation – design and architecture for automation – requirements for a test tool – challenges in automation – Test metrics and measurements – project, progress and productivity metrics.
Text Books:
1. Paul C. Jorgensen, "Software Testing: A Craftsman's Approach", Fourth Edition, CRC Press, 2013. 2. Srinivasan Desikan and Gopalaswamy Ramesh, "Software Testing – Principles and Practices", Pearson Education, 2006. 3. Ilene Burnstein, "Practical Software Testing", Springer International Edition, 2003.
References:
1. Ali Mili, Fairouz Chier, "Software Testing: Concepts and Operations", Wiley, 2015. 2. Dorothy Graham, Mark Fewster, "Experiences of Test Automation: Case Studies of Software TestAutomation", Pearson Education, 2012. 3. Aditya P. Mathur, "Foundations of Software Testing _ Fundamental Algorithms and Techniques", Dorling Kindersley (India) Pvt. Ltd., Pearson Education, 2008.

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19IT603.1	Define the test cases which are suitable for a software development for different domain
R19IT603.2	Explain fundamental concepts in software testing, strategies and methods for a software development for different domains.
R19IT603.3	Determine the suitable tests to be carried out.
R19IT603.4	Design test cases and prepare a test plan document.
R19IT603.5	Describe the usage of the automatic testing tools.

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R19IT604	Introduction to Blockchain Technology	L	T	P	C
		3	0	0	3

1. Course Description:

This course provides a comprehensive understanding of blockchain technology, equipping students with the ability to describe its foundational concepts and emerging models. Students will explore the process of cryptocurrency issuance, proof-of-work, and alternative consensus mechanisms, while also gaining familiarity with the operational aspects of the cryptocurrency ecosystem. The course emphasizes practical implementation, enabling students to integrate blockchain technology in various domains, applying it to real-world scenarios and multiple perspectives.

2. Course Objectives:

1. To describe the foundational concepts and explain the workings of blockchain technology.
2. To explore and comprehend emerging abstract models in blockchain technology.
3. To gain insight into cryptocurrency issuance, proof-of-work, and alternative consensus mechanisms.
4. To understand the functional and operational aspects of the cryptocurrency ecosystem.
5. To apply and implement blockchain technology across various domains and perspectives.

3. Syllabus:

Unit-I: Basics of Blockchain

Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. Cryptography: Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof.

Unit-II: Blockchain

Introduction, Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public blockchain.

Unit-III: Distributed Consensus

Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate.

Unit-IV: Cryptocurrency

History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin

Unit-V: Cryptocurrency Regulation

Stakeholders, Roots of Bit coin, Legal Aspects-Crypto currency Exchange, Black Market

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and GlobalEconomy. **Applications:** Internet of Things, Medical Record Management System, Domain Name Service and future of Blockchain.
Text Books:
1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin andCryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016). 2. Imran Bashir, "Mastering Blockchain - Distributed ledgers, decentralization and smart contracts explained", Packt Publishing Ltd., Second Edition, 2017.
References:
1. Andreas M. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies, O'Reilly Media, Inc., December 2014 2. Bikramaditya Singhal, Gautama, Panda, "Beginning Blockchain: A Beginner's Guide to Building Blockchain Solutions", Apress. 3. DR. Gavin Wood, "ETHEREUM: A Secure Decentralized Transaction Ledger", Yellow paper 2014.

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19IT604.1	Describe and explain blockchain technology
R19IT604.2	Understand emergingabstract models for Blockchain Technology.
R19IT604.3	Understand the process of Cryptocurrencies issuance, proof-of-work and alternative consensus mechanisms and transaction
R19IT604.4	Familiarize the functional /operational aspects of Cryptocurrency ecosystem
R19IT604.5	Integrate ideas from various domains and implement them using block chain technology in different perspectives.

R19IT605	Soft Computing Technologies	L	T	P	C
		3	0	0	3

1. Course Description:

This course provides a deep dive into the fundamentals of artificial intelligence, beginning with an understanding of human intelligence and its connection to AI. Students will explore the basics of fuzzy logic and neural networks, delving into concepts like fuzzy sets and heuristic approaches inspired by human reasoning. The course also examines genetic algorithms and random search procedures, emphasizing their role in self-learning and optimization tasks. In addition, students will gain exposure to current research problems and methods in soft computing, fostering an understanding of cutting-edge developments in this field.

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2. Course Objectives:

1. To learn the fundamental concepts of human intelligence and how they relate to artificial intelligence.
2. To gain a foundational understanding of fuzzy logic and neural networks.
3. To explore the concepts of fuzzy sets, fuzzy logic, and the use of heuristics derived from human experience.
4. To investigate the use of genetic algorithms and random search methods for finding global optima in self-learning scenarios.
5. To develop familiarity with current research challenges and methods in soft computing techniques.

3. Syllabus:

Unit-I: Introduction to Soft Computing

Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques, Fuzzy Computing, Neural Computing, Genetic Algorithms, Associative Memory, Adaptive Resonance Theory, Classification, Clustering, Bayesian Networks

Unit-II: Artificial Neural Networks

Neural Network: Biological and Artificial Neuron, Neural Networks, Supervised and Unsupervised Learning. Single Layer Perceptron - Multilayer Perceptron – Back propagation Learning.

Unit-III: Fuzzy Systems

Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets – Classical Relations and Fuzzy Relations - Membership Functions -Defuzzification – Fuzzy Arithmetic and Fuzzy Measures -Fuzzy Rule Base and Approximate Reasoning

Unit-IV: Genetic Algorithms

Basic Concepts- Working Principles -Encoding- Fitness Function – Reproduction - Inheritance Operators – Cross Over – Inversion and Deletion -Mutation Operator

Unit-V: Hybrid Systems

Hybrid Systems -Neural Networks, Fuzzy Logic and Genetic -GA Based Weight Determination – LR- Type Fuzzy Numbers – Fuzzy Neuron – Fuzzy BP Architecture – Learning in Fuzzy BP

Text Books:

1. Herbert Schildt, "C – The Complete Reference", Tata McGraw Hill Publishing Company, New Delhi, 2017.
2. N.P.Padhy, S.P.Simon, "Soft Computing with MATLAB Programming", Oxford University Press, 2015
3. J.S.R.Jang, C.T.Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", PHI, 2004, Pearson Education 2004

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1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, —Neuro-Fuzzy and Soft Computing, Prentice-Hall of India, 2002.
2. KwangH.Lee, —First course on Fuzzy Theory and Applications, Springer, 2005.
3. George J. Klir and Bo Yuan, —Fuzzy Sets and Fuzzy Logic-Theory and Applications, Prentice Hall,1996.
4. S.N.Sivanandam , S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt. Ltd., 2nd Edition, 2011.

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19IT605.1	Understand human intelligence and AI
R19IT605.2	Generalize basics of Fuzzy logic and neural networks
R19IT605.3	Discuss the ideas of fuzzy sets, fuzzy logic and use of heuristics based on human experience
R19IT605.4	Examine with genetic algorithms and other random search procedures useful while seeking global optimum in self-learning situations
R19IT605.5	Experiment some familiarity with current research problems and research methods in Soft Computing Techniques.

R19IT606	Fundamentals of IT Infrastructure Management	L	T	P	C
		3	0	0	3

1. Course Description:

This course provides a comprehensive understanding of IT infrastructure design, starting with the basics of ITIL and its role in improving IT services. Students will explore various IT infrastructure management operations and learn to distinguish their key components. The course also covers strategic methods for managing storage in IT environments and introduces the essentials of security management in Information Technology. Additionally, students will stay up to date with the latest global trends in IT, gaining insight into current innovations and how they impact the industry worldwide.

2. Course Objectives:

1. To learn the fundamental principles of IT infrastructure design and the ITIL framework.
2. To develop the ability to differentiate between different IT infrastructure management operations.
3. To gain knowledge of strategic methods for managing storage in IT systems.
4. To learn the principles and practices of security management in Information Technology.
5. To gain detailed knowledge of recent trends and innovations in IT on a global scale.

3. Syllabus:

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Unit-I: IT Infrastructure: Overview
Introduction - Challenges in IT Infrastructure Management, DesignIssues- Determining Customer's Requirements, IT Systems and Service Management Process, IT Infrastructure Library.
Unit-II: IT Infrastructure Management
Service Delivery Process: Service Level Agreements, Financial Management, IT Service Continuity Management, Capacity Management, Availability Management.
Unit-III: Storage Management
Introduction, Backup and Storage, Archive and Retrieve, Disaster Recovery, Space Management, Database and Application Protection, BMR, and Data Retention.
Unit-IV: Security Management
Security Management: Introduction, Computer Security, Internet Security, Physical Security, Identity Management, Access Control, Intrusion Detection.
Unit-V: Emerging Trends in IT
E-Commerce, Electronic Data Interchange, Global System for Mobile Communication (GSM), Bluetooth, Infrared Technology.
Text Books:
1. Phalguni Gupta, "IT Infrastructure and Its Management", Tata McGraw Hill Publishing Company, New Delhi, 2010. 2. Rich Schiesser, "IT Systems Management: Designing, Implementing, and Managing World-Class Infrastructures", Pearson, 2001.
References:
1. S.C.Mourya," IT Infrastructure and Its Management- A conceptual Approach", TechnicalPublications, 2014. 2. Anita Sengar "IT Infrastructure Management", S K Kataria publications, 2012. 3. Mani Subrahmanian, "Network Management, Principles and Practice", Pearson Education,2010.

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19IT606.1	Understand the basics of IT infrastructure design and ITIL.
R19IT606.2	Distinguish between various IT Infrastructure Management Operations.
R19IT606.3	Understand the strategic methods of storage management in Information Technology.
R19IT606.4	Able to know the Security Management in Information Technology.
R19IT606.5	Able to Know about the Detailed Knowledge of IT Recent Trends in Globally.

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R19IT607	Mobile Application Development	L	T	P	C
		3	0	0	3

1. Course Description:

This course focuses on the intricacies of mobile application design and development, starting with an exploration of the challenges developers face in creating user-friendly and efficient applications. Students will learn to apply practical knowledge to design mobile applications that meet specific requirements, and they will implement these designs using the Android SDK. The course covers the development of applications utilizing various components of the Android framework, equipping students with the skills to build robust mobile solutions. Additionally, learners will gain hands-on experience in integrating file handling and database management into their Android applications, ensuring they can create fully functional and data-driven mobile experiences.

2. Course Objectives:

1. To understand and articulate the common challenges faced in the design and development of mobile applications.
2. To utilize practical knowledge to create designs for mobile applications tailored to specific user needs.
3. To learn to implement mobile application designs using the Android Software Development Kit (SDK).
4. To gain experience in developing mobile applications utilizing various components of the Android framework.
5. To develop Android applications that effectively integrate file handling and database management functionalities.

3. Syllabus:

Unit-I: Fundamentals of Android

Introduction to Android, Android versions and its feature,Android Development Environment - SystemRequirements, Android SDK, Installing Java, and ADT bundle - Eclipse Integrated Development Environment (IDE), Creating Android Virtual Devices (AVDs)- Market and business drivers for mobile applications – Requirements gathering and validation for mobile applications.

Unit-II: Design Aspects

Introduction – Basics of embedded systems design – Embedded OS - Design constraints for mobile applications, both hardware and software related – Architecting mobile applications – Android Libraries, Application Framework, Creating a New Android Project , Defining the Project Name and SDK Settings, Project Configuration Settings, Configuring the Launcher Icon, Creating an Activity, Running the Application in the AVD, Stopping a Running Application, Modifying the Example Application, Reviewing the Layout and Resource Files

Unit-III: Android Development Platform

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Understanding Java SE and Virtual Machine, The Directory Structure of an Android Project, Common Default Resources Folders, The Values Folder, Leveraging Android XML, Screen Sizes , Launching Your Application: The AndroidManifest.xml File,Creating Your First Android Application
Unit-IV: Android Framework Overview
Android Application Components, Android Activities: Defining the UI, Android Services: Processing inthe Background, Broadcast Receivers: Announcements and Notifications Content Providers: Data Management. Android Intent Objects: Messaging for Components. Android Manifest XML: Declaring Your Components, Views and View Groups, Android Layout Managers, The View Hierarchy, Designing an Android User Interface using the Graphical Layout Tool
Unit-V: Files, Content Providers, and Databases
Saving and Loading Files, SQLite Databases, Android Database Design, Exposing Access to a Data Source through a Content Provider, Content Provider Registration, Native Content Providers, Packaging and deployment – Interaction with server side applications – Using Google Maps, GPS and Wifi – Integration with social media applications
Text Books:
1. Code Complete: A Practical Handbook of Software Construction, 2016, 2nd Edition by Steve McConnell. 2. Mobile Apps Made Simple: The Ultimate Guide to Quickly Creating, Designing and Utilizing MobileApps for Your Business, 2016,2nd Edition by Jonathan McCallister 3. Android Application Development Cookbook- 2016, Second Edition by Rick Boyer and Kyle Mew
References:
1. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", Wrox, 2012 2. Charlie Collins, Michael Galpin and Matthias Kappler, "Android in Practice", DreamTech, 2012 3. James Dovey and Ash Furrow, "Beginning Objective C", Apress, 2012. 4. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, "Beginning iOS 6 Development: Exploring the iOS SDK", Apress, 2013.

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19IT607.1	Describe the challenges in mobile application design and development
R19IT607.2	Use Practical Knowledge of the design for mobile applications forspecific requirements
R19IT607.3	Implement the design using Android SDK
R19IT607.4	Develop applications using components of android framework
R19IT607.5	Develop android applications including files and databases

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R19IT651	Basics of Cloud Technology	L	T	P	C
		2	0	2	3

1. Course Description:

Delve into Cloud Computing fundamentals, virtualization, and deployment models, alongside software security objectives, design principles, and development practices. Assess risks, challenges, and threats to infrastructure, data, and access control, while addressing security architecture issues, identity management, and autonomic security for comprehensive cloud protection and management

2. Course Objectives:

To make students familiar with:

1. Fundamentals of Cloud Computing
2. The Concepts of Virtualization and the Cloud delivery and Deployment Models
3. Cloud computing software security objectives, design principles and development practices
4. Cloud computing risks, challenges and threats to infrastructure, data and access control
5. Cloud computing security architectural issues, Identity management and Autonomic security

3. Syllabus:

Unit-I: Cloud Computing fundamentals

Essential characteristics, Architectural Influences, Technological Influences, and Operational Influences.

Unit-II: Cloud Computing Architecture

Cloud Delivery models, The SPI Framework, Cloud Software as a Service (SaaS) , Cloud Platform as a Service(PaaS), Cloud Infrastructure as a Service(IaaS), Cloud deployment models, Public Clouds, Community Clouds, Hybrid Clouds, Alternative Deployment models, Expected benefits.

Unit-III: Cloud Computing Software Security fundamentals

Cloud Information Security Objectives, Confidentiality, Integrity, Availability, Cloud Security Services, Relevant Cloud Security Design Principles, Secure Cloud Software Requirements, Secure Development practices, Approaches to Cloud Software Requirement Engineering, Cloud Security Policy Implementation.

Unit-IV: Cloud Computing Risk Issues & challenges

Cloud Computing Risk Issues: The CIA Traid, Privacy and Compliance Risks, Threats to Infrastructure, Data and Access Control, Cloud Access Control Issues, Cloud Service Provider Risks.

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Unit-V: Cloud Computing Security Architecture
Architectural Considerations, General Issues, Trusted Cloud Computing, Secure Execution environments and Communications, Micro architectures, Identity Management and Access Control, Autonomic Security
List of Experiments:
1. Install Virtual box and create a windows/linux virtual image and analyze the virtual configuration 2. Register with Amazon AWS and create a windows/linux instance and connect with RDP and create S3 buckets. 3. A case study on Amazon Elastic Cloud Services 4. A case study on Azure 5. Installation and Configuration of Just cloud.
Text Books:
1. Ronald L. Krutz, Russell Dean Vines, "Cloud Security A Comprehensive Guide to secure Cloud Computing" Wiley.
References:
1. John W. itinghouse james F. Ransome, "Cloud Computing Implementation, Management and Security", CRC Press 2. Borko Furht. Armando Escalante, "Handbook of Cloud Computing", Springer 3. Charles Badcock, "Cloud Revolution" , TMH

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19IT651.1	Articulate the main concepts, key technologies, strengths, limitations of cloud computing and the possible applications for state-of-the-art cloud computing.
R19IT651.2	Identify the architecture and infrastructure of cloud computing, including cloud delivery and deployment models.
R19IT651.3	Analyze the core issues of cloud computing such as security, privacy, and interoperability
R19IT651.4	Identify problems and analyze the various cloud computing solutions.
R19IT651.5	Analyze appropriate cloud computing solutions and recommendations according to the applications used.

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R19IT652	Introduction to Computer Networks	L	T	P	C
		2	0	2	3

1. Course Description:

This course provides a comprehensive understanding of computer networks, beginning with the division of network functionalities into layers and the role of transmission media. Students will study data link layer protocols and be introduced to IEEE standards that define how networks operate. The course also covers the tracing of data flow between nodes in a network, providing insights into how information is transmitted efficiently. Learners will gain a solid understanding of different routing protocols used to manage data traffic across networks. Additionally, students will familiarize themselves with various network applications and their functionalities, preparing them for practical applications in the field of networking.

2. Course Objectives:

1. To learn the concept of dividing network functionalities into layers and understand the role of transmission media.
2. To study various data link layer protocols and get introduced to IEEE networking standards.
3. To understand how data flows from one node to another in a network.
4. To gain knowledge of various routing protocols used for directing data in networks.
5. To explore common network applications and understand their functionalities in network environments.

3. Syllabus:

Unit – I: Networking Fundamentals

Computer Networks Applications-Network Types: PAN, LAN, MAN and WAN Network-Internet-Reference Models: OSI Reference Model-TCP/IP Reference Model-Comparison of OSI and TCP/IP-Critique of Reference Models.

Unit-II: Datalink Layer

Framing; Error control including Bit-parity, CRC and Hamming Codes; Reliable transmission and Automatic Repeat Request (ARQ) protocols including Stop-and-Wait, Go-back-N, Selective Repeat. Performance analysis of ARQ protocols. Example protocols such as HDLC and PPP.

Unit – III: Transport Layer

Elements of Transport Layer Protocols, The Internet Transport Protocols: Details of TCP header and operation, Performance problems in Computer Networks, UDP Header.

Unit – IV: Network Layer

Network Design issues, Routing protocols including distance-vector and link-state approaches Routing Algorithms including Dijkstra's algorithm and distributed Bellman-Ford algorithm; Example protocols: OSPF, RIP, BGP. Approaches to Congestion Control, Packet scheduling, Ipv4 and Ipv6 addressing and headers. Gateway protocol concepts.

Unit – V: Application Layer

DNS–The Domain Name System, Electronic mail, The World wide web: Architectural overview, FTP, HTTP and Mobile web.

List of Experiments:

1. Setting up LAN connections using Ethernet cables, configure IP addresses and subnet masks manually and using DHCP.

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2. Installing and configuring a simple HTTP server (e.g., Apache, Nginx), Creating and hosting a basic website, and accessing the website from different computers within the network.
3. Setting up an FTP server, Uploading and downloading files using FTP clients & explore FTP commands and permissions.
4. Configuring a DNS server (e.g., BIND) for domain name resolution, Creating and managing DNS records (A, CNAME, MX records), Testing name resolution using nslookup and dig commands.
5. Configuring a firewall (e.g., iptables) to allow/block specific traffic, implementing access control lists (ACLs) to restrict network access, Testing firewall rules and monitoring network traffic.
6. Setting up a wireless access point (WAP) and configuring SSIDs and security settings, connecting devices to the wireless network and test connectivity & Analyze wireless network performance and signal strength.
7. Using network monitoring tools (e.g., Wireshark) to capture and analyze network packets, identify network protocols, traffic patterns, and anomalies, troubleshoot network issues based on packet analysis.
8. Designing and simulate network topology with routers, switches, PCs using network simulation software (e.g., Cisco Packet Tracer, GNS3) & Configuring routers with RIP to connect different network.
9. Simulate OSPF protocol in Packet Tracer / GNS3 to optimize network selection among routers.
10. Test network behavior after configuring exterior protocol EIGRP.

Text Books:

1. JamesF. Kurose, KeithW. Ross, "Computer Networking: A Top-Down Approach", Seventh Edition, Pearson Education, 2017.
2. S.Tanenbaum,David J,Wetherall, "Computer Networks Andrew S". Pearson Education India 5th Edition, 2013

References:

1 LarryL.Peterson,BruceS.Davie,"ComputerNetworks:ASystemsApproach",FifthEditio n,Morgan Kaufmann Publishers, 2011.

2 BehrouzA.Forouzan,"DatacommunicationandNetworking",FourthEdition,TataMcGra w –Hill, 2011

4. Course Outcomes:

CO. No.	Course Outcome
R19IT652.1	Understanding of networking concepts, including protocols, topologies, addressing schemes, and OSI/TCP/IP models.
R19IT652.2	Articulate the functions and operations of data link layer protocols such as HDLC, PPP, Ethernet, and IEEE 802.11.
R19IT652.3	Describe and differentiate between various transport layer protocols such as TCP (Transmission Control Protocol) and UDP (User Datagram Protocol)
R19IT652.4	Comprehend the role and functions of the network layer in the OSI and TCP/IP models, including routing, addressing, and packet forwarding.
R19IT652.5	Describe and differentiate between various application layer protocols such as HTTP, FTP, SMTP, DNS, and their functionalities.

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R19IT653	Game Programming Fundamentals	L	T	P	C
		2	0	2	3

1. Course Description:

This course helps the students to gain foundational knowledge in the video game development process. In this course, The students can able to learn about the Game Design, Game play Development, Understand the inner workings of an engaging game such as game play mechanics, artificial intelligence, and user experience, Game Assets.

2. Course Objectives:

1. To learn Game Essentials, Types of Games, Stages of Design process
2. To understand requirements of designing a game
3. To learn how a concept turns into a game, and game world
4. To create a expressive play, characters in the game
5. To learn general principles of level design and design issues of online gaming

3. Syllabus:

Unit – I:Design and Development of Games

Games and Video Games: Game, Conventional Games Versus Video Games, Games for Entertainment, Serious Games; **Designing and Developing Games:** An Approach to the Task, Key Components of Video Games, The Structure of a Video Game, Stages of the Design Process, Game Design Team Roles, Game Design Documents, The Anatomy of a Game Designer.

Unit-II: Understanding the Game Genres

The Major Genres: Genre, The Classic Game Genres; **Understanding Your Player**: VandenBerghe's Five Domains of Play, Demographic Categories, Gamer Dedication, The Dangers of Binary Thinking**; Understanding Your Machine:** Home Game Consoles, Personal Computers, Portable Devices Other Devices.

Unit – III: GAME World

Game Concepts: Getting an Idea, From Idea to Game; **Concept Game Worlds**: Game World, The Purposes of a Game World, The Dimensions of a Game World, Realism

Unit – IV: Characteristics of GAME & Story Telling

Creative and Expressive Play: Self-Defining Play, Creative Play, Other Forms of Expression, Game Modifications; **Character Development:** The Goals of Character Design, The Relationship Between Player and Avatar, Visual Appearances, Character Depth, Audio Design; **Storytelling:** Put Stories in Games, Key Concepts, The Storytelling Engine, Linear Stories, Nonlinear Stories, Granularity, Mechanisms for Advancing the Plot, Emotional Limits of Interactive Stories, Scripted Conversations and Dialogue Trees, When to Write the Story, Other Considerations

Unit – V:Creating the User Experience

General Principles of Level Design: Level Design, Key Design Principles, Layouts, Expanding on the Principles of Level Design, The Level Design Process, Pitfalls of Level Design; **Design Issues for Online Gaming**: Online Games, Advantages of Online Games, Disadvantages of Online Games, Design Issues, Technical Security, Persistent Worlds, Social Problems

Text Books:

1. Ernest Adams," Fundamentals of Game Design", Third Edition, by, New Riders, 2022,ISBN: 9780133435726

References:

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1. Tynan Sylvester, "Designing Games: A Guide to Engineering Experiences", OREILLY Publication, 2013.
2. Briar Lee Mitchell, "Game Design Essentials", Sybex Publications, 2013.

List of Experiments:

1. OpenGL. OpenGL graphics library: basic concepts and usage
2. Data types and multi-platform issues.
3. 3D graphics. 3D objects and conventions. Coordinate systems and transformations. Coding / drawing. Drawing and managing 3D objects.
4. Input and sounds. Handling buttons and other input devices. The XBox 360 controller. Multi-channel sound. Managing game sounds
5. Simple game physics. Moving objects. Concepts in collision detection
6. Cameras and images. Cameras: Othographic, bitmap and perspective views. Loading, drawing and managing images.
7. Texture mapping. Basic concepts of texture application. UV coordinates, texels and rendering operations
8. Mini Project

5. Course Outcomes:

CO. No.	Course Outcome
R19IT653.1	Examine the Game Essentials, Types of Games, Stages of Design process
R19IT653.2	Identify the requirements of designing a game
R19IT653.3	Create a expressive play and characters in the game
R19IT653.4	Experiment with the various components of storytelling
R19IT653.5	Apply the general principles of level design and design issues of online gaming

R19ME601	Product Design and Innovation	L	T	P	C
		3	0	0	3

1.Course Description:

This course explores the principles, methodologies, and practices involved in the creation and innovation of products. Students will learn about the complete product design process, from initial research and concept development to prototyping and final production. The course integrates design thinking, user-centered design, and lean methodologies to foster a deep understanding of how to create innovative and marketable products. Through a combination of theoretical knowledge and practical exercises, students will develop the skills necessary to generate creative ideas, solve complex design problems, and bring their concepts to life.

2. Course Objectives:

1. Understand the Fundamentals of Product Design and Innovation
2. Apply Design Thinking Principles
3. Conduct Effective Research and Analysis
4. Develop Prototypes and Iterate Designs

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5. Manage the Product Development Process
6. Present and Communicate Design Ideas

3.Syllabus

Unit-I: Introduction

Need for design creativity – creative thinking for quality – essential theory about directed creativity

Unit-II: Mechanism of Thinking and Visualization

Definitions and theory of mechanisms of mind heuristics and models: attitudes, Approaches and Actions that support creative thinking - Advanced study of visual elements and principles- line, plane, shape, form, pattern, texture gradation, colour symmetry. Spatial relationships and compositions in 2 and 3 dimensional space - procedure for genuine graphical computer animation – Animation aerodynamics – virtual environments in scientific Visualization – Unifying principle of data management for scientific visualization – Unifying principle of data management for scientific visualization - Visualization benchmarking

Unit-III: Creativity

Methods and tools for Directed Creativity – Basic Principles – Tools of Directed Creativity – Tools that prepare the mind for creative thought – stimulation of new ideas – Development and Actions: - Processes in creativity ICEDIP – Inspiration, Clarification, Distillation, Perspiration, Evaluation and Incubation – Creativity and Motivation the Bridge between man creativity and the rewards of innovativeness – Applying Directed Creativity to the challenge of quality management

Unit-IV: Design

Process Design, Emotional Design – Three levels of Design – Visceral, Behavioural and Reflective- Recycling and availability-Creativity and customer needs analysis – Innovative product and service designs, future directions in this application of creativity thinking in quality management

Unit-V: Innovation

Achieving Creativity – Introduction to TRIZ methodology of Inventive Problem Solving - the essential factors – Innovator's solution – creating and sustaining successful growth – Disruptive Innovation model – Segmented Models – New market disruption - Commoditation and DE-commoditation – Managing the Strategy Development Process – The Role of Senior Executive in Leading New Growth – Passing the Baton

Text Books:

1. Donald A. Norman," Emotional Design", Perseus Books Group New York, 2004
2. Geoffrey Petty," how to be better at Creativity", The Industrial Society 1999

Reference Books:

1. Clayton M. Christensen Michael E. Raynor," The Innovator's Solution", Harvard Business School Press Boston, USA, 2003
2. Semyon D. Savransky," Engineering of Creativity – TRIZ", CRC Press New York USA," 2000

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3. Rousing Creativity: Think New Now, Floyd Hurr, ISBN 1560525479, Crisp Publications Inc. 1999

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19ME601.1	(Understand) Understand the various techniques adopted for stimulating creativity and innovation
R19ME601.2	(Apply) Apply the techniques to the design and development of new products
R19ME601.3	(Analyze) Identify and analyse the product design and development processes in the manufacturing industry.
R19ME601.4	(Apply) Apply creative process techniques in synthesizing information, problem-solving and critical thinking.
R19ME601.5	(Apply) Use the Product Design and Development Process, as a means to manage the development of an idea from concept through to production.

R19ME602	3D Printing and Tooling	L	T	P	C
		3	0	0	3

1. Course Description:

This course provides an in-depth exploration of 3D printing technologies and their applications in modern tooling and manufacturing processes. Students will gain a comprehensive understanding of additive manufacturing techniques, materials used in 3D printing, and the design considerations necessary for creating functional and efficient tools. The course combines theoretical knowledge with hands-on experience, enabling students to design, print, and evaluate 3D-printed components. Key topics include CAD modelling, the operation of 3D printers, post-processing techniques, and the integration of 3D printing into traditional manufacturing workflows.

2. Course Objectives:

1. Understand the Fundamentals of 3D Printing
2. Apply design principles that take into account the limitations and advantages of 3D printing, such as support structures, layer orientation, and material properties.
3. Understand the properties of various 3D printing materials, including plastics, metals, and composites.
4. Apply post-processing methods such as sanding, painting, and annealing to improve the quality and functionality of 3D-printed parts.
5. Analyze the benefits and challenges of integrating 3D printing into existing manufacturing workflows.

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3.Syllabus
Unit-I: Introduction
Need - Development of AM systems – AM process chain - Impact of AM on Product Development - Virtual Prototyping- Rapid Tooling – RP to AM -Classification of AM processes- Applications.
Unit-II: Reverse Engineering and CAD Modelling
Basic concept- Digitization techniques – Model reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data requirements – Geometric modelling techniques: Wireframe, surface and solid modelling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation Software for AM- Case studies.
Unit-III: Liquid Based and Solid Based Additive Manufacturing Systems
Stereo lithography Apparatus (SLA): Principle, pre-build process, part-building and post-build processes, photo polymerization of SL resins, part quality and process planning, recoating issues, materials, advantages, limitations and applications. Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications. Fused deposition Modeling (FDM): Principle, details of processes, process variables, types, products, materials and applications. Laminated Object Manufacturing (LOM): Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies
Unit-IV: Powder Based Additive Manufacturing Systems
Selective Laser Sintering (SLS): Principle, process, Indirect and direct SLS- powder structures, materials, post processing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping (LENS): Processes, materials, products, advantages, limitations and applications– Case Studies.
Unit-V: Tooling
Classification, Soft tooling, Production tooling, Bridge tooling, direct and indirect tooling, Fabrication processes, Applications Case studies automotive, aerospace and electronics industries.
Text Books:
1. Chua, C.K., Leong K.F. and Lim C.S., "Rapid prototyping: Principles and applications", second edition, World Scientific Publishers, 2010. 2. Gibson, I., Rosen, D.W. and Stucker, B., "Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010.
Reference Books: 1. Gebhardt, A., "Rapid prototyping", Hanser Gardener Publications, 2003 2. Kamrani, A.K. and Nasr, E.A., "Rapid Prototyping: Theory and practice", Springer, 2006.

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3. Hilton, P.D. and Jacobs, P.F., Rapid Tooling: Technologies and Industrial Applications, CRC press, 2005.
4. Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications: A toolbox for prototype development", CRC Press, 2011.

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19ME602.1	(Understand) Understand the history, concepts and terminology of additive manufacturing
R19ME602.2	(Apply) Apply the reverse engineering concepts for design development
R19ME602.3	(Understand) Understand the variety of additive manufacturing techniques
R19ME602.4	(Apply) Design and develop newer tooling models
R19ME602.5	(Analyze) Analyse the cases relevant to mass customization and some of the important research challenges associated with AM and its data processing tools

R19ME603	Quality Management	L	T	P	C
		3	0	0	3

1.Course Description:

This course provides a comprehensive overview of quality management principles, practices, and methodologies. Students will explore the concepts and tools necessary to ensure quality in products and services, focusing on both theoretical foundations and practical applications. Topics covered include the history and evolution of quality management, key quality frameworks and standards (such as ISO 9001), statistical quality control, Six Sigma, and Total Quality Management (TQM). Through case studies, real-world examples, and hands-on projects, students will learn how to implement quality management systems and continuous improvement initiatives to enhance organizational performance.

2. Course Objectives:

1. Trace the historical development of quality management and its key contributors.
2. Develop and implement quality management systems (QMS) in organizational settings.
3. Utilize various tools such as Pareto charts, cause-and-effect diagrams, and flowcharts to identify and solve quality issues.
4. Implement process improvement strategies to enhance efficiency and effectiveness.
5. Develop strategies to improve customer satisfaction and loyalty.

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6. Implement best practices from different quality standards to improve organizational performance.

3.Syllabus

Unit-I: Introduction

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, and Customer retention.

Unit-II: TQM Principles

Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

Unit-III: TQM Tools And Techniques I

The seven traditional tools of quality - New management tools - Six Sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Benchmarking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

Unit-IV: TQM Tools And Techniques II

Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

Unit-V: Quality Management System

Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements—Implementation—Documentation—Internal Audits—Registration- Environmental Management System: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001—Benefits of EMS.

Text Books:

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, "Total Quality Management", Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.
2. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.

Reference Books:

1. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
2. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
3. ISO 9001-2015 standards

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4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19ME603.1	(Understand) Acquire the basic concepts of total quality management and contributions by Deming, juran and Crossby.
R19ME603.2	(Understand) Acquire the knowledge of total quality management principles and apply the same in manufacturing and service organizations
R19ME603.3	(Apply) Explain the various tools and techniques of total quality management and solve various quality-related problems.
R19ME603.4	(Apply) Explain the various tools and techniques and apply the concepts of Six Sigma in the manufacturing &service sectors.
R19ME603.5	(Apply) Apply ISO 9000-2000 & ISO 14000 quality systems in a product and service organization.

R19ME604	Enterprise Resource Planning	L	T	P	C
		3	0	0	3

1.Course Description:

This course offers a comprehensive understanding of Enterprise Resource Planning (ERP) systems and their role in integrating various business processes across an organization. Students will learn about the core components of ERP systems, including modules for finance, human resources, supply chain management, and customer relationship management. The course covers the selection, implementation, and management of ERP systems, as well as the challenges and best practices associated with ERP projects. Through case studies, practical exercises, and real-world examples, students will gain the skills necessary to effectively utilize ERP systems to improve organizational efficiency and decision-making.

2. Course Objectives:

1. Define ERP and explain its purpose and importance in modern organizations.
2. Understand the technological advancements that have shaped ERP systems.
3. Map out key business processes and identify how they are integrated within an ERP system.
4. Develop criteria for selecting the appropriate ERP system for an organization.
5. Learn best practices for project management, including risk management and change management.
6. Understand the future direction of ERP systems and their potential impact on businesses.

3.Syllabus

Unit-I: Enterprise Resource Planning

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Principle – ERP framework – Business Blue Print – Business Engineering vs Business process Re-Engineering – Tools – Languages – Value chain – Supply and Demand chain – Extended supply chain management – Dynamic Models –Process Models.
Unit-II: Technology and Architecture
Client/Server architecture – Technology choices – Internet direction – Evaluation framework – CRM – CRM pricing – chain safety – Evaluation framework.
Unit-III: ERP System Packages
SAP, People soft, Baan and Oracle – Comparison – Integration of different ERP applications – ERP as sales force automation – Integration of ERP and Internet – ERP Implementation strategies – Organisational and social issues.
Unit-IV: ERP Architecture
Overview – Architecture – AIM – applications – Oracle SCM.SAP: Overview – Architecture – applications -Before and after Y2k – critical issues – Training on various modules of IBCS ERP Package-Oracle ERP and MAXIMO, including ERP on the NET
Unit-V: ERP Procurement Issues
Market Trends – Outsourcing ERP – Economics – Hidden Cost Issues – ROI – Analysis of cases from five Indian Companies.
Text Books:
1. ERPWARE, ERP Implementation Framework, Garg & Venkitakrishnan, Prentice Hall, 1999 2. Sadagopan.S , ERP-A Managerial Perspective, Tata Mcgraw Hill, 1999.
Reference Books: 1. Jose Antonio Fernandez, The SAP R/3 Handbook, Tata Mcgraw Hill, 1998. 2. Thomas E Vollmann and BeryWhybark, Manufacturing and Control Systems, Galgothia Publications, 1998. 3. Vinod Kumar Crag and N.K.Venkitakrishnan, Enterprise Resource Planning – Concepts and Practice, Prentice Hall of India, 1998.

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19ME604.1	(Understand) Provide an integrated view of the various facets of business, including planning, manufacturing, sales, finance and marketing.
R19ME604.2	(Understand) Understand the development of software to integrate business activities such as inventory management and control, order tracking, customer service, finance and human resources.

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R19ME604.3	(Apply) Become aware of the software applications and tools that are available to business to use to drive out costs and improve efficiency.
R19ME604.4	(Apply) Identify the important business functions provided by typical business software such as enterprise resource planning and customer relationship management
R19ME604.5	(Analyze) Develop skills necessary for building and managing relationships with customers, and stakeholders.

R19ME605	Micro Electro Mechanical Systems	L	T	P	C
		3	0	0	3

1.Course Description:

This course explores MEMS and Microsystems, covering materials, working principles, mechanics, scaling laws, design considerations, fabrication processes (including photolithography and micromachining), packaging technologies, and micrometrology techniques. Emphasis is on integrating theory with practical applications across various industries.

2. Course Objectives:

1. Understand MEMS materials and fabrication techniques to design microsystems for diverse applications.
2. Learn scaling laws and engineering principles to optimize the design and performance of MEMS devices.
3. Implement advanced micromachining processes for precise fabrication of microstructures.
4. Understand packaging technologies to ensure reliability and functionality of microsystems.
5. Utilize micro metrology tools for accurate characterization and analysis of MEMS components.

3.Syllabus

Unit-I: Introduction

Overview of MEMS and Microsystems: MEMS and Microsystems, Evolution of Microfabrication, Microsystems and Microelectronics, Microsystems and miniaturization-Materials for MEMS and Microsystems: substrates and wafers, active substrate materials, Silicon, Gallium Arsenide, Piezoelectric Crystals, Polymers, Packaging materials-Working principles of Microsystems: micro sensors, micro actuation, MEMS with microactuators, Micro accelerometers, micro fluidics-Applications of Microsystems in various industries.

Unit-II: Mechanics, Scaling and Design

Engineering Mechanics for Microsystems design: Introduction, Static bending of Thin Plates, Mechanical Vibration, Thermomechanics, Thermofluid, Engineering and microsystem design, Laminar fluid flow, Incompressible fluid Flow, Heat conduction in

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solids-scaling Laws in Miniaturization, Introduction to scaling, Scaling in (Electrostatic forces electromagnetic forces, Electricity, fluid mechanics, heat transfer)-Microsystems Design: Design Consideration, Process design, Mechanical Design, Design of Micro fluidic Network systems
Unit-III: Micro System Fabrication Processes
Introduction: Photolithography, Ion implantation; Chemical Vapour Deposition, Physical Vapour Deposition; Bulk micromachining : etching, isotropic and anisotropic etching, wet and dry etching- Surface micro machining :process, mechanical problems associated with surface micro machining; LIGA process: General description, materials for substrates and photo resists-SLIGA process-Abrasive jet micro machining-Laser beam micro machining-Micro Electrical Discharge Micro Machining –Ultrasonic Micro Machining- Electro chemical spark micro machining- Electron beam micro machining-Focused Ion Beam machining
Unit-IV: Microsystems Packaging
Introduction: Microsystems Packaging, Interfaces in Microsystems Packaging, Essential Packaging Technologies; Die preparation, surface bonding, wire bonding, sealing; Three-dimensional Packaging, Assembly of Microsystems, Signal Mapping and Transduction
Unit-V: Micro metrology And Characterization
Microscopy and visualization, Lateral and vertical dimension, optical microscopy, Scanning white light interferometry; Confocal Laser scanning microscopy, Molecular measuring machine; Micro coordinate measuring machine: Electrical measurements, Physical and chemical analysis – XRD, SEM; Secondary Ion mass spectrometry: Auger Electron Spectroscopy, SPM
Text Books:
3. Franssila, S., "Introduction to Micro Fabrication" John Wiley & sons Ltd, 2004.ISBN:470- 85106-6 4. Hsu, T.R., "MEMS & Microsystems Design and Manufacture", Tata McGraw Hill, 2002, ISBN: 9780070487093 5. Hak M.G., "MEMS Handbook", CRC Press, ISBN: 8493-9138-5, 2006. 6. Jackson, M.J., "Microfabrication and Nanomanufacturing" Taylor and Francis 2006.
Reference Books:
1. Jain, V.K., "Introduction to Micromachining" Narosa Publishing House, 2010. 2. McGeough, J.A., "Micromachining of Engineering Materials", CRC Press, ISBN: 0824706447, 2001.

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19MT605.1	Use mechanics principles to analyze the mechanical performance of microsystems.

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R19ME605.2	Be familiar with the tools and processes used in micromachining of microelectromechanical systems (MEMS).
R19ME605.3	Explain MEMS technology, present, future and challenges.
R19ME605.4	Explain micro sensors, micro-actuators, their types and applications.
R19ME605.5	Explain about fabrication processes for producing micro-sensors and actuators.

R19ME606	Quality Control Tools and Techniques	L	T	P	C
		3	0	0	3

1.Course Description:

This course covers fundamental concepts of quality management, including quality dimensions, control charts for variables and attributes, statistical process control techniques, acceptance sampling methods, and their applications in ensuring product and process quality in various industrial contexts.

2. Course Objectives:

1. Understand the evolution and importance of quality concepts in industrial practices.
2. Implement control charts for variables to monitor and improve process performance.
3. Learn statistical process control methods to enhance process stability and capability.
4. Apply control charts for attributes to minimize defects and non-conformities in production.
5. Learn the acceptance sampling techniques for efficient quality assurance and compliance with standards.

3.Syllabus

Unit-I: Quality Fundamentals

Importance of quality; evolution of quality; definitions of quality; dimensions of quality; quality control: quality assurance, areas of quality, quality planning; quality objectives and policies; quality costs, economics of quality; Quality loss function: Quality Vs Productivity, Quality Vs reliability

Unit-II: Control Charts For Variables

Process variation preliminary decisions, control limits and their computation; construction and application of X bar, R and S charts; Warning and modified control limits; process adjustment for trend; Comparison of process variation with specification limits; O.C. curve for X bar chart.

Unit-III: Statistical Process Control

Process stability: process capability study using control charts, capability indices; Cp, Cpk and Cpm; capability analysis using histogram and normal probability plot; machine

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capability study: gauge capability study, setting statistical tolerances for components and assemblies- individual measurement charts: X-chart, moving average and moving range chart, multi-variable chart.
Unit-IV: Control Charts for Attributes
Limitations of variable control charts, Control charts for fraction non-conforming; p and np charts; variable sample size; operating characteristic function, run length; Control chart for nonconformities (defects) c, u, ku charts, demerits control chart, applications.
Unit-V: Acceptance Sampling
Need, Economics of sampling, sampling procedure, single and double sampling, O.C. curves; Average outgoing quality, Average sample number, Average total inspection, Multiple and sequential sampling, Standard sampling plans; MIL Standards, Dodge, Roming; IS 2500.
Text Books:
1. Douglus C. Montgomery, "Introduction to Statistical Quality Control", Wiley-India, Seventh Edition, 2013. 2. Krishnaiah K.," Applied Statistical Quality Control and Improvement", PHI, 2014. 3. AmitavaMitra, "Fundamentals of Quality Control and Improvement", Wiley, Third Edition, 2008.
Reference Books:
1. Dale H. Besterfield, Quality Control, Pearson Education Asia, Eighth Edition, 2008. 2. Eugene L. Grant and Richard S. Leaven Worth, "Statistical Quality Control", McGraw-Hill Education, Seventh Edition, 2000.

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19ME606.1	Familiar with details of quality costs, economies and planning
R19ME606.2	Control the quality of processes using control charts for variables in manufacturing/service industries.
R19ME606.3	Good understanding and in depth knowledge have been imparted in the process capability study.
R19ME606.4	Control the occurrence of defects in product or service industries
R19ME606.5	Determine the acceptance sampling procedures that are practised.

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R19ME607	World Class Manufacturing	L	T	P	C
		3	0	0	3

1.Course Description:

This course examines industrial trends from decline to resurgence, emphasizing manufacturing excellence across regions. It explores customer-focused principles, value assessment, strategic linkages, and identifies impediments in operational effectiveness, providing insights into achieving stability and competitiveness in global markets.

2. Course Objectives:

1. Understand and evaluate the historical and global trends in industrial decline and ascendancy, focusing on manufacturing excellence across different regions and decades.
2. Develop and apply customer-focused principles in design, operations, human resources, quality, and marketing to enhance organizational effectiveness.
3. Understand and assess the importance of product costing, enterprise quality, and organizational stability, including the roles of individual and team contributions to overall project cohesiveness.

3.Syllabus

Unit-I: Industrial Decline and Ascendancy

Manufacturing excellence: US Manufacturers, French Manufacturers; Japan decade; American decade; Global decade.

Unit-II: Building Strength through Customer – Focused Principles

Customer; Focused principles; General principles: Design, Operations, Human resources; Quality and Process improvement; Promotion and Marketing.

Unit-III: Value and Valuation

Product Costing: Motivation to improve, Value of the enterprises QUALITY; The Organization: Bulwark of stability and effectiveness; Employee stability; Quality Individuals Vs. Teams; Team stability and cohesiveness; Project cohesiveness and stability

Unit-IV: Strategic Linkages

Product decisions and customer service; Multi-company planning; Internal manufacturing planning; Soothing the demand turbulence.

Unit-V: Impediments

Bad plant design; Mismanagement of capacity, Production Lines, Assembly Lines; Whole Plant Associates: Facilitators, Teams Manship; Motivation and reward in the age of continuous Improvement.

Text Books:

1. By Richard B. Chase, Nicholas J. Aquilano, F. Robert Jacobs – "Operations Management for Competitive Advantage", McGraw-Hill Irwin, ISBN 0072323159

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2. Moore Ran, "Making Common Sense Common Practice: Models for Manufacturing Excellence", Elsevier Multiworth
Reference Books: 1. Narayanan V. K., "Managing Technology & Innovation for Competitive Advantage", Pearson Education Inc 2. Korgaonkar M. G., "Just In Time Manufacturing", MacMillan Publishers India Ltd., 3. Sahay B. S., Saxena K. B. C., Ashish Kumar, "World Class Manufacturing", MacMillan Publishers

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19ME607.1	Understand the concept and the importance of manufacturing strategy for industrial enterprise competitiveness.
R19ME607.2	Apply appropriate techniques in the analysis an devaluation of company's opportunities for enhancing competitiveness in the local regional and global context.
R19ME607.3	Identify formulation and implement strategies for manufacturing and therefore enterprise competitiveness.
R19ME607.4	Analyzing how World Class Manufacturing technique can create value generation for organization.
R19ME607.5	Apply smart techniques to bring competitive business culture for improving organization performance

R19ME608	Industrial Safety Engineering	L	T	P	C
		3	0	0	3

1.Course Description:

This course covers industrial safety, maintenance engineering, wear and corrosion prevention, fault tracing, and periodic/preventive maintenance. It includes accident causes and control, safety regulations, maintenance strategies, lubrication methods, fault detection, and preventive maintenance procedures, ensuring comprehensive understanding of maintaining and improving industrial equipment and workplace safety.

2. Course Objectives:

1. Identify and control industrial hazards to ensure workplace safety and compliance with safety regulations.
2. Implement maintenance strategies for efficient operation and longevity of industrial equipment.
3. Apply fault tracing techniques to diagnose and resolve issues in various industrial systems

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3.Syllabus

Unit-I: Industrial Safety

Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Unit-II: Maintenance Engineering

Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-III: Wear and Corrosion and their prevention

Wear: types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications: i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication; Definition, principle and factors affecting the corrosion; Types of corrosion; corrosion prevention methods.

Unit-IV: Fault Tracing

Fault tracing: concept and importance, decision tree concept, need and applications, sequence of fault-finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like: i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors; Types of faults in machine tools and their general causes.

Unit-V: Periodic and Preventive Maintenance

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: i. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, Advantages of preventive maintenance. Repair cycle concept and importance.

Text Books:

1. L M Deshmukh, Industrial Safety Management, Tata McGraw-Hill Education, 2005
2. Charles D. Reese, Occupational Health and Safety Management: A Practical Approach, CRC Press, 2003.
3. Edward Ghali, V. S. Sastri, M. Elboujdaini, Corrosion Prevention and Protection: Practical Solutions, John Wiley & Sons, 2007.
4. Garg, HP, Maintenance Engineering, S. Chand Publishing.

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Reference Book:

1. J Maiti, Pradip Kumar Ray, Industrial Safety Management: 21st Century Perspectives of Asia, Springer, 2017.

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19ME608.1	(Apply)Explain the fundamental concept and principles of industrial safety
R19ME608.2	(Apply)Apply the principles of maintenance engineering.
R19ME608.3	(Analyze)Analyze the wear and its reduction.
R19ME608.4	(Evaluate)Evaluate faults in various tools, equipment and machines.
R19ME608.5	(Apply)Apply periodic maintenance procedures in preventive maintenance

R19ME609	Introduction to Industry 4.0	L	T	P	C
		3	0	0	3

1.Course Description:

Introduction to Industry 4.0 covers the fundamentals of road to Industry 4.0, related Disciplines, System, Technologies, role Of Data, Information, Knowledge and Collaboration in Future Organizations and Business Issues in Industry 4.0.

2. Course Objectives:

1. To study the basics of Industrial Revolution
2. To study the basic concepts of Industry 4.0
3. To study the Concepts of related disciplines, system, technologies for enabling industry 4.0
4. To study the role of data, information, knowledge and collaboration in future organizations
5. To analyse the Business issues in Industry 4.0

3.Syllabus

Unit-I: Introduction to Industry 4.0

The Various Industrial Revolutions, Digitalization and the Networked Economy: Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0; The Journey so far: Developments in USA, Europe, China and other countries; Comparison of Industry 4.0 Factory and Today's Factory, Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation.

Unit-II: Road to Industry 4.0

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Internet of Things (IoT), Industrial Internet of Things (IIoT) and Internet of Services; Smart Manufacturing, Smart Devices and Products, Smart Logistics, Smart Cities and Predictive Analytics.
Unit-III: Related Disciplines, System, Technologies for Enabling Industry 4.0
Big data, Physical Systems, Robotic Automation and Collaborative Robots; Support System for Industry 4.0: Mobile Computing, Artificial intelligence and Machine learning, Cyber Security, Digital twin, Digital thread, PLM, Augmented reality and Virtual Reality.
Unit-IV: Role of Data, Information, Knowledge and Collaboration In Future Organizations
Resource: based view of a firm, Data as a new resource for organizations; Harnessing and sharing knowledge in organizations: Cloud Computing Basics, Cloud Computing and Industry 4.0.
Unit-V: Business Issues in Industry 4.0
Opportunities and Challenges, Future of Works and Skills for Workers in the Industry 4.0 Era; Strategies for competing in an Industry 4.0 world: legacy, social issues and their solutions.
Text Book:
1. Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", A press, 2016.
Reference Books:
1. "The Fourth Industrial Revolution" by Klaus Schwab, World Economic Forum 2. "Internet of Things: A Hands-On Approach" by Arsheep Bahga and Vijay Madisetti, University Press 3. NOC: Introduction to Industry 4.0 and Industrial Internet of Things

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19ME609.1	(Understand) Understand the basics of Industrial Revolution
R19ME609.2	(Understand) Understand the basic concepts of Industry 4.0
R19ME609.3	(Understand) Understand the Concepts of related disciplines, system, and technologies for enabling Industry 4.0
R19ME609.4	(Understand) Understand the role of data, information, knowledge and collaboration in future organizations
R19ME609.5	(Analyze) Analyze the Business issues in Industry 4.0

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R19ME610	Lean Six Sigma and Supply Chain Management	L	T	P	C
		3	0	0	3

1.Course Description:

This course integrates Lean Six Sigma principles into supply chain management, focusing on waste reduction, process optimization, quality improvement, and achieving operational excellence through practical tools and project-based learning.

2. Course Objectives:

1. To integrate Lean principles (waste reduction) and Six Sigma methodologies (defect reduction) to optimize supply chain processes.
2. To apply tools like Value Stream Mapping and DMAIC (Define, Measure, Analyze, Improve, Control) to streamline supply chain operations.
3. To implement Six Sigma practices to enhance product and service quality, reduce defects, and improve overall efficiency.
4. To create a culture of continuous improvement and operational excellence throughout the supply chain.
5. To engage in practical projects to apply Lean Six Sigma concepts in real-world supply chain scenarios, emphasizing measurable outcomes and sustainable improvements.

3.Syllabus

Unit-I: Introduction to Lean And Six-Sigma

Introduction to Lean: Definition, Purpose, features of Lean; top seven wastes, Need for Lean, Elements of Lean Manufacturing, Lean principles, the lean metric, Hidden time traps. Introduction to quality, Definition of six-sigma, origin of six-sigma, six-sigma concept, and Critical success factors for six-sigma. Evolution of lean six-sigma, the synergy of Lean and six sigma, Definition of lean six-sigma, the principles of lean six-sigma, Scope for lean six sigma, Features of lean six sigma, the laws of lean six-sigma, Benefits of lean six-sigma.

Unit-II: Tools for Lean Six- Sigma

Define tools, Project Definition Form(PDF) and SIPOC; Measure tools: Process mapping, Parato chart, cause and effect matrix, FMEA, Brain-storming, NGT, Multi-voting, Cause & Effect diagram, Check sheets, Gauge R&R, Run charts, Control charts and process capability analysis; Analyze tools: scatter plots, ANOVA, Regression analysis and time trap analysis; Improve tools: Mistake proofing, KAIZEN, Reducing congestions and delays, SMED, TPM, Design of Experiments and the pull system; Control tools: SPC.

Unit-III: Design for Lean Six-Sigma

Predicting and improving team performance, nine team roles, Team leadership, Team building & Team exercise. DMAIC process and toll gate reviews, Need for institutionalizing Lean Six- Sigma, Comply, commit, embed and encode; Steps in institutionalizing the Lean Six- Sigma, Objectives of Design for Lean Six-Sigma, Improving design velocity, Reducing product line complexity, Design for Lean Six-Sigma-QFD,TRIZ, Robust design.

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Unit-IV: Concepts of Supply Chain
Service and manufacturing supply chain dynamics, Evolution of supply chain management, Multiple views and flows, Service supply chains, Manufacturing supply chains, Measures of supply chain performance, Differentiation, Bullwhip effect.
Unit-V: Supply Chain Processes and Strategies
Integrated supply chains design, Customer relationship process, Order fulfilment process, Supplier relationship process, Supply chain strategies, Strategic focus, Mass customization, Lean supply chains, Outsourcing and offshoring, Virtual supply chains.
Text Books:
1. Michael L. George, Lean Six Sigma, McGraw-Hill, 2002. 2. Sunil Chopra Peter Meindl, D.V.Kalra," Supply chain management", Pearson Education, Prentice Hall of India, 2010.
Reference Books: 1. Forrest W. Breyfogle III, Implementing Six Sigma: Smarter Solutions Using Statistical Methods, 1999. 2. James P. Womack, Daniel T. Jones, Lean Thinking, Free press business, 2003.

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19ME610.1	(Understand) Understand issues & challenges in implementing & developing lean manufacturing techniques from TPS & its contribution.
R19ME610.2	(Apply) Apply lean techniques to bring competitive business culture for improving organization performance.
R19ME610.3	(Analyze) Analyze how lean techniques can be applied to the manufacturing & service industry.
R19ME610.4	(Apply) Developing lean management strategy for Supply chain management.
R19ME610.5	(Analyze) Analysing how lean technique can create value generation for organization.

R19ME611	Business Organization and Development	L	T	P	C
		3	0	0	3

1.Course Description:
This course focus on understanding structures, strategic planning, organizational effectiveness, entrepreneurship, legal compliance, financial management, market analysis, growth strategies, risk management, and global business dynamics.
2. Course Objectives:

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1. To understand various business structures and their implications for operations and governance.
2. To develop skills in formulating and implementing business strategies aligned with organizational goals.
3. To explore methods to enhance leadership, team dynamics, and adaptability within organizations.
4. To study the principles of entrepreneurship, fostering innovation, and seizing business opportunities.
5. To understand legal requirements and ethical considerations in business operations, emphasizing compliance and responsible corporate conduct.

3.Syllabus

Unit-I: Business Environment

Nature and purpose of business, classification of business activities: industry, commerce and trade, objective of business and essential of successful business, economic environment: basic problems of scarcity and choice, allocation of resources, opportunity cost; Business growth and measurement of size ,International Environment-balance of trade ,the trade gap ,and balance of payments, role and methods of trade protectionism, Business Ethics.

Unit-II: Business Structure and Organization

Historical view of business development forms of business organization: sole proprietorship, partnership, join stock companies, co-operative societies, public enterprise; Definition, Meaning, characteristics, Advantages and Disadvantages; Role of Government in business activity, organization charts.

Unit-III: Elements of Business Activity

Purchasing: choosing suppliers, overview of stock control, production-scale of production, main features of job, mass and batch production systems; Marketing: concept and role of marketing, marketing mix, channels of distribution; Finance: sources of finance, assessing business performance.

Unit-IV: Human Resources

Demographic trends and their impact on business concerns; Unemployment: effects and types of unemployment; Local trends in employment in various sectors, selection, recruitment, training of workers, motivation, basic knowledge of working age, contract of work, minimum wage, statutory hours of work, statutory benefits.

Unit-V: Foreign Trade and Banking

Foreign trade: meaning, nature, importance, procedure of export and import, globalization, MNC, MNE; Introductory idea about commercial banks: functions and services; Insurance: meaning, types, principles, benefits.

Text Books:

1. Joel Dean - Managerial Economics, Prentice Hall/Pearson, 2007.

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2. Rangarajan - Principles of Macro Economics, Tata McGraw Hill
Reference Books: 1. Marketing Management - Philip Kotler - Pearson Education- Millennium Edition 2. Gary Dessler, "Human Resource Management", Seventh edition, Prentice-Hall of India P.Ltd., Pearson

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19ME611.1	(Understand) Explain the basic fundamentals of the business environment, organisational theory and marketing, including capacity to recognise and use relevant terminology
R19ME611.2	(Understand) Read, understand and critically evaluate the information contained in relevant academic texts.
R19ME611.3	(Understand) Organise and present information to a satisfactory standard in oral presentations, essays and reports.
R19ME611.4	(Understand) Give an idea about organisation structure and different types of organisations
R19ME611.5	(Understand) Provide idea about motivation, importance of foreign trade and Principles of coordinating the import and export

R19ME612	Product Distribution and Promotion Management	L	T	P	C
		3	0	0	3

1.Course Description:

This course focuses on developing strategies for efficient product distribution through effective channel management and logistics. It also covers promotional techniques like advertising and digital marketing to maximize product visibility and sales effectiveness.

2. Course Objectives:

1. To develop effective distribution channels and logistics plans to optimize product flow and reach target markets.
2. To study the various methods including advertising, sales promotions, and digital marketing to enhance product visibility and consumer engagement.
3. To identify and target specific customer segments to tailor distribution and promotional strategies accordingly.
4. To understand how to manage relationships with distributors and retailers to ensure efficient product placement and availability.
5. To provide sales teams with the necessary tools and strategies to effectively promote and sell products in diverse market environments.

3.Syllabus

Unit-I: Introduction

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Marketing: Definitions, Conceptual frame work; Marketing environment: Internal and External; Marketing interface with other functional areas: Production, Finance, Human Relations Management, Information System; Marketing in global environment: Prospects and Challenges.
Unit-II: Product Distribution Strategy
Marketing strategy formulations, Key Drivers of Marketing Strategies; Strategies for Industrial Marketing: Consumer Marketing, Services marketing; Competitor analysis: Analysis of consumer and industrial markets; Strategic Marketing Mix components.
Unit-III: Marketing Mix Decisions
Product planning and development, Product life cycle; New product Development and Management: Market Segmentation, Targeting and Positioning, Channel Management; Advertising and sales promotions: Pricing Objectives, Policies and methods.
Unit-IV: Buyer Behaviour
Understanding industrial and individual buyer behaviour, influencing factors; Buyer Behaviour Models: Online buyer behaviour; Building and measuring customer satisfaction: Customer relationships management, Customer acquisition, Retaining, Defection.
Unit-V: Marketing Research & Trends in Marketing
Marketing Information System: Research Process. Concepts and applications: Product. Advertising, Promotion, Consumer Behaviour; Retail research, Customer driven organizations, Cause related marketing, Ethics in marketing, Online marketing trends.
Text Books:
1. Philip Kotler and Kevin Lane Keller, Marketing Management, PHI 14th Edition, 2012 2. KS Chandrasekar, "Marketing management-Text and Cases", Tata McGraw Hill, First edition,2010
Reference Books:
1. Lamb, hair, Sharma, Mc Daniel– Marketing – An Innovative approach to learning and teaching-A South Asian perspective, Cengage Learning — 2012 2. Paul Baines, Chris Fill and Kelly Page, Marketing, Oxford University Press, 2nd Edition,2011.

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19ME612.1	(Understand) Understand the concepts of marketing management
R19ME612.2	(Understand) Learn about marketing process for different types of products and services

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R19ME612.3	(Understand) Understand the tools used by marketing managers in decision situations
R19ME612.4	(Understand) Understand the marketing environment
R19ME612.5	(Understand) Demonstrate effective understanding of relevant functional areas of marketing management and its application.

R19ME613	Business Ethics, Corporate Social Responsibilities and Governance	L	T	P	C
		3	0	0	3

1.Course Description:

The course aims to enhance understanding of ethical decision-making, integrate corporate social responsibility into business practices, explore governance principles, engage stakeholders effectively, and ensure legal compliance in organizational operations.

2. Course Objectives:

1. To develop awareness of ethical issues and dilemmas in business contexts, and learn frameworks for ethical decision-making.
2. To understand the importance of CSR, and learn strategies to integrate ethical practices into business operations.
3. To explore corporate governance structures, roles, and responsibilities of boards, and practices for transparency and accountability.
4. To study the methods to effectively engage and manage relationships with stakeholders, considering their interests and expectations.
5. To understand legal frameworks related to ethics, CSR, and governance, ensuring adherence to regulations and ethical standards in business practices.

3.Syllabus

Unit-I: Introduction

Definition & nature Business ethics, Characteristics, Ethical theories; Causes of unethical behavior; Ethical abuses; Work ethics; Code of conduct; Public good.

Unit-II: Ethics Theory and Beyond

Management of Ethics - Ethics analysis [Hosmer model]; Ethical dilemma; Ethics in practice-ethics for managers; Role and function of ethical managers- Comparative ethical behaviour of managers; Code of ethics; Competitiveness, organizational size, profitability and ethics; Cost of ethics in Corporate ethics evaluation. Business and ecological / environmental issues in the Indian context and case studies.

Unit-III: Legal Aspects of Ethics

Political – legal environment; Provisions of the Indian constitution pertaining to Business; Political setup – major characteristics and their implications for business; Prominent features of MRTP & FERA. Social – cultural environment and their impact on business operations, Salient features of Indian culture and values

Unit-IV: Environmental Ethics

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Economic Environment; Philosophy of economic grow and its implications for business, Main features of Economic Planning with respect to business; Industrial policy and framework of government contract over Business; Role of chamber of commerce and confederation of Indian Industries.
Unit-V: Corporate Social Responsibility and Governance
Definition- Evolution- Need for CSR; Theoretical perspectives; Corporate citizenship; Business practices; Strategies for CSR; Challenges and implementation; Evolution of corporate governance; Governance practices and regulation; Structure and development of boards; Role of capital market and government; Governance ratings; Future of governance-innovative practices; Case studies with lessons learnt.
Text Books:
1. Robert A.G. Monks and Nell Minow, Corporate governance, John Wiley and Sons, 2011. 2. William B. Werther and David B. Chandler, Strategic corporate social responsibility, Sage Publications Inc., 2011
Reference Books:
1. S.A. Sherlekar, Ethics in Management, Himalaya Publishing House, 2009. 2. Beeslory, Michel and Evens, Corporate Social Responsibility, Taylor and Francis, 1978.

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19ME613.1	(Understand) Students will be able to explain the concept of business ethics, its necessity, and its role in contemporary business.
R19ME613.2	(Understand) Students will understand and apply ethical theories like utilitarianism, deontology, and virtue ethics to real-world business dilemmas.
R19ME613.3	(Analyze) Learners will analyse examples of ethical abuses and their impact on business and society, providing insights into avoiding such practices.
R19ME613.4	(Understand) Students will understand the significance of maintaining strong work ethics and adhering to a company's code of conduct.
R19ME613.5	(Apply) Learners will explore different theoretical perspectives on CSR and how they apply to business practices.

R19PH601	Laser Technology	L	T	P	C
		3	0	0	3
1. Course Description:					
Laser technology course is designed to offer engineering students with a sturdy base in the field of laser incorporating its basic principles and its potential applications in various fields.					
2. Course Objectives:					
1. Facilitating the students to restate the basics of lasers, characteristics and their types.					

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2. To build knowledge on basics of holography and its applications.
3. Encouraging the students to gain a comprehensive understanding on the applications of laser in industries.
4. Assisting the learners in gaining exposure on the medicinal applications of laser.
5. Helping students acquaint themselves with atmospheric applications.

3. Syllabus

Unit-I: Foundation to Laser and its Types

Introduction to laser - Requirements for obtaining population inversion - 2,3 and 4 level systems: Pumping schemes - Threshold gain coefficient - Ruby laser - Nd:YAG laser - He-Cd laser - X-ray laser - Carbon dioxide laser - Semiconductor laser: Homojunction and Hetrojunction lasers - Liquid lasers - Dye laser - Quantum well laser - Free electron Lasers - Fiber Lasers.

Unit-II: Holography

Holography: Basic Principle - Holography vs. photography - Principle of Hologram Recording - Condition For Recording - A hologram - Holographic components - Construction and Reconstruction of a hologram - Viewing the holographic image - Holography for non-destructive testing (HNDT) - Speckle Non Destructive Testing (SNDT) - Optical disk storage.

Unit-III: Industrial Applications

Laser parameters for welding, drilling, cutting: Dependence of wavelength, pulse width, repetition rate, modulation and gas shielding factors influencing the parameters - Recent developments - Hybrid welding - Cooling parameters for welding processes - Advantages of laser processing versus conventional methods.

Unit-IV: Medical Applications

Laser and tissue interaction - Medical applications of lasers: Dermatology - Plastic surgery - Wound healings - Nerve stimulation - Dentistry - Ophthalmology - Laser instruments for surgery - Removal of tumours of vocal cards - Brain surgery - Gynaecology Oncology - Cancer diagnosis and therapy - Laser safety fundamentals - Basic laser tweezers.

Unit-V: Metrological Applications

Interferometric techniques - Calibration Methods - LIDARS - Theory and different experimental arrangements - Pollution monitoring by remote sensing - Applications - Laser gyroscope.

Text Books:

1. Nambiar, K.R., "Laser Principles, Types & Applications", New Age International, 2004.

2. Duley,W.W., "Laser Processing and Analysis of Materials", Plenum Press, New York,1983.

3. Ghatak, A.K., Thyagarajan, K., "Lasers: Theory and Applications", McMillan, 2003.

References:

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Reference Books:

1. Thyagarajan, K., Ghatak,A., "Lasers: Fundamentals and Applications", Springer, 2012.

2. Nityanand Choudhary, RichaVerma, "Laser Systems and Applications", PHI Learning Private Ltd, 2011.

3. Nagabhushana, S., Sathyanarayana B., "Lasers and Optical Instrumentation", I.K. International Publishing House Pvt. Ltd, 2010.

4. KoechnerW., "Solid State Laser Engineering", Springer Series in Optical Sciences, Vo.1, Springer Verlag

Journals:

1. https://www.sciencedirect.com/journal/optics-and-laser-technology

2. https://www.hilarispublisher.com/lasers-optics-photonics.html

Video References:

3. https://www.youtube.com/watch?v=XkU9jWg49rg

4. https://archive.nptel.ac.in/courses/104/104/104104085/

5. https://ocw.mit.edu/courses/res-6-005-understanding-lasers-and-fiberoptics-spring-2008/resources/laser-fundamentals-i/

MOOC/NPTEL/SWAYAM Courses:

4. https://archive.nptel.ac.in/courses/115/102/115102124/

5. https://onlinecourses.nptel.ac.in/noc22_me92/preview

6. https://onlinecourses.nptel.ac.in/noc20_cy17/preview

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19PH601.1	Realize the fundamentals of lasers, laser systems, their characteristics and types.
R19PH601.2	Acquire knowledge on principles of holography and its applications in various fields.
R19PH601.3	Identify and explore the various industrial applications of laser.
R19PH601.4	Gain capabilities to explore the applications of laser in medical field in addition to their safety guidelines.
R19PH601.5	Interpret the knowledge on investigating applications of laser in the atmosphere and its phenomena, including both weather and climate.

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R19PH602	Nanomaterials and Applications	L	T	P	C
		3	0	0	3

1. Course Description:

Nanomaterials are materials with nanoscale dimensions where the surface or interface properties dominate over the bulk properties. The very large surface area of these nanomaterials can result in novel physical and chemical properties, such as increased catalytic activity, improved solubility, or different optical behavior. Nanomaterials are already found in a wide variety of consumer products, such as textiles, paints, sunscreens, and other healthcare products. Intensive research is being done in the use of nanomaterials for energy storage and energy conversion, pharmaceuticals, life science applications, solar cells, catalysis, and composite materials, to name just a few.

2. Course Objectives:

1. To enable the students to learn the properties of nanomaterials.
2. To prepare the students to understand the concept of different characterization techniques used for analysing the various samples.
3. To enable the students to understand the impact of nanotechnology in the environment.
4. To enable the students to learn the applications of nanomaterials in different sectors.

3. Syllabus

Unit-I: Nanomaterials: Properties and Synthesis

Introduction, quantum confinement: 0D, 1D, 2D & 3D structures; Unique properties of materials, Difference between bulk and nano materials, Synthesis andpreparation of nanomaterials: Sol Gel processing, Micro emulsion, Hydrothermal, Solvo thermal, Microwave assisted synthesis, Organic-Inorganic hybrid nano composites – Quantumdot (QDs) synthesis.

Unit-II: Nanosensors and Nanotubes

Introduction: Nano sensors, Characteristic and terminology; Nano wire based sensors, Properties and fabrication of nano wires, Nano wires sensors for Gas sensing application, Electron Skin, Field effect transistors, Gold nano particles, Carbon nano tubes: Structure, Properties, Synthesis and applications of CNT – Fullerenes.

Unit-III: Nanomaterials Characterization Techniques

Diffraction analysis: X-ray diffraction, Powder diffraction, Lattice parameters, Structure Analyses, Strain analyses, Phase identification, Particle size analyses using Scherer's formula, X-ray Photoelectron spectroscopy (XPS); Infra-Red spectroscopy (IR); Rotational & Vibrational ;UV-Visible , Raman Spectroscopy; Photo Luminescence (PL), Cathode Luminescence (CL).

Unit-IV: Nanotechnology in Environment

Environmental pollutants in air, water, soil, hazardous and toxic wastes: Water treatment, Drinking water and Air/Gas purifications; The challenge to occupational health and hygiene; Toxicity of nano particles, Effects of inhaled Nano sized particles, Skin exposure to nano particlesHazards and risks of exposure to nano particles, Monitoring nano particles

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in work place and sensors.

Unit-V: Applications of Nanotechnology

Nanoelectronics, Nanotechnology in Diagnostics, Environmental, Agricultural and food processing, Nanotechnology for energy systems.

Text Books:

1. Sanjay Mathur and Mrityunjay Singh," Nanostructured Materials and Nanotechnology", II Eds., Willey, 2008.
2. S. Vijaya, G.Rangarajan, "Materials Science", M, Tata McGraw Hill publishing company Ltd., NewDelhi, 2003.
3. Geoffrey A. Ozin, Andre C. Arsenault and Ludovico Cademartiri, "Nanochemistry: A Chemical Approach to Nanomaterials", Second New edition, Royal Society of Chemistry, Cambridge UK, 2008.

References:

Reference Books:

1. Schmidt.G ,"Nanoparticles: From theory to applications", Wiley –VCH, 2006.
2. Zhong Lin Wang, Yi Liu and Ze Zhang," Hand Book of Nanophase& Nanostructured materials", Volumes I-IV, Springer,2002.
3. Chaudhery Mustansar Hussain, Ajay Kumar Mishra," Nanotechnology in Environmental Science", Wiley-VCH, 2018.
4. Zishan Husain Khan, "Nanomaterials and Their Applications", Springer, 2018.
5. Kevin C. Honeychurch," Nano sensors for Chemical and Biological Applications" Sensing with Nanotubes, Nanowires and Nanoparticles", Woodhead publishing Ltd., 2014.

Journals:

1. http://www.aspbs.com/jnn/
2. https://iopscience.iop.org/journal/0957-4484
3. https://onlinelibrary.wiley.com/journal/8384
4. https://www.nature.com/nnano/
5. https://www.sciencedirect.com/journal/nanomedicine-nanotechnology-biology-and-medicine
6. https://www.sciencedirect.com/journal/environmental-nanotechnology-monitoring-and-management

Video References:

1. https://youtu.be/ebO38bbq0_4?list=PLbMVogVj5nJTdeiLvuGSB_AE8hloTAHWJ
2. https://youtu.be/EABqmh2aDPU
3. https://youtu.be/lFYs3XDu4fQ
4. https://youtu.be/Y32Csnt-1Pw

https://youtu.be/0EWCqCIsFOA?list=PLyqSpQzTE6M8682dGkNTN8936vSY4CbqZ

MOOC/NPTEL/SWAYAM Courses:

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1. https://nptel.ac.in/courses/118102003
2. https://onlinecourses.nptel.ac.in/noc19_mm21/preview
3. https://archive.nptel.ac.in/courses/118/107/118107015/
4. https://archive.nptel.ac.in/courses/118/102/118102003/
5. https://archive.nptel.ac.in/courses/118/104/118104008/

4. Course Outcomes

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19PH602.1	Explain the effects of quantum confinement on the electronic structure and corresponding physical and chemical properties of materials at nanoscale.
R19PH602.2	Explore the properties of nanotubes and sensors for different applications.
R19PH602.3	Identify the suitable technique for characterization of nanomaterials and devices for various applications.
R19PH602.4	Identify impacts of nano pollutants on environment and E-waste management techniques.
R19PH602.5	Examine the different applications of nanomaterials.

R19PH603	Physics for Solar PV System	L	T	P	J	C
		3	0	0	0	3

1. Course Description:

This course offers cutting-edge knowledge within the field of photovoltaic system technology. This course is unique and provides the spotlight on the solar resources and how photovoltaic energy conversion can be applied to produce electric power. It incorporates the design and operation of different solar cell, the various photovoltaic system components for various applications.

2. Course Objectives:

1. To impart knowledge on photovoltaic fundamentals and to build solar cells of better efficiency.
2. To offer a blend of technical expertise required for design and operation of a solar photovoltaic systems.
3. To review on the classification of photovoltaics and the components used to apply in various advanced photovoltaic devices.

3. Syllabus

Unit-I: Photovoltaic Fundamentals

Solar radiation, its measurements and analysis - Solar angles- day length, angle of incidence on tilted surface, Sun path diagrams- Shadow determination- P-N junction- homo and hetro junctions, Metal-semiconductor interface, Dark and illumination characteristics - Figure of merits of Solar Cell - Efficiency limits - Variation of efficiency with band-gap.

Unit-II: PV Module Performance

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Photovoltaic modules - Solar PV modules from solar cells - Series and parallel connection of cells, mismatch in series connection - Hot spots in module, bypass diode, mismatching in parallel connection. Solar PV Systems - Components: PV array, inverter, energy storage, Performance analysis of solar photovoltaic (PV) Cell - Efficiency of solar cell - Limitation of Solar Cell, Solar module & Solar Array -Solar power plant battery, Inverter, system charge control, load, balance of systems (BOS) components. Maintenance of solar lighting system, types and advantages of solar outdoor lighting.
Unit-III: Design of Photovoltaic System
Principles of designing high - Quality PV systems: load, suitability, site adequacy, weather, system balance, additional considerations. Classification of PV system - Classification - Stand-alone PV system, Grid-Interactive PV System, Small system for consumer applications, Hybrid solar PV system. Commercial solar cells - Production process of single crystalline silicon cells, multi crystalline silicon cells, amorphous silicon, cadmium telluride, copper indium gallium di selenide cells. Design of solar PV systems and cost estimation.
Unit-IV: Photovoltaic Classification and Components
Classification - Central Power Station System, Distributed PV System, Stand-alone PV system, Grid Interactive PV System, small system for consumer applications - System Components - PV arrays, inverters, batteries, charge controls, net power meters - PV Array Installation, Operation, Costs, Reliability.
Unit-V: Solar Photovoltaic System Applications
Building - integrated photovoltaic units - grid-interacting central power stations - standalone devices for distributed power supply in remote and rural areas - solar cars, aircraft, space solar power satellites -Socio-economic and environmental merits of photovoltaic systems.
Text Books:
1. Sukhatme, S.P and Nayak, J.K, "Solar Energy", Tata McGraw Hill Private Ltd, 2010. 2. Chetansingh Solanki, "Solar Photovoltaic", PHI Learning Private Ltd., 2018. 3. Partain, L.D and Fraas, L.M., "Solar Cells and their Applications", 2nd ed., Wiley, 2010.
References:

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Reference Books:

1. Dr. H. Naganagouda, "Solar Power Hand Book", 2014.
2. G.N. Tiwari, "Solar Energy, Fundamentals Design, Modelling and Application", 2015.
3. Michale Boxwell, "Solar Electricity Handbook", 2017.
4. D.P. Kothari and K.C. Signal, "Renewable Energy Sources and Emerging Technologies",

PHI Publications, 2nd Edition, 2011.

Journals:

1. https://www.sciencedirect.com/journal/solar-energy-materials-and-solar-cells
2. https://onlinelibrary.wiley.com/journal/1099159x
3. https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=5503869
4. https://link.springer.com/journal/11949
5. https://www.ises.org/what-we-do/publications/solar-energy-journal

Video References:

1. https://www.youtube.com/watch?v=LOVZE9WalRE
2. https://www.youtube.com/watch?v=r5A_N29ZchE
3. https://www.youtube.com/watch?v=pH03Y5KwpjU
4. https://www.youtube.com/watch?v=r5qbf5hNYUU
5. https://www.youtube.com/watch?v=yuThr48A2cY

MOOC/SWAYAM/NPTEL Courses:

1. https://archive.nptel.ac.in/courses/115/107/115107116/
2. https://archive.nptel.ac.in/courses/117/108/117108141/
3. https://archive.nptel.ac.in/courses/115/103/115103123/

4. Course Outcomes:

After the completion of syllabus, the student should be able to:

CO. No.	Course Outcome
R19PH603.1	Apply the basic principle of direct solar energy conversion to power using PV technology of radiation, the energy balance of earth.
R19PH603.2	Acquire knowledge on performance analysis of solar photovoltaic cell and limitations of solar cell.
R19PH603.3	Build the concept to design PV systems for various applications.
R19PH603.4	Learn the socio-economic and environmental merits of photovoltaic systems for a variety of applications.
R19PH603.5	Summarize the prospects of photovoltaic technology for sustainable power generation.

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R19PH604	Medical Physics	L	T	P	C
		3	0	0	3

1. Course Description:

This course will provide a solid background in the radiation physics, interaction of radiation with matter and the basic dosimetry concepts and radiation detectors. It enables to make use of the methods and technologies employed in modern medical physics. It is concerned with the use of various imaging modalities to aid in the diagnosis of disease, radiation therapy and radiation protection.

2. Course Objectives:

1. To teach the different electromagnetic spectrum and radiation aspects to categorize the interaction of radiation with matter.
2. To impart knowledge on the basics of how radiological imaging is computed to experiment with various imaging Equipment.
3. To review the radiation principles and to utilize the working and applications of various advanced analytical devices.

3. Syllabus

Unit-I: Introduction to X-Rays

Electromagnetic Spectrum - Production of X-rays - X-ray Spectra - Bremsstrahlung - Characteristic X-ray - X-ray Tubes - Coolidge Tube - X-ray Tube Design - Tube Cooling - Stationary Mode - Rotating Anode X-ray Tubes - Tube Rating - Quality and Intensity of X-ray, X-ray Generator Circuits - HT Cables.

Unit-II: Radiation Physics

Radiation Units - Exposure - Absorbed Dose - Rad Gray - Relative Biological Effectiveness - Effective Dose - Sievert - Inverse Square Law - Interaction of Radiation with Matter - Linear Attenuation Coefficient. Radiation Detectors -Thisble Chamber - Condenser Chambers - Geiger Counter - Scintillation Counter - Ionization Chamber - Dosimeters.

Unit-III: Medical Imaging Physics

Radiological Imaging - Radiography - Filters - Grids - Cassette - X-ray Film - Film Processing - Fluoroscopy - Computed Tomography Scanner - Principal Function - Display - Generations - Mammography. Ultrasound Imaging, Magnetic Resonance Imaging - Thyroid Uptake System - Gamma Camera (Only Principle, Function and Display)

Unit-IV: Radiation Therapy Physics

Radiotherapy - Kilo Voltage Machines - Deep Therapy Machines - Tele-cobalt Machines - Medical Linear Accelerator. Basics of Teletherapy Units - Deep X-ray, Telecobalt Units, Medical Linear Accelerator - Radiation Protection - External Beam Characteristics - Phantom - Dose Maximum and Build Up - Bolus - Percentage Depth Dose - Tissue - Air Ratio - Back Scatter Factor.

Unit-V: Radiation Protection

Principles of Radiation Protection - Protective Materials - Radiation Effects - Somatic, Genetic Stochastic and Deterministic Effect, Personal Monitoring Devices - TLD Film Badge - Pocket Dosimeter.

Text Books:

1. Thayalan, K. "Basic Radiological Physics", Jayapee Brothers Medical Publishing Pvt Ltd, New Delhi, 2003.

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2. Khan, F.M. "Physics of Radiation Therapy", Williams and Wilkins [3rd Edition] 2003.

References:

Reference Books:

1. Williams and Wilkins, "Christensen's Physics of Diagnostic Radiology", Cutry Dowdey and Murry - Lippincot, 1990.
2. Bushberg, Seibeft, Leidholdt, Boone Lippincot Williams and Wilkins, "The Essential physics of Medical Imaging [2nd Edition], 2002.

Journals:

1. https://www.sciencedirect.com/journal/physica-medica
2. https://aapm.onlinelibrary.wiley.com/journal/15269914
3. https://iopscience.iop.org/page/medical-physics-and-biophysics
4. https://journals.lww.com/jomp/pages/default.aspx
5. https://medicalphysics.imedpub.com/

Video References:

1. https://www.youtube.com/watch?v=7LBkmoOuMXY
2. https://www.youtube.com/watch?v=cLMVb6NvRq4
3. https://www.youtube.com/watch?v=0q9wTyGhqFs
4. https://www.youtube.com/watch?v=gEwo4mHhzS0
5. https://www.youtube.com/watch?v=NyEqt-yF7J4

MOOC/SWAYAM/NPTEL Courses:

1. https://archive.nptel.ac.in/courses/113/106/113106069/
2. https://archive.nptel.ac.in/courses/108/105/108105091/
3. https://archive.nptel.ac.in/content/storage2/courses/104103068/module1/lec1/2.html

4. Course Outcomes:

After the completion of syllabus, students should be able to:

CO. No.	Course Outcome
R19PH604.1	Recall on the Characteristics and Production of X-rays.
R19PH604.2	Summarize Theory of Radiation and Various Radiation Chambers.
R19PH604.3	Explain Principle and the Function of Various Imaging System.
R19PH604.4	Discuss Basic Teletherapy Techniques.
R19PH604.5	Analyze Various Measures and Radiation Protection Devices.

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R19CY601	Chemical Sensors and Bio Sensors	L	T	P	C
		3	0	0	3

1. Course Description:

This course provides the understanding of how to measure and analyze chemical and biological processes but also contributes to advancements in various fields that directly impact daily life and global challenges. These types of sensors are critical in scientific research and help in research development, chemical analysis and environmental studies, healthcare, pharmaceuticals, and biological research and medical diagnostics for biological contaminants or pathogens. The aim of this course is to offer students with an insight into the engineering students for optimal utilization of resources in scientific, research, technological, and industrial applications.

2. Course Objectives:

1. To obtain the knowledge about basic principles of biological, chemical and optical sensors and its characteristics applications
2. To acquire industrial and medical applications in sensors and key its role in medicinal and industrial real time benefits.
3. To study innovative methods and up-to-date chemical knowledge that inspires pupils to Communicate well and express them.
4. To gain the knowledge of sensors and its types in various industrial and research development field.

3. Syllabus

Unit-I: Introduction to Sensors

Definitions, Basic principles, theoretical background-components of interactions (covalent and non-covalent), Fundamental sensing, Molecular sensors.

Unit-II: Chemical Sensing Elements

Ionic recognition: molecular recognition-chemical recognition agent-spectroscopic recognition- biological Recognition agents; Immobilization of biological components: performance reactors of Urea Biosensors, Amino Acid Biosensors, Glucose Biosensors and Uric Acid, factors affecting the performance of sensors.

Unit-III: Biosensors

Bio sensors: Catalytic biosensors; mono enzyme electrodes; bi-enzyme electrodes: enzyme sequence electrodes and enzyme competition electrodes; Affinity-based biosensors; Inhibition based biosensors; cell-based biosensors; Biochips and biosensor arrays; problems and limitations.

Unit-IV: Chemical Sensors

Introduction to chemical sensing; Potentiometry: fundamental principles, membrane potentials,
Applications of potentiometry; ion-selective electrodes; Amperometry: fundamental principles, diffusion limited currents, Applications of Amperometry; the Clark oxygen electrode; glucose sensors in diabetes: enzyme electrodes, immunosensors.

Unit-V: Application of Sensors

Automotive Sensors: Environmental Sensors-Sensors for Medical Diagnosis and patient monitoring, Aerospace sensors.

Text Books:

1. Brain R Eggins -Biosensors an Introduction, First edition, John Wiley & Sons

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Publishers, 1996

2. T.E. Edmonds, Chapman and Hall: Principles of Chemical Sensors, J Janata, Plenum Press

References:

Reference Books:

1. Chemical Sensors and Biosensors; Brian, R Eggins; Wiley; New York, Chichester, 2002.
2. Biosensor: A Practical Approach, J. Cooper & C. Tass, Oxford University Press, 2004.
3. Donald G. Buerk - Biosensors Theory and Applications, First Edition Technomic Publishing, Co,Inc, 1993.
4. Sensors- A Comprehensive study-W.Gopal, J Hesse, J N Zemel

Journals:

1. https://onlinelibrary.wiley.com/doi/book/10.1002/9781118354162

2. https://www.springer.com/series/5346

3. https://pubs.rsc.org/en/content/articlelanding/2015/ra/c4ra13080d

4 https://www.sciencedirect.com/science/article/abs/pii/S0166526X03801149

Video References:

1. https://www.youtube.com/watch?v=8-Gtr6eWSTY

2 .https://www.youtube.com/watch?v=z4hgRj5QsZQ

3. https://www.youtube.com/watch?v=9IVmGDgVFdQ.

4. https://www.youtube.com/watch?v=kQ6CYiqpGjY

5. https://www.youtube.com/watch?v=nfxhJxmuUYE

MOOC/SWAYAM/NPTEL Courses:

1. https://nptel.ac.in/courses/102104062

2. https://onlinecourses.nptel.ac.in/noc24_ee45/preview

3. https://nptel.ac.in/courses/115107122

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CY601.1	To understand the basic principles of biosensing in terms of biological, chemical and optical responses.
R19CY601.2	To realize the chemical sensing methods and material characteristics to be applied in biosensors.
R19CY601.3	Demonstrate knowledge of the industrial and socioeconomic context of biosensor development and market.
R19CY601.4	Understand the operation principle of potentiometric, aerometric sensors their applications.
R19CY601.5	Apply the sensor measurements for various applications.

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R19CY602	Energy Storage Devices	L	T	P	C
		3	0	0	3

1. Course Description:

This course provides the understanding of how to measure and analyze chemical and biological processes but also contributes to advancements in various fields that directly impact daily life and global challenges. These types of sensors are critical in scientific research and help in research development, chemical analysis and environmental studies, healthcare, pharmaceuticals, and biological research and medical diagnostics for biological contaminants or pathogens. The aim of this course is to offer students with an insight into the engineering students for optimal utilization of resources in scientific, research, technological, and industrial applications.

2. Course Objectives:

1. understanding about conventional energy resources and its applications
2. Acquire industrial compressed air, bio-chemical energy storage systems and various types of applications.
3. Obtain idea about various existing batteries to the currently available batteries to Communicate well and express them.
4. To gain knowledge of fuel cells and their basic principle, comparative performance of supercapacitors which corresponds with futuristic materials

3. Syllabus

Unit-I: Energy Demands and Energy Sources

Energy Scenario: Indian and Global Perspectives: Need, consumption and demand. Non-conventional renewable energy Sources-Potential of renewable energy sources- Solar energy types. Wind energy. Wave, tidal and OTEC.

Unit-II: Energy Storage: Different Approaches

Potential energy: Pumped hydro storage, KE and Compressed gas system: Flywheel storage, compressed air energy storage, Electrical and magnetic energy storage: Capacitors, electromagnets. Chemical Energy storage: Thermo-chemical, photo-chemical, bio-chemical, electro-chemical, fossil fuels and synthetic fuels: Hydrogen for energy storage and Solar Ponds for energy storage

Unit-III: Batteries

Primary, Secondary batteries; the difference between primary and secondary batteries, chemistries of primary batteries such as Zinc-Carbon, Alkaline and secondary batteries such as Lead acid, Nickel Cadmium, Metal hydrides, lithium-ion, high-temperature batteries-sodium-sulphur.

Unit-IV: Fuel Cells

Fuel Cell Technology: type of fuel cells, Operating principles of Fuel Cell, Fuel and Oxidant Consumption, Fuel Cell System Characteristics, application and limits.

Unit-V: Supercapacitors

Super/ultracapacitors; Basics of Electrochemical Supercapacitors, Types and electrolyte interfaces and their capacitances, Charge-Discharge density, RuOz as a material for electrochemical capacitors, various metal Coupling with batteries and fuel cells-Applications.

Text Books:

1. C. Daniel and Jurgen O. Besenhard, Handbook of Battery Materials, Wiley-VCH

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Verlag, 2011

2. Battery Technology Handbook by H. A. Kiehne, Marcel Dekker, Inc. , New York, Basel

References:

Reference Books:

1. Doughty Liaw, Narayan and Srinivasan, "Batteries for Renewable Energy Storage", The 1' Electrochemical Society, New Jersy,2010.
2. "Jim Eyer, Garth Corey", Energy Storage for the Electricity Grid: Benefits and Market Potential Assessment Guide, Report, Sandia National Laboratories, Feb 2010.
3. Electrochemical Supercapacitors, Scientific Fundamentals and Technological Applications
   By B. E. Conway, Kluwer Academic/ Plenum Publishers, New York, Boston, Dordj€ncht,
   London, Moscow, 1999.

Journals:

1. https://www.sciencedirect.com/topics/engineering/energy-storage-application
2. https://www.mdpi.com/1996-1073/16/16/5930
3. https://www.sciencedirect.com/science/article/pii/S259000722300059X
4.https://www.intechopen.com/chapters/83927

Video References:

1. https://www.youtube.com/watch?v=qMlOgDzPEKU
2 .https://www.youtube.com/watch?v=f_DTiHSZqqw
3. https://www.youtube.com/watch?v=5_lDGna9MBM
4 .https://www.youtube.com/watch?v=LKw5KjOr8hw
5. https://www.youtube.com/watch?v=E-m7Psbuup0

MOOC/SWAYAM/NPTEL Courses:

1. https://www.youtube.com/watch?v=yar51GJVqgg
2. https://archive.nptel.ac.in/courses/113/105/113105102/
3. https://onlinecourses.nptel.ac.in/noc22_ch66/preview

4. Course Outcomes:

After the successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CY602.1	Understand the characteristics of energy from various sources and need for storage
R19CY602.2	Classify various types of energy storage and various devices used for the purpose
R19CY602.3	To address the underlying concepts, methods and application of batteries
R19CY602.4	Illustrate the various types and working principle of R fuel cells

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R19CY602.5	Understand the utilization of next generation super-capacitors and its applications.

R19CY603	Chemistry in Forensic Science	L	T	P	C
		3	0	0	3

1. Course Description:

This course provides the understanding of how to measure and analyze chemical and biological processes but also contributes to advancements in various fields that directly impact daily life and global challenges. These types of sensors are critical in scientific research and help in research development, chemical analysis and environmental studies, healthcare, pharmaceuticals, biological research and medical diagnostics for biological contaminants or pathogens. This course aims to offer students with an insight into the engineering students for optimal utilization of resources in scientific, research, technological, and industrial applications.

2. Course Objectives:

1. Understanding conventional energy resources and their applications.
2. Acquire industrial compressed air, bio-chemical energy storage systems and various types of applications.
3. Obtain ideas about various existing batteries to the currently available batteries to communicate well and express them.
4. To gain knowledge of fuel cells and their basic principle, comparative performance of supercapacitors which corresponds with futuristic materials

3. Syllabus

Unit-I: Preamble to Forensic Science

Forensic Science: History and development - Scope and need of forensic science in criminal
justice system- Role of the Forensic Laboratory: Organization setup of Forensic Science Laboratory: Structure and function of State, Regional and Central Forensic Science Laboratories.

Unit-II: Forensic Tools and Techniques

Principles of Chromatography, Classification of Chromatographic Methods, Adsorption and Partition Chromatography. Thin Layer Chromatography: Basic Principle, Setup, visualization
and Forensic applications.

Unit-III: Chemistry and Analysis of Drugs

Drug Chemistry, Origin, Pharmacology, Methods of preparation, Storage, Diluents and Adulterants, Sample Handling, Optimization of Experimental Conditions, Screening- and Confirmatory Methods: Colour/spot test, Microcrystalline tests, NMR, UV Spectrophotometry, IR Spectrophotometry.

Unit-IV: Explosives and Arson

Explosives: Chemistry of explosives, Characteristics of high and low explosives. Analysis of
Explosive: Pre-blast and Post blast residue collection, Systematic examination of explosives and explosion residues in the laboratory using chemical and instrumental techniques and Interpretation of results.

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Arson: Arson motives, Degrees of Arson, Scheme of analysis: Extraction of samples from debris (Direct and solvent extraction methods, SPME, Distillation), Analysis (GC-MS, SEM),
Interpretation of GC-MS spectra.

Unit-V: Analytical Forensic Toxicology

Samples required in Toxicological analysis - Alternative specimens: Drugs in oral fluid, Detection of drugs in sweat etc. - Alcohol Intoxication & analysis, Chemical tests for alcohol in blood and urine. Breath Alcohol Screening devices- Method of analysis of beverages in biological materials by chemical methods (Kozelka- Hine) and instrumental Methods (GC).

Text Books:

1. James, S.H and Nordby, J.J. "Forensic Science: An introduction to scientific and investigative techniques CRC Press", 2003.

References:

Reference Books:

1. Nanda B.B and Tewari R.K, "Forensic Science in India- A vision for the twenty-first century", Select Publisher, New Delhi, 2001.
2. Houck M M, "Mute witness: trace evidence analysis", Academic Press, 2001.
3. Yinon Litrin, "Modern Methods & Application in Analysis of Explosives," John Wiley Sons, England, 1993.

Journals:

1. https://www.sciencedirect.com/journal/forensic-chemistry
2. https://www.frontiersin.org/journals/analytical-science/sections/forensic-chemistry
3. https://link.springer.com/chapter/10.1385/1-59259-946-X:91
4. https://link.springer.com/journal/11419

Video References:

1. https://www.youtube.com/watch?v=wl9prpOuHD8
2. https://www.youtube.com/playlist?list=PLCP8L39atqUrkDliAkEMdIMA_idd_v0AU
3. https://www.youtube.com/watch?v=TPV6T3KpAmo
4. https://www.youtube.com/watch?v=QevbUnyEgzs
5. https://www.youtube.com/watch?v=iNW37r_snHY

MOOC/SWAYAM/NPTEL Courses:

1. https://archive.nptel.ac.in/noc/courses/noc21/SEM2/noc21-cy28/
2. https://www.youtube.com/user/nptelhrd
3. https://www.youtube.com/c/NPTELSpecialLectureSeries

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO No.	Course Outcome
R19CY603.1	Understand various branches of Forensic science and their functions.

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R19CY603.2	Describe how different tools and assays can be used in Investigations.
R19CY603.3	Understand the composition of drugs.
R19CY603.4	Apply summarize the chemistry behind arson and explosives.
R19CY603.5	Identify and assess the value of various techniques for forensic applications.

R19CY604	Industrial and Material Chemistry	L	T	P	C
		3	0	0	3

1. Course Description:

This course delves into the intersection of chemistry with industrial processes: exploration of large-scale chemical production methods, including reactions, separation techniques, and process optimization. This topic describes the principles and environmental impact, sustainability improvement, and industrial progression. Its main focus is on material properties, synthesis methods, and applications in technology and manufacturing.

2. Course Objectives:

1. Understand the requirements of food and packaging
2. Apply the concepts relevant to petroleum products
3. Summarize the manufacturing processes of various fertilizers.
4. Understand, identify the ingredients and types of soaps and detergents.
5. Understand the controlling methods of environmental problems in metallurgical processes.

3. Syllabus

Unit-I: Food and Packaging Industry

Chemical Composition of common foodstuffs, methods of food preservation and processing by heat, chill storage, deep freezing, drying, concentration, fermentation and radiation. Packaging- Concepts & Significances. Primary packaging media - Paper boards, metals, plastics, glass, flexible materials Labels, caps and adhesives. Testing & evaluation of packaging media. Environmental, ecological & Economic issues, recycling and waste disposal.

Unit-II: Petrochemical Industries

Crude oil - constitution and distillation - composition of different distillates -ignition point, flash point octane number - cracking - catalysts used in petroleum industries - structure, selectivity and applications, Manufacture of synthetic petrol - Fischer Tropsh process- Manufacture of petrochemicals and petrochemical polymers.

Unit-III: Fertilizers and Speciality Chemicals

Fertilizers -Raw materials, manufacture (flow chart - chemical process with equations) of ammonium nitrate, ammonium sulphate, urea, calcium ammonium nitrate, sodium nitrate, ammonium chloride, ammonium phosphate, superphosphate of lime, NPK fertilizers. Manufacture - Properties and industrial uses of solvents - DMF, DMSO and THF.

Unit-IV: Oils, Soaps and Detergents

Oils - the difference between oils and fats - manufacture of cotton seed oil and soya bean oil -

manufacture of soaps - toilet and transparent soaps - Detergents - synthetic detergents -

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. surface active agents and their classification - manufacture of anionic, cationic and non-ionic detergents and shampoo.
Unit-V: Metallurgy
General methods of metallurgy - ores - types - methods of concentrations of ores - hydrometallurgy, pyrometallurgy, refining of metals extraction of Cr, Mfl, Pt, U and Th. Environmental problems of chemical industries -waste management. methods of control - sewage treatment and waste management.
Text Books:
1. Sharma 8.K., Industrial Chemistry, Goel Publishing House, Meerut, 2003,
References:
Reference Books: 1. Alan Cottrel, An Introduction to Metallurgy, Orient Longman, 2000. 2. James A. Kent, Riegel's Handbook of Industrial Chemistry. Springer Science & ustness Media, 2003. **Journals:** 1. https://www.sciencedirect.com/journal/materials-chemistry 2. https://asianpubs.org/index.php/ajmc 3. https://www.rsc.org/journals-books-databases/about-journals/industrial-chemistry-materials/ 4 https://www.sciencedirect.com/journal/journal-of-industrial-and-engineering-chemistry **Video References:** 1. https://www.youtube.com/playlist?list=PLLnAFJxOjzZs8uuljB_7T4otrip_evaVz 2. https://www.youtube.com/watch?v=inz_n9veiXY 3. https://www.youtube.com/user/wwwrscorg 4. https://www.youtube.com/channel/UCBNvvmhKeuZZhWCA7Yddkig **MOOC/SWAYAM/NPTEL Courses:** 1. https://archive.nptel.ac.in/courses/104/105/104105103/ 2. https://nptel.ac.in/courses/104104011 3. https://nptel.ac.in/courses/104103019

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19CY604.1	Understand the requirements of food and packaging Industries.
R19CY604.2	Apply the concepts relevant to petroleum products
R19CY604.3	Summarize the manufacturing processes of various fertilizers.
R19CY604.4	Identify the ingredients and types of soaps and detergents.

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R19CY604.5	Understand the controlling methods of environmental problems in metallurgical processes.

R19HS601	English for Competitive Examinations	L	T	P	C
		3	0	0	3

1. Course Description:

This open elective course is designed to equip engineering students with the essential English language skills needed to excel in competitive examinations. Emphasizing technical proficiency and general communication, the course covers key areas such as comprehension, vocabulary building, grammar, and writing skills, all tailored to the context of engineering

2. Course Objectives:

6. Develop a strong command of technical and general English vocabulary relevant to engineering disciplines.
7. Enhance reading comprehension skills through the analysis of academic texts, articles, and examination papers.
8. Improve writing skills for technical reports, essays, and application letters.
9. Strengthen listening and speaking skills through interactive discussions, presentations, and mock interviews.
10. Familiarize students with the format and types of questions commonly found in competitive exams.

3. Syllabus

Unit I: Vocabulary Enrichment

Spelling Rules: Root words, Prefix, Suffix – Synonyms & Antonyms – Practice – Punctuations – Question Mark (?), Exclamation Mark(!), Full stop (.), Comma (,), Quotation Mark (“”), Colon (:), Semi-Colon (;), Apostrophe (‘) – Commonly Misspelled Words – Practice.

Unit II: Essential of Tenses

Tenses – Present, Past, Future Tenses Essential – Practice – Active and Passive Voice – Direct & Indirect Speech – Fill in Blans – Sentence Correction/Error Spotting – Rearrangement of Sentences – Paragraph Completion.

Unit III : Essential Parts of Speech

Noun – Traditional and Modern Nouns – Gerund, Gender, Number, Case – Practice – Pronoun – Types of Pronouns and its Essentials – Verbs – Types of Verbs and its Essentials – Adverb – Types of Adverbs and its Essentials – Adjective – Types of Adjectives and its Essentials.

Unit IV :Parts of Speech

Prepositions – Types of Prepositions and its Essentials – Conjunctions – Types of Conjunctions and its Essentials – Interjections – Types of Interjection and its Essentials – Fill in the Blanks – Conjunctions, Preposition etc – Concord; Subject Verb agreement – Degrees of Comparison – Articles – Conditional Sentences.

Unit V : Principles of Writing

Reading Comprehension – Hints Development – Paragraph Writing – Essay Writing (Expository Essays, Persuasive Essays, Narrative Essays, Descriptive Essays) – Letter Writing/ Precise Writing – Email Etiquette/ Email Writing.

Text Books:

3. APAART: Speak Well 1 (English language and communication)
4. APPART: Speak Well 2 (Soft Skills)

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5. 2. S. N. Mahalakshmi, "Communicative for Engineers", V. K. Publications; Chennai, Ninth Edition, 2019.

References:

Reference Books:

4. Rizvi M.Ashraf, "Effective Technical Communication", Tata McGraw Hill Publishing Company; New Delhi, 2007.
5. Alan Mccarthy and O'dell – English Vocabulary in Use – Third Edition – Cambridge University Press 2017.
6. Dr. Saroj Hiermath – Business Communication – Nirali Prakashan.
7. Richards C. Jack, "Interchange", Fourth edition; Cambridge University Press, 2012.
8. Butterfield, Jeff, "Soft skills for Everyone", Sixth Indian Reprint, 2015.

Journals:

1. The Journal of English Language Teaching
2. English Language Teaching Journal
3. TESOL Quarterly

Video References:

1. www.youtube.com/watch?v=Hzj6Lbp3z0Y
2. www.youtube.com/watch?v=53V09Wuv0m0

Web References:

1. https://leo.stcloudstate.edu/grammar/subverag.html
2. http://www.learningdifferences.com/Main%20Page/Topics/Compound%20Word%20Lists/Compound_Word_%20Lists_complete.htm
3. http://examples.yourdictionary.com/examples-of-active-and-passive-voice.html
4. http://www.perfectyourenglish.com/grammar/numeral-adjectives.htm
5. https://en.wikipedia.org/wiki/Commonly_misspelled_English_words
6. https://www.englisch-hilfen.de/en/grammar/if.htm
7. http://www.englishforeveryone.org/Topics/Reading-Comprehension.htm

MOOC/SWAYAM/NPTEL Courses:

1. https://archive.nptel.ac.in/courses/109/106/109106116/
2. https://onlinecourses.nptel.ac.in/noc24_hs73/preview

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19HS601.1	Remember the Vocabulary and Punctuation rules.
R19HS601.2	Understand the concept, process and importance of communication.
R19HS601.3	Apply Essentials of the different parts of speech in English.
R19HS601.4	Organize and write grammatically correct sentences.
R19HS601.5	Make them to write and appreciate different types of prose.

R19HS602	Personality Development and Interpersonal Skills	L	T	P	C
		3	0	0	3

1. Course Description:

This open elective course is designed for engineering students to enhance their personal and professional growth through the development of essential interpersonal skills and personality traits. In today's competitive environment, technical proficiency alone is not sufficient;

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effective communication, teamwork, and emotional intelligence are critical for success in the engineering field.

2. Course Objectives:

1. To understand the components of personality and how they influence personal and professional interactions.
2. To develop effective communication skills, including verbal, non-verbal, and written communication.
3. To cultivate emotional intelligence and self-awareness for better relationship management.
4. To enhance teamwork and collaboration skills through group activities and discussions.
5. To build confidence in public speaking and presentation skills.

3. Syllabus:

Unit-I: Personality Development

Personality: Concept, Significance, Determinants, Dimensions, Personal Grooming, Personal Hygiene, Social Etiquette.

Unit-II: Aspects of Personality Development

Character building, Leadership and qualities, Teamwork, Decision, Problem-solving, Time management, Conflict & Stress Management, Work ethics.

Unit-III:Traits Required for Personality Development

Importance of self-motivation, Attitude, Factors affecting attitude, Positive attitude, Advantages, Negative attitude, Disadvantages, Ways to develop positive attitude, Difference between Personalities having Positive and Negative Attitude, Significance, Internal & external motives

Unit-IV:Essentials of Body Language

Body Language: Verbal & Non-Verbal Communication, Significance, Types and functions of Body Language, Mock Sessions, 7'Cs of Effective Communication.

Unit-V: Interpersonal Relationships

Interpersonal Relationship, Self-Analysis (Strength & Weakness), Teaming, Types of Reams, Team Roles and Behaviour (Developing positive personality), Analysis of strengths and weakness, Group Discussion, Concept, Etiquettes, Mock GD.

Text Books:

1. APAART: Speak Well 1 (English language and communication)
2. APAART: Speak Well 2 (Soft Skills)
3. S Bhatnagar, Nitin and Mamta Bhatnagar. Communicative English for Engineers and Professionals. Pearson: New Delhi, 2010.
4. Hughes, Glyn and Josephine Moate. Practical English Classroom. Oxford University Press: Oxford, 2014.

References:

Reference Books:

1. Rizvi M. Ashraf, "Effective Technical Communication", Tata McGraw Hill Publishing Company; New Delhi, 2007.
2. Ladousse, Gillian Porter. Roll. Play. Oxford University Press: Oxford, 2014.
3. Richards C. Jack. Person to Person (Starter). Oxford University Press: Oxford, 2006.

Journals:

1. Journal of Personality and Social Psychology
2. International Journal of Interpersonal Relationships
3. Journal of Applied Psychology

Video References:

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1. www.youtube.com/watch?v=J8N6R_Lq6I4
2. www.youtube.com/watch?v=9pTg7ZmAiH4

Web References:

1. https://leo.stcloudstate.edu/grammar/subverag.html
2. http://www.learningdifferences.com/Main%20Page/Topics/Compound%20Word%20Lists/Compound_Word_%20Lists_complete.htm
3. http://examples.yourdictionary.com/examples-of-active-and-passive-voice.html
4. http://www.perfectyourenglish.com/grammar/numeral-adjectives.htm
5. https://en.wikipedia.org/wiki/Commonly_misspelled_English_words
6. https://www.englisch-hilfen.de/en/grammar/if.htm
7. http://www.englishforeveryone.org/Topics/Reading-Comprehension.htm

MOOC/SWAYAM/NPTEL Courses:

1. nptel.ac.in/courses/109/103/109103131/
2. nptel.ac.in/courses/109/104/109104149/

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19HS602.1	Understand the concepts, process and importance of Personality Development.
R19HS602.2	Understand the essentials of Body language.
R19HS602.3	Recognize the ethical dimensions of interpersonal relation.
R19HS602.4	Understand the concept of personality and personality development and its significance.
R19HS602.5	Understand and develop various traits required for personality development.

R19HS603	Communication Techniques for Employability	L	T	P	C
		3	0	0	3

1. Course Description:

This open elective course equips engineering students with essential communication skills to enhance employability in competitive job markets. Recognizing that effective communication is vital in professional settings, this course focuses on developing verbal, non-verbal, and written communication techniques tailored to the engineering field.

2. Course Objectives:

1. To understand the role of communication in professional success.
2. To improve verbal and non-verbal communication skills for interviews and presentations.
3. To develop strong written communication skills, including resume writing and email etiquette.
4. To practice effective listening and feedback techniques.
5. To enhance networking skills and professional relationship-building.

3. Syllabus:

Unit-1: Communication Skills

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Methods of communication – Verbal – Non-Verbal – Principles of Effective Communication – Barriers to effective communication – Measures to overcome barriers in effective communication.

Unit -II: Self-Management Skills

Self-regulation – Self Motivation – Significance and its uses – self-awareness – Types of self-awareness – ability to work independently – Types of Meaning and importance of stress management – Stress management techniques – physical exercise, yoga, meditation – Vacations with family and friends – Taking nature Walks.

Unit -III: Information and Communication Technology Skills

Classes of operating systems – Menu, icons and taskbar on the desktop – File concept, file operations, file organization, directory structures, and file – system structures – Creating and managing files and folders Importance and need of care and maintenance of computer – Cleaning computer components – Preparing maintenance schedule – Protecting computer against viruses – Scanning and cleaning viruses and removing SPAM files, temporary – files and folders.

Unit -IV: Entrepreneurial Skills

Entrepreneurship and society – Qualities and functions of an entrepreneur – Role and importance of an entrepreneur – Entrepreneurship as a career options.

Unit-V: Employability Quotient

Resume building – The art of participating in group discussion – Acing the Personal (HR & Technical) Interview – Frequently Asked Questions - Psychometric Analysis – Mock Interview Sessions.

Text Books:

1. APAART : Speak Well I(English language and communication).
2. Ahmad, K. (2012). Relationship between employability and graduates' skill. International Business Management,6,440-445.
3. S Bhatnagar, Nitin and Mamta Bhatnagar. Communicative English for Engineers and Professionals Pearson: New Delhi,2020.
4. Hughes,Glyn and Josephine Moate. Practical English Classroom, Oxford University Press: Oxford,2014.

References:

Reference Books:

1. Rizvi M.Ashraf, "Effective Technical Communication", Tata McGraw Hill Publishing Company; New Delhi, 2007.
2. Kalam, A.P.J. A (2006).Capacity building for entrepreneurship, University News (An AIU Newsletter), 44,189-190.

Journals:

1. Journal of Communication
2. Business Communication Quarterly
3. International Journal of Business Communication
4. Communication Education
5. Journal of Applied Communication Research
6. Journal of Workplace Learning

Video References:

1. www.youtube.com/watch?v=kaWw9FJSy6E
2. www.youtube.com/watch?v=OT1-Z9IoUO4

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NPTEL/MOOC/SWAYAM Courses:
1. nptel.ac.in/courses/109/104/109104149/
2. nptel.ac.in/courses/109/105/109105136/

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19HS603.1	Demonstrate the knowledge and various methods of communication.
R19HS603.2	Identify the stress management techniques.
R19HS603.3	Apply basic skills for care and maintenance of the operating system.
R19HS603.4	Understand the concept of Entrepreneurial skills.
R19HS603.5	Develop and maintain a Good Resume.

R19HS604	Mass Communication	L	T	P	C
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Course Description:

This open elective course explores the fundamental concepts and practices of mass communication, tailored specifically for engineering students. In an age where technology and communication converge, understanding mass media is crucial for effective information dissemination and public engagement. Students will examine various media forms, the role of communication in society, and the skills necessary to communicate effectively within and beyond their technical fields.

Course Objectives:

1. Analyse the evolution and functions of various media channels, including print, broadcast, and digital platforms, and their impact on society and technology.
2. Learn to create engaging and informative content suitable for diverse audiences, focusing on clarity, coherence, and effective storytelling techniques.
3. Improve verbal and written communication skills to effectively convey technical information to non-specialist audiences, facilitating better understanding and collaboration.
4. Foster critical thinking skills to assess media content, identify biases, and understand the role of media in shaping public perception and opinion.
5. Examine ethical issues in mass communication, including the responsibilities of communicators, the impact of misinformation, and the importance of responsible media practices.

Syllabus:

Unit I Communication

Elements, Functions and Dimensions – Theories of Communication (Cross Cultural Communication,
Cultural Identity Theory, Face Negotiation Theory – Accommodation Theory (CTA), - Barriers of Communication: Semantic, Physical, Environmental, Attitudinal and Cultural.

Unit II Principles of Mass Communication

Nature and Process of Human Communication – Communication Models – Nature and Process of Mass Communication – Media Systems and Theories – Ownership – Patterns of mass media – media and Social Responsibility.

Unit III Development of Media

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Print: Language and Society – Early Communications Systems in India – Newspapers and Magazines in the 19th century in India – Birth of the Indian Languages Press – The Indian Press and Freedom Movement – Journalism in Indian Languages – The press in India after Independence –Social Issues –

Radio: Development of Media as a medium of Mass Communication - Emergence of AIR – Commercial broadcasting – FM: Television – Development of Television as a Medium of Mass Communication – Historical Perspective of Television in India – Satellite and Cable Television in India – Films – Early efforts – Film as a Mass Medium – Historical Developments of Indian Films – Silent era – Indian Cinema after Independence – Parallel Cinema/Commercial cinema – Documentaries –Issues and Problems of Indian Cinema – Folk Media: Traditional Media in India – Regional Diversity – Content, Form, Utility, Evaluation, Future – New Media: Development of New Media – Convergence – Internet.

Unit IV Print Media

Reporting: News – Interviewing- Interpretative Reporting – Investigative Reporting – political Reporting – Legislative Reporting – Diplomatic Reporting – Scoops and Specialized Reporting –Editing: meaning and Purpose – Proof Reading – News Desk, editorial department set-up, news flow, copy management and organization – Headlines – Magazine Editing, Layouts, Graphics.

Unit V Advertising

Evolution and Growth of Advertising - Advertising tools and practices - Mass Media Laws concerning advertising - Ad Agency Management - Activity based on advertising - Client-related issues and process - Process of Motivation and theories of motivation - Advertising research.

Text Books:

1. Bever S.H., et.al., The Sociology of Mass Media Communications, The Social Review, The University of Keele, Staffordshire, 1969.
2. David K. Berlo, The Process of communication, Holt Rhinehart and Winston, 1960.
3. Keval J. Kumar, Mass Communication in India, Vikas Publications New Delhi, 1994.
4. Hughes, Glyn and Josephine Moate. Practical English Classroom. Oxford University Press: Oxford, 2014.

References

References Books:

3. Krishna Moorthy, V.S., Modern Trends in Printing Technology
4. Clement J. Jones, Mass Media, Code of Ethics and Councils.

Journals:

1. Journalism & Mass Communication Quarterly
2. Mass Communication and Society
3. Communication Research
4. Journal of Communication
5. New Media & Society
6. Television & New Media

Video References:

1. https://www.youtube.com/shorts/K6rUorovQ2E
2. https://www.youtube.com/shorts/fIOyB36seYg
3. https://www.youtube.com/shorts/uxM2esd93lI

NPTEL/SWAYAM/MOOC Courses:

1. https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/125
2. https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/79

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4. COURSE OUTCOMES:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
R19HS604.1	Understand basic concepts of communication and its role in society
R19HS604.2	Understands the basics of journalism and its role in society.
R19HS604.3	Introduce different types of media and their characteristics, merits and demerits.
R19HS604.4	Make students understand the historical underpinnings of media theories with relevant models.
R19HS604.5	Understand the importance of advertising and the role of journalism in framing it.

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