B.E. (Mechanical Engineering)

CURRICULUM AND SYLLABUS HANDBOOK
Regulation 2023

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

NAAC
NATIONAL ASSESSMENT AND ACCREDITATION COUNCIL

NBA

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Kinathukadavu, Coimbatore - 641 202.

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 Mechanical Engineering

Vision

"To become an integrated centre of excellence focusing on design, manufacturing, and industrial engineering, providing societal benefits through academic services including research and innovation."

Mission

M1: Develop curriculum and delivery approach ensuing horizontal exposure and vertical expertise to the learners.

M2: Provide opportunities for faculties to enrich their knowledge and skills.

M3: Establish connections for local, national and global expertise for an active enhanced learning environment.

M4: Execute societal outreach activity providing solutions to industries and society

M5: Establish contemporary facilities for providing practical learning experience.

3.0 B.E. (Mech.) Programme Educational Objectives (PEOs)

PEO1: Graduates will take up careers in Mechanical Engineering fields like Manufacturing, Design, and Thermal and involve in carrying out mechanical engineering products.

PEO2: Graduates will engage in a post graduate program in the field of Engineering Design leading to academic and research careers.

PEO3: Graduates will take up entrepreneurship as a career.

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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 behaviour 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. (Mech.) Program Outcomes (POs)

PO1: **Engineering Knowledge**: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialisation 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)

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)

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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. (Mech.) Programme Specific Outcomes (PSOs)

PSO1: Apply contemporary approaches in the field of manufacturing and design

PSO2: Apply concepts and approaches for improving the productivity in a professional working environment

7.0 B.E. (Mech.) 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 specialisation or branch.

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

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.

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Student Induction Programme (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. B.E (Mech.) - Curriculum

Outcome-Based Education (OBE) with Choice-Based Credit System (CBCS).

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Semester I

Sl. No.	Course Code	Course Name	Category	Periods/wk				TC	C
				L	T	P	J		
Theory Courses									
-	-	Induction Program	-	-	-	-	-	-	-
1	U23MA201	Calculus for Engineers	BS	3	1	0	0	4	4
2	U23CS301	Problem Solving using C	ES	3	0	0	0	3	3
3	U23ME301	Engineering Graphics	ES	2	1	0	0	3	3
Theory cum Practical Courses									
4	U23HS181	Technical English	HS	2	0	2	0	4	3
5	U23PH283	Engineering Physics	BS	3	0	2	0	5	4
Practical Courses									
6	U23GE351	Engineering Practices Laboratory	ES	0	0	2	0	2	1
7	U23CS351	Problem Solving using C Laboratory	ES	0	0	4	0	4	2
Professional Development Course									
8	U23EM751	Soft Skills	EM	0	0	2	0	2	1
Mandatory Course									
9	U23MC901	தமிழர் மரபு/ Heritage of Tamils	HSMC	1	0	0	0	1	1
Total				**14**	**2**	**12**	**0**	**28**	**22**

Semester II

Sl. No.	Course Code	Course Name	Category	Periods/wk				TC	C
				L	T	P	J		
Theory Courses									
1	U23MA206	Complex Variables and Partial Differential Equations	BS	3	1	0	0	4	4
2	U23CS302	Data Structures and Algorithms	ES	3	0	0	0	3	3
3	U23ME401	Engineering Mechanics	PC	3	1	0	0	4	4
	U23NCC01	NCC Credit Course Level I#	OC	2	0	0	0	2	2
Theory cum Practical Courses									
4	U23HS5XX	Language Elective*	HS	2	0	2	0	4	3
				3	0	0	0	3	3
5	U23CY281	Engineering Chemistry	BS	2	0	2	0	4	3
Theory cum Practical with Project Course									
6	U23AD481	Python for AI	ES	2	0	2	2	6	4
Practical Course									
7	U23CS352	Data Structures and Algorithms Laboratory	ES	0	0	4	0	4	2
Professional Development Course									
8	U23EM752	Logical Thinking	EM	0	0	2	0	2	1
Mandatory Course									

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Sl. No.	Course Code	Course Name	Category	Periods/wk				TC	C
				L	T	P	J		
9	U23MC902	தமிழரும் தொழில்நுட்பமும் /Tamils and Technology	HSMC	1	0	0	0	1	1
Total				**16**	**2**	**12**	**2**	**32**	**25**

*-U23HS581: Business English (2-0-2-0-3); U23HS501: Basic Japanese (3-0-0-0-3); U23HS502: Basic German (3-0-0-0-3); #-Offered only for NCC students

Semester III

Sl. No.	Course Code	Course Name	Category	Periods/wk				TC	C
				L	T	P	J		
Theory Courses									
1	U23MA208	Linear Algebra and Numerical Methods	BS	3	1	0	0	4	4
2	U23ME402	Materials and Manufacturing - I	PC	3	0	0	0	3	3
3	U23ME403	Engineering Thermodynamics	PC	3	1	0	0	4	4
Theory cum Practical Courses									
4	U23EC381	Electronics and Microprocessors	ES	3	0	2	0	5	4
5	U23ME481	Fluid Mechanics and Machinery	PC	3	0	2	0	5	4
6	U23OXXXX	Open Elective – I*	OE	2	0	2	0	4	3
Practical Courses									
7	U23ME451	Computer Aided Drafting and Modelling Laboratory	PC	0	0	2	0	2	1
8	U23ME452	Manufacturing Technology Laboratory	PC	0	0	2	0	2	1
Professional Development Course									
9	U23EM753	Advanced Logical Thinking	EM	0	0	2	0	2	1
Mandatory Course									
10	U23MC904	Universal Human Values	MC	1	0	0	0	1	NC
Total				**18**	**2**	**12**	**0**	**32**	**25**

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

Semester IV

Sl. No.	Course Code	Course Name	Category	Periods/wk				TC	C
				L	T	P	J		
Theory Courses									
1	U23MA209	Probability and Statistics	BS	3	1	0	0	4	4
2	U23ME404	Materials and Manufacturing - II	PC	3	0	0	0	3	3
Theory cum Practical Courses									
3	U23ME482	Strength of Materials	PC	3	0	2	0	5	4
4	U23ME483	Thermal Engineering	PC	3	0	2	0	5	4
5	U23OXXXX	Open Elective – II*	OE	2	0	2	0	4	3
	U23NCC02	NCC Credit Course Level II#	OC	2	0	2	0	4	3#
Theory cum Practical with Project Course									
6	U23EC391	Real time Systems and IoT	ES	2	0	2	2	6	4
Practical Course									

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Sl. No.	Course Code	Course Name	Category	Periods/wk				TC	C
				L	T	P	J		
7	U23ME453	CAD/CAM Laboratory	PC	0	0	2	0	2	1
Project Work									
8	U23ME651	Project with Design Thinking (Product / Software Development Life Cycle)	PW	0	0	0	2	2	1
Mandatory Course									
9	U23MC903	Environmental Science	MC	1	0	0	0	1	NC
Total				**17**	**1**	**12**	**4**	**32**	**24**

*- Electives Structure: 3 0 0 0 3 / 2 0 2 0 3; #-Offered only for NCC students

Semester V

Sl. No.	Course Code	Course Name	Category	Periods/wk				TC	C
				L	T	P	J		
Theory Courses									
1	U23ME405	Metrology and Instrumentation	PC	3	0	0	0	3	3
2	U23ME406	Theory of Machines	PC	3	1	0	0	4	4
3	U23ME407	Machine Design	PC	3	1	0	0	4	4
4	U23ME5XX	Professional Elective I*	PE	3	0	0	0	3	3
Theory cum Practical Courses									
5	U23ME484	Heat and Mass Transfer	PC	3	0	2	0	4	4
6	U23OXXXX	Open Elective III*	OE	2	0	2	0	4	3
Practical Courses									
7	U23ME454	Metrology and Dynamics Laboratory	PC	0	0	4	0	4	2
8	U23IMEXX	Industry Oriented Course$	PC	0	0	2	0	2	1
Professional Development Course									
9	U23EM754	Summer Internship	EM	-	-	-	-	-	1
Total				**17**	**2**	**10**	**0**	**28**	**25**

*- Electives Structure: 3 0 0 0 3 / 2 0 2 0 3; $ - IOC Structure: 1 0 0 0 1 or 0 0 2 0 1.

Semester VI

Sl. No.	Course Code	Course Name	Category	Periods/wk				TC	C
				L	T	P	J		
Theory Courses									
1	U23ME408	Finite Element Analysis	PC	3	0	0	0	3	3
2	U23ME409	Intelligent Robotic System	PC	3	0	0	0	3	3
3	U23ME5XX	Professional Elective II*	PE	3	0	0	0	3	3
Theory cum Practical Course									
4	U23ME485	Fluid Power Systems and Industrial Automation	PC	3	0	2	0	5	4
	U23NCC03	NCC Credit Course Level III#	OC	2	0	2	0	4	3#
Theory with Practical and Project Course									
5	U23AM499	Artificial Intelligence and Machine Learning in Mechanical Systems	PC	2	0	2	2	6	4
Practical Course									

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Sl. No.	Course Code	Course Name	Category	Periods/wk				TC	C
				L	T	P	J		
6	U23ME455	Computer Aided Simulation and Analysis Laboratory	PC	0	0	2	0	2	1
Project Work									
7	U23ME652	Innovative / Multi-Disciplinary Project	PW	0	0	0	2	2	1
Total				**14**	**0**	**6**	**4**	**24**	**19**

*- Electives Structure: 3 0 0 0 3 / 2 0 2 0 3, #-Offered only for NCC students

Semester VII

Sl. No.	Course Code	Course Name	Category	Periods/wk				TC	C
				L	T	P	J		
Theory Courses									
1	U23CB103	Principles of Management	HS	3	0	0	0	3	3
2	U23CB104	Project Management and Finance	HS	1	0	0	0	1	1
3	U23ME410	Operations Research	PC	3	0	0	0	3	3
4	U23ME5XX	Professional Elective III*	PE	3	0	0	0	3	3
5	U23ME5XX	Professional Elective IV*	PE	3	0	0	0	3	3
Project Work									
6	U23ME653	Project Work – Phase I	PW	0	0	0	6	6	3
Total				**13**	**0**	**0**	**6**	**19**	**16**

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

Semester VIII

Sl. No.	Course Code	Course Name	Category	Periods/wk				TC	C
				L	T	P	J		
Project Work									
1	U23ME654	Project Work – Phase II	PW	0	0	0	16	16	8
Total				**0**	**0**	**0**	**16**	**16**	**8**

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

CREDIT SUMMARY*

Sl. No.	Course Category	Credits per Semester								Credits	Credit %
		I	II	III	IV	V	VI	VII	VIII		
1	HS	3	3	-	-	-	-	4	-	10	6.1
2	BS	8	7	4	4	-	-	-	-	23	14.0
3	ES	9	9	4	4	-	-	-	-	26	15.9
4	PC	-	4	13	12	18	15	3	-	65	39.6
5	PE	-	-	-	-	3	3	6	-	12	7.3
6	OE	-	-	3	3	3	-	-	-	9	5.5
7	PW	-	-	-	1	-	1	3	8	13	7.9
8	EM	1	1	1	-	1	-	-	-	4	2.4
9	MC	-	-	√	√	√	-	-	-	-	-
10	HSMC	1	1	-	-	-	-	-	-	2	1.2
	OC	-									-
Total		**22**	**25**	**25**	**24**	**25**	**19**	**16**	**8**	**164**	**100%**

Total Number of Credits: 164.

* Excluding NCC & Honours courses

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7.3 Professional Elective Courses:

Sl. No.	Course Code	Course Name	Category	Periods/ Week				TC	C
				L	T	P	J		
Vertical 1 — Robotics and Automation									
1	U23ME511	Sensors and Instrumentation	PE	3	0	0	0	3	3
2	U23ME512	Electrical Drives and Actuators	PE	3	0	0	0	3	3
3	U23ME513	Collaborative Robotics	PE	3	0	0	0	3	3
4	U23ME514	Industry 4.0	PE	3	0	0	0	3	3
5	U23ME581	Embedded Systems and Programming	PE	2	0	2	0	4	3
6	U23ME582	Robot Kinematics and Dynamics	PE	2	0	2	0	4	3
7	U23ME583	Drone Technologies	PE	2	0	2	0	4	3
8	U23ME584	Digital Twin and Industry 5.0	PE	2	0	2	0	4	3
Vertical 2 — Smart Mobility Systems									
1	U23ME521	Automobile Engineering	PE	3	0	0	0	3	3
2	U23ME522	Electric and Hybrid Vehicles	PE	3	0	0	0	3	3
3	U23ME523	Automotive Electronics	PE	3	0	0	0	3	3
4	U23ME524	Vehicle Styling and Design	PE	3	0	0	0	3	3
5	U23ME525	Aircraft Mechatronics	PE	3	0	0	0	3	3
6	U23ME526	Smart Mobility and Intelligent Vehicles	PE	3	0	0	0	3	3
7	U23ME527	Advanced Driver Assistance Systems	PE	3	0	0	0	3	3
8	U23ME585	Automotive System Modelling and Simulation	PE	2	0	2	0	4	3
Vertical 3 — Design and Manufacturing									
1	U23ME531	Robot and Machine Elements Design	PE	3	0	0	0	3	3
2	U23ME532	Design Concepts in Engineering	PE	3	0	0	0	3	3
3	U23ME533	Non-traditional Machining Processes	PE	3	0	0	0	3	3
4	U23ME534	Precision Manufacturing	PE	3	0	0	0	3	3
5	U23ME535	Failure Analysis and NDT Techniques	PE	3	0	0	0	3	3
6	U23ME586	Computer Aided Design and Manufacturing	PE	2	0	2	0	4	3
7	U23ME587	Rotating Machinery Design	PE	2	0	2	0	4	3
8	U23ME588	Tool Design	PE	2	0	2	0	4	3
Vertical 4 — Digital and Green Manufacturing									
1	U23ME541	Robots and Systems in Smart Manufacturing	PE	3	0	0	0	3	3
2	U23ME542	Industrial Robotics and Expert Systems	PE	3	0	0	0	3	3
3	U23ME543	Lean Manufacturing	PE	3	0	0	0	3	3
4	U23ME544	Logistics and Supply Chain Management	PE	3	0	0	0	3	3
5	U23ME545	Computer Aided Inspection and Testing	PE	3	0	0	0	3	3
6	U23ME589	Digital Manufacturing and IoT	PE	2	0	2	0	4	3
7	U23ME590	Green Manufacturing Design and Practices	PE	2	0	2	0	4	3
8	U23ME591	Environment Sustainability and Impact Assessment	PE	2	0	2	0	4	3
Vertical 5 — Product and Process Development									
1	U23ME551	Design for Manufacturing and Assembly	PE	3	0	0	0	3	3
2	U23ME552	Total Quality Management	PE	3	0	0	0	3	3
3	U23ME553	Advanced Manufacturing Systems	PE	3	0	0	0	3	3
4	U23ME554	Product Life Cycle Management	PE	3	0	0	0	3	3
5	U23ME555	Process Planning and Cost Estimation	PE	3	0	0	0	3	3

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Sl. No.	Course Code	Course Name	Category	Periods/ Week				TC	C
				L	T	P	J		
6	U23ME592	Product Design and Development	PE	2	0	2	0	4	3
7	U23ME593	Robotic Process Automation	PE	2	0	2	0	4	3
8	U23ME594	Additive Manufacturing	PE	2	0	2	0	4	3
Vertical 6 — Green Energy Technologies									
1	U23ME561	Energy Conservation in Industries	PE	3	0	0	0	3	3
2	U23ME562	Energy Storage Devices	PE	3	0	0	0	3	3
3	U23ME563	Energy Efficient Buildings	PE	3	0	0	0	3	3
4	U23ME564	Bioenergy Conversion Technologies	PE	3	0	0	0	3	3
5	U23ME565	Renewable Powered Off-Highway Vehicles	PE	3	0	0	0	3	3
6	U23ME566	Thermal Management of Batteries and Fuel Cells	PE	3	0	0	0	3	3
7	U23ME595	Renewable Energy Technologies	PE	2	0	2	0	4	3
8	U23ME596	Equipment for Pollution Control	PE	2	0	2	0	4	3
Vertical 7 — Artificial Intelligence and Machine Learning									
1	U23ME571	Machine Diagnostics and Condition Monitoring	PE	3	0	0	0	3	3
2	U23ME572	Microsystems Design and Applications	PE	3	0	0	0	3	3
3	U23ME573	Machine Vision	PE	3	0	0	0	3	3
4	U23ME574	Haptics and Immersive Technologies	PE	3	0	0	0	3	3
5	U23ME575	Advanced Statistics and Data Analytics	PE	3	0	0	0	3	3
6	U23ME597	Generative AI for Engineering Design	PE	2	0	2	0	4	3
7	U23ME598	Exploratory Data Analysis and Visualisation	PE	2	0	2	0	4	3
8	U23ME599	IoT Systems Design	PE	2	0	2	0	4	3

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7.4 Open Electives (OEs):

Sl. No.	Course Code	Course Name	Category	Periods/week				TC	C
				L	T	P	J		
1	U23OAD81	Data Science Essentials	OE	2	0	2	0	4	3
2	U23OAD82	Machine Learning Techniques	OE	2	0	2	0	4	3
3	U23OAD83	Exploratory Data Analysis and Visualization	OE	2	0	2	0	4	3
4	U23OAD84	Foundations of Artificial Intelligence	OE	2	0	2	0	4	3
5	U23OCC81	Network Protocols	OE	2	0	2	0	4	3
6	U23OCC01	High Speed Networks	OE	3	0	0	0	3	3
7	U23OCC02	Introduction to Industrial Networking	OE	3	0	0	0	3	3
8	U23OCC03	Basics of Mobile Communication	OE	3	0	0	0	3	3
9	U23OCC04	Introduction to Wireless Communication Networks	OE	3	0	0	0	3	3
10	U23OCB81	Algorithmic Trading Strategies	OE	2	0	2	0	4	3
11	U23OCB82	Business Simulation	OE	2	0	2	0	4	3
12	U23OCB01	Principles of Taxation	OE	3	0	0	0	3	3
13	U23OCB83	Strategic Business Leader	OE	2	0	2	0	4	3
14	U23OCB02	Information Systems Control and Audit	OE	3	0	0	0	3	3
15	U23OCS81	Object Oriented Programming using Java	OE	2	0	2	0	4	3
16	U23OCS82	Database Technologies	OE	2	0	2	0	4	3
17	U23OCS83	Full Stack Technologies	OE	2	0	2	0	4	3
18	U23OCS84	Agile Software Practices	OE	2	0	2	0	4	3
19	U23OCS85	Fundamentals of Python Programming	OE	2	0	2	0	4	3
20	U23OAM01	Deep Learning Models	OE	3	0	0	3	3	3
21	U23OAM02	Video and Speech Analytics	OE	3	0	0	3	3	3
22	U23OAM03	Industrial Machine Learning	OE	3	0	0	3	3	3
23	U23OAM04	Machine Learning for Smart Cities	OE	3	0	0	3	3	3
24	U23OSY01	Foundations of Ethical Hacking	OE	3	0	0	0	3	3
25	U23OSY02	Cyber Security Auditing and Assurance	OE	3	0	0	0	3	3
26	U23OSY03	Application Security	OE	3	0	0	0	3	3
27	U23OEC01	Principles of Analog and Digital Communication	OE	3	0	0	0	3	3
28	U23OEC81	Introduction to VLSI Design	OE	2	0	2	0	4	3
29	U23OEC02	Basics of Biomedical Instrumentation	OE	3	0	0	0	3	3
30	U23OEC82	Introduction to Image Processing	OE	2	0	2	0	4	3
31	U23OEC83	Embedded C and RTOS	OE	2	0	2	0	4	3
32	U23OEC03	Drone Technology	OE	3	0	0	0	3	3
33	U23OEE81	Solid State Electronics	OE	2	0	2	0	4	3
34	U23OEE82	Non-Conventional Energy Resources	OE	2	0	2	0	4	3
35	U23OEE01	Energy Conservation Practices	OE	3	0	0	0	3	3

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Sl. No.	Course Code	Course Name	Category	Periods/week				TC	C
				L	T	P	J		
36	U23OEE83	Energy Auditing and Management	OE	2	0	2	0	4	3
37	U23OEE02	Introduction to Hybrid and Electric Vehicles	OE	3	0	0	0	3	3
38	U23OEE03	Design of Solar Photovoltaic Systems	OE	3	0	0	0	3	3
39	U23OEE84	PLC and SCADA	OE	2	0	2	0	4	3
40	U23OIT01	Introduction to Blockchain Technology	OE	3	0	0	0	3	3
41	U23OIT02	Fundamentals of IT Infrastructure Management	OE	3	0	0	0	3	3
42	U23OIT81	Basics of Cloud Technology	OE	2	0	2	0	4	3
43	U23OIT82	Introduction to Computer Networks	OE	2	0	2	0	4	3
44	U23OIT83	Game Programming Fundamentals	OE	2	0	2	0	4	3

7.5 Industry Oriented Courses :

Sl. No.	Course Code	Course Name	Category	Periods/ Week				TC	C
				L	T	P	J		
1	U23IME01	Value Analysis and Value Engineering	EM	1	0	0	0	1	1
2	U23IME02	Process Engineering and Costing	EM	1	0	0	0	1	1
3	U23IME51	Computational Fluid Flow and Heat Transfer Analysis of Mechanical Systems	EM	0	0	2	0	2	1
4	U23IME52	Geometric Dimensioning and Tolerancing	EM	0	0	2	0	2	1
5	U23IME53	HVAC Systems Design	EM	0	0	2	0	2	1
6	U23IME54	Prototyping using VERGE 3D and 3D Printing	EM	0	0	2	0	2	1
7	U23IME55	Mastering Digital Twin Technology	EM	0	0	2	0	2	1

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8.0. B.E (Mech.) SYLLABUS

SEMESTER I

U23MA201	Calculus for Engineers	L	T	P	J	C
		3	1	0	0	4

1. Course Description:

This course is designed to provide solid foundations in differential and integral calculus, emphasizing practical applications in science and engineering disciplines. Differential equations are essential for understanding dynamic systems, physical phenomena, mathematical modelling, and simulating real world problems. Vector calculus explores the mathematical framework necessary for understanding and analyzing vector fields in three-dimensional space.

2. Course Objectives:

1. Familiarize the students with the functions of several variables.
2. Acquaint them with methods of evaluating multiple integrals.
3. Facilitate them with techniques in solving ordinary differential equations.
4. Impart an idea of vector calculus and its physical interpretation.
5. Elucidate various techniques of vector integration.

3. Syllabus **45 + 15= 60 Periods**

Unit-I: Differential Calculus **(9+3)**

Limits and Continuity; Partial derivatives: Total derivative, differentiation of implicit functions; Jacobian, properties; Taylor's series; Maxima and minima of functions of two variables.

Unit-II: Integral Calculus **(9+3)**

Double integrals: Integrals in cartesian and polar coordinates; Area enclosed by plane curves; Change of order of integration; Change of variables between cartesian and polar co-ordinates.

Unit-III: Ordinary Differential Equations **(9+3)**

Higher order linear differential equations with constant coefficients; Method of variation of parameters; Cauchy's and Legendre's linear differential equations; Application of ordinary differential equations in spring-mass system.

Unit-IV: Vector Differentiation **(9+3)**

Vector and scalar functions; Derivatives: Curves, tangents, arc length, curves in mechanics, velocity and acceleration; Gradient of a scalar field; Directional derivative; Divergence of a vector field; Curl of a vector field; Scalar potential function.

Unit-V: Vector Integration **(9+3)**

Line Integral; Green's theorem in a plane; Triple integral; Gauss divergence theorem; Stoke's theorem (statement only).

List of Tutorials:

1. The working procedure, Basic commands and symbolic computation. (CO 1)
2. Drawing the curve for the given function f(x) and the surface for the given function. (CO 1)
3. To find the Partial derivative of a given function f (x, y). (CO 1)
4. Evaluating Extreme values of a single variable function. (CO 1)
5. Evaluating the Maxima and minima of functions of two variables. (CO 1)
6. Differentiation of various functions. (CO 1)
7. Integration - Definite and indefinite integrals - Constant and variable limits. (CO 2)

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8. Understanding integration as an Area under the curve. (CO 2)
9. Evaluating triple integrals. (CO 2)
10. Visualizing different surfaces. (CO 2)
11. Evaluating gradient, curl and divergence. (CO 4)
12. Directional derivative of a given function. (CO 4)
13. Evaluating line integrals. (CO 5)

Text Books:

1. Erwin Kreyszig, "Advanced Modern Engineering Mathematics", 10th Edition, John Wiley and Sons (Asia) Ltd, Singapore, 2017.
2. Dennis G Zill, "Advanced Engineering Mathematics", 6th Edition, Jones & Bartlett India P Ltd., New Delhi, 2017.
3. B. S, "Higher Engineering Mathematics", 44th Edition, Khanna Publications, New Delhi, 2015.
4. Maurice D. Weir, Joel Hass, Christopher Heil "Thomas' Calculus",14th Edition, Pearson Education, New Delhi, 2018.

Reference Books:

1. John Bird, "Higher Engineering Mathematics", An imprint of Elsevier, Burlington, Reprint 2010.
2. Bali. N. P and Manish Goyal," A Textbook of Engineering Mathematics", 8th Edition, Laxmi Publications Ltd, 2011.
3. Srimanta Pal and Subodh C Bhunia, "Engineering Mathematics", 3rd Edition, Oxford University Press, New Delhi, 2016.

Journal References:

1. Journal of Differential Equations: https://www.sciencedirect.com/journal/journal-of-differential-equations
2. Journal of the Australian Mathematical Society: https://www.cambridge.org/core/journals/journal-of-the-australian-mathematical-society

Web Resources:

1. https://www.youtube.com/watch?v=riXcZT2ICjA
2. https://www.youtube.com/watch?v=1CBOwkS7nII
3. https://www.youtube.com/watch?v=rfG8ce4nNh0
4. https://www.youtube.com/playlist?list=PL5Dqs90qDljXm4Q6htsu9C88_gSebN33z

MOOC/NPTEL/SWAYAM Courses:

1. https://archive.nptel.ac.in/courses/111/104/111104092/
2. https://archive.nptel.ac.in/courses/111/105/111105122/

4. Course Outcomes:

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

CO. No.	Course Outcome
U23MA201.1	Classify the extreme values of functions of two variables.
U23MA201.2	Apply integration concepts to compute **the** area of the given surfaces, integrals in cartesian and polar coordinates.
U23MA201.3	Assess various techniques in solving differential equations.
U23MA201.4	Compare the ideas of vector differentiation and exhibit the relation between them.
U23MA201.5	Apply Green's theorem, Stoke's theorem and Divergence theorem to evaluate integrals.

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U23CS301	Problem Solving using C	L	T	P	J	C
		3	0	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 students in effectively working with strings, user-defined data types, and file operations.

3. Syllabus **45 periods**

Unit-I: C Fundamentals **(9)**

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

Unit-II: Control Structures **(9)**

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 **(9)**

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 **(9)**

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 **(9)**

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:

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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
U23CS301.1	Understand problem-solving techniques and typical programming constructs C
U23CS301.2	Apply looping and conditional constructs to solve real-world problems
U23CS301.3	Apply arrays and functions effectively to address complex programming challenges
U23CS301.4	Understand and apply best practices in pointers, memory allocation and error handling for modular programming efficiency
U23CS301.5	Choose and implement complex data structures using structures and Unions, applying advanced file operations in C for effective problem-solving

U23ME301	Engineering Graphics	L	T	P	J	C
		2	1	0	0	3

1. Course Description:

This course provides a comprehensive introduction to engineering drawing techniques, emphasizing fundamental principles such as orthographic projection, dimensioning, and geometric construction. Students will learn to create accurate and detailed engineering drawings manually and using Computer-Aided Design (CAD) software. Through practical exercises, students will develop proficiency in visual communication and problem-solving skills essential for engineering design and drafting. This course will also cover industry standards and conventions, ensuring students are prepared for professional practice.

2. Course Objectives:

1. To develop proficiency in fundamental drawing techniques, including line work, dimensioning, and geometric construction, to accurately represent engineering designs on paper and digitally.

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2. To impart Knowledge on orthographic projection methods to generate multiple views (e.g., plan, elevation, section) of engineering objects, ensuring clear and precise communication of design intent.
3. To expose the student to understand isometric projections to represent three-dimensional objects with equal foreshortening along each axis, facilitating visualisation and understanding.
4. To gain Knowledge on perspective projection techniques to accurately depict depth and spatial relationships in engineering drawings.

3. Syllabus **45 Periods**

Unit – I: Free Hand Sketching and Curves **(6+3)**

Introduction: Importance of graphics in engineering applications; Use of drafting instruments; BIS conventions and specifications: Size, layout, folding of drawing sheets, Lettering, dimensioning.

Free Hand sketching; Visualisation principles; Representation of Three-Dimensional objects; Layout of views; Application of freehand sketching.

Curves

Comics: Construction of ellipse, parabola and hyperbola by eccentricity method; Construction of cycloid; construction of involutes of square and circle; Applications: Engineering Curves

Computer Aided Drafting (for demonstration Only)

Study the Basics of 2D and 3D modelling; Lettering, title block drafting; and DWG file development using any CAD software

Unit – II: Projection of Points, Lines and Surfaces **(6+3)**

Projection: Points, Straight lines located in the first quadrant using the rotating line method; Traces; Projection of plane surfaces: polygonal lamina, circular lamina; Applications: Projection of points, lines, surfaces.

Computer Aided Drafting (for demonstration only)

Drafting of simple geometrics: Lines, planes, simple 2D drawings.

Unit – III: Projection of Solids **(6+3)**

Projections of simple solids: Prism, Pyramid, Cylinder and Cone; Drawing views when the axis of the solid is inclined to one reference plane by rotating object method; Applications: Projection of solids.

Unit – IV: Sections and Development **(6+3)**

Section of simple solids: Simple vertical position, when the cutting plane is inclined to one of the principal planes, perpendicular to the other; Obtaining true shape of section; Development of lateral surfaces: Truncated prisms, pyramids, cylinders, cones; Applications: sections of solids, development of lateral surfaces.

Unit – V: Isometric and Perspective Projection **(6+3)**

Principles of isometric projection; isometric scale; Isometric projections (Simple, Truncated): Prisms, pyramids, cylinders, cones, a combination of two solid objects in simple vertical positions; Perspective projection (Visual ray method): Prisms, pyramids, cylinders, cone; Applications: Isometric projection, perspective projection.

Computer Aided Drafting (Demonstration Only)

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Introduction to computer-aided drafting, dimensioning using appropriate software; 2D drawing commands: Zoom, Picture editing commands, Dimensioning, Isometric drawing, Isoplanes, 3D drafting; Plotting of drawing; Practice: Projection of lines, planes, solids; Isometric view practice: prisms, pyramids, cylinders, cones.

Text Books:

1. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2019.
2. Venugopal K. And PrabhuRaja V., "Engineering Graphics", New Age International (P) Limited, 2019.

References:

Reference Books:

1. Bhatt N.D, "Machine Drawing", Charotar Publishing House, 1st Edition, 2010.
2. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, 1st Edition, 2008.
3. Gopalakrishna K.R., "Machine Drawing in first angle projection, Subhas Stores, Bangalore, 1st Edition, 2007.
4. K Leo Dev Wins., "Engineering Drawing", Pearson (Wins) Publications, Latest Edition, 2019.
5. Luzzader, Warren.J. and Duff, John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
6. N S Parthasarathy and Vela Murali, "Engineering Graphics", Oxford University Press, New Delhi, 2015.

NPTEL/MOOC/SWAYAM Course:

1. Engineering drawing and computer graphics
   https://onlinecourses.swayam2. ac.in/aic22_ts42/preview

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

Special points applicable to Semester End Examinations on Engineering Graphics:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use an appropriate scale to fit the solution within an A3 size.
4. The examination will be conducted in appropriate sessions on the same day.

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4. Course Outcomes:

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

CO. No.	Course Outcome
U23ME301.1	Demonstrate the ability to perform freehand sketching of basic geometrical constructions and accurately represent multiple views of objects enhancing their visualisation and communication skills in engineering design.
U23ME301.2	Project points, lines, and plane surfaces onto orthographic views using appropriate projection techniques, facilitating the creation of clear and comprehensive technical drawings essential for engineering communication.
U23ME301.3	Draw the projection of simple solids employing graphic principles, ensuring accurate representation and visualisation of three-dimensional objects in engineering drawings.
U23ME301.4	Develop the capability to draw sectional views of simple solids to reveal internal details and structures, as well as to develop the surfaces of sheet metal components, enabling them to create comprehensive engineering drawings for manufacturing and fabrication processes.
U23ME301.5	Draw isometric projections to represent three-dimensional objects with equal foreshortening along each axis and perspective projections to provide realistic representations of simple objects, enhancing their ability to visually communicate engineering designs effectively.

U23HS181	Technical English	L	T	P	J	C
		2	0	2	0	3

1. Course Description:

This course provides foundational education in technical communication for first-year BE/B.Tech. students, focusing on vocabulary development for diverse academic and professional contexts. It emphasizes the enhancement of LSRW (Listening, Speaking, Reading, and Writing) skills to improve overall communication proficiency. Additionally, the course covers critical areas such as Grammar, Word Formation, Summarizing, and Report Writing, which are essential for success in the Engineering and Technology fields.

2. Course Objectives:

1. Help students learn different reading techniques like skimming and scanning, so they can better understand and analyze various texts.
2. Improve students' skills in writing clear and organized sentences and paragraphs, and teach them how to write informal letters for different purposes.
3. Strengthen students' understanding of basic grammar rules, such as parts of speech, articles, and tenses, to make their writing and speaking more accurate.
4. Train students to listen carefully to audio materials and participate in speaking activities like introductions and role-plays to improve their communication skills.
5. Encourage students to use their language skills in everyday situations, like writing informal letters and doing role-plays, to build confidence and fluency in English.

3. Syllabus **30 + 30 = 60 Periods**

Unit-I: Fundamentals of Language Skills **(6)**

Types of Reading: Intensive and Extensive - Skimming and Scanning Techniques - Reading Comprehension Strategies; Word Formation Techniques - Sequence Words in Writing - Hints Development for Writing - Informal Letters: Congratulating, Apologizing, etc.; Grammar:

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Parts of Speech - Articles (Definite and Indefinite) – Tense; Listening Types - Listening to Audio files and answering; Speaking - Introducing oneself & Family - Role Play
Unit-II: Advanced Reading and Writing Strategies **(6)**
Reading articles from Newspapers & Magazines - Cloze Exercises; Writing Instructions and Recommendations - Paragraph Writing Techniques; Grammar: Homonyms, Homophones, and Homographs - Subject – Verb Agreement - Modal Verbs - Question Types: Wh-type, Yes/No, and Tag Questions; Listening for Specific Information: Announcements and Radio Broadcasts Speaking: Extempore - Just A Minute (JAM) Sessions
Unit-III: Advanced Communication Skills **(6)**
Reading for Specific Information & Identifying Lexical and Contextual Meaning; Writing Formal Letters: Seeking Permission for Industrial Visit - Letter of Invitation (Acceptance/Declination) - Arranging Jumbled Sentences; Grammar: Cause and Effect Expressions - Purpose and Function - Phrases - Compound Nouns; Listening to TED Talks & News Reading from English News Channels (CNN, NDTV, India Today, etc.) Speaking: Group Discussion
Unit-IV: Effective Written Communication **(6)**
Summarizing Techniques: Paraphrasing Skills - Note Making Strategies; Preparing Job Application - Email Etiquette and Writing Emails - Free Writing on Any Given Topic; Grammar: Phrasal Verbs - Types of Sentences (Simple, Compound, Complex) - Single Sentence Definitions; Listening and summarizing; Speaking: Narrating a Story
Unit-V: Technical Presentation Skills **(6)**
Reading practice based on Competitive Examinations; Writing: Preparing Transcripts for Speeches - Pictorial Representations: Flowcharts, Pie Charts, Bar Charts, Tabular Columns; Grammar: Single Word Substitutes - Spotting Errors; Listening to Eminent Personality Interviews & Other Forms of Interviews; Speaking - Compering, Welcome Address & Vote of Thanks
List of Exercises: **(30)**
1. Listening to Audio files and answering the questions. (CO 1) 2. Listening for specific information like announcements and Radio Broadcasts (CO 1) 3. Practice developing hints into full sentences or paragraphs. (CO 1) 4. Practice delivering short, impromptu speeches on various topics. (CO 2) 5. Listening to TED Talks & News Reading from English News Channels (CNN, NDTV, India Today etc.) (CO 1) 6. Listening to interviews of eminent personalities and analysing the content. (CO 4) 7. Practising self-introduction in role-play scenarios. (CO 3) 8. Participating in group discussions on various topics with emphasis on communication strategies and effective participation. (CO 3) 9. Exercises on narrating stories, focusing on structure and engagement. (CO 4) 10. Compering events, delivering Welcome Addresses, and practising Vote of Thanks. (CO 5)
Text Books:
1. Jack C. Richards, "Interchange Student's Book 1", Cambridge University Press; Fourth Edition, 2015. 2. S. N. Mahalakshmi, "Technical English for Engineers", V. K. Publications; Chennai, Eighth Edition, 2020.

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References:

Reference Books:

1. Rizvi M. Ashraf, "Effective Technical Communication", Tata McGraw Hill Publishing Company; New Delhi, 2015.
2. Andrea J.Rutherfoord, "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 Resources:

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
U23HS181.1	Apply basic reading techniques, construct clear sentences for informal correspondence, and enhance grammar and listening skills for effective communication.
U23HS181.2	Analyze complex texts, formulate precise instructions and recommendations, and utilize advanced grammar in spoken communication.
U23HS181.3	Simplify specific and contextual information, compose formal letters, and actively engage in group discussions.
U23HS181.4	Interpret and take notes proficiently, compose professional documents and emails, and demonstrate strong listening skills.
U23HS181.5	Analyze and create detailed technical documents and visual aids, deliver formal presentations and conduct interviews with confidence.

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U23PH283	Engineering Physics	L	T	P	J	C
		3	0	2	0	4

1. Course Description:

Engineering Physics is a fundamental course designed to provide mechanical engineering students with a strong foundation in the field of mechanical, thermal, magnetic, electrical properties of material, and also nanomaterials used in latest technologies which are very useful to solve real time problems.

2. Course Objectives:

1. Guide students to grasp core physics principles and understand how these concepts apply to engineering challenges.
2. Equip students to apply wave optics and laser principles in solving numerical problems, reinforcing theoretical understanding through practice.
3. Teach students to classify different magnetic and superconducting materials and analyze their unique properties.
4. Encourage students to compare nano materials with bulk materials, while also gaining insight into various fabrication methods.
5. Help students study and apply the mechanical, electrical, and thermal properties of materials in practical engineering contexts.

3. Syllabus **45+30=75 Periods**

Unit-I: Mechanical Properties of Solids and Fluids **(9)**

Elasticity: Hooke's law, Stress-strain diagram and its uses, factors affecting elastic modulus; Torsional stress and deformations: twisting couple, torsion pendulum, theory and experiment; Bending of beams: bending moment, cantilever: theory and experiment, Applications: I-shaped girders; Viscosity: coefficient of viscosity, Stoke's theorem, Bernoulli's theorem, Applications.

Unit-II: Electrical and Thermal Properties of Materials **(9)**

Classical free electron theory: Success and failures, Expression for electrical conductivity, Wiedemann Franz law; Quantum free electron theory: Fermi- Dirac statistics, Density of energy states; Energy bands in solids; Transfer of heat energy: Thermal conduction, convection and radiation, Thermal expansion of solids and liquids, expansion joints, bimetallic strips; Thermal conductivity: Lee's disc method, theory and experiment, applications; Heat exchangers: refrigerators; Thermal insulation.

Unit-III: Wave Optics and Lasers **(9)**

Simple harmonic motion: Wave equations, plane electromagnetic waves; Lasers: population of energy levels; Einstein's A and B coefficients derivation, resonant cavity, optical amplification (qualitative), pumping methods, Types of Lasers: CO2 Lasers, Semiconductor Lasers: Homojunction and Heterojunction, Applications.

Unit-IV: Magnetism and Superconductivity **(9)**

Atomic magnetic moment, classification of magnetic materials; Ferromagnetism: Domain theory, different types of energies involved in the domain growth; Hysteresis: Soft and hard magnetic materials; Superconductivity: properties, Type I and Type II superconductor, Levitating trains and magnetoencephalograms.

Unit-V: Introduction to Nanoscience **(9)**

Nano Scale: Quantum Confinement, Quantum dot; Different forms of nano materials; Fabrication methods: Top down and bottom up approach, Ball milling, CVD, Properties of nano materials; Dendrimers; Coulomb blockade effects: Single electron phenomena and Single electron transistor; Carbon nano tubes: properties and applications.

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List of Experiments:	30 Periods

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

Text Books:

1. Avathanulu, M.N. and Kshirsagar, P.G., "A text book of Engineering Physics", S. Chand and company, 2018.
2. Bhattacharya, D.K. and Poonam, T. "Engineering Physics", Oxford University Press, 2017.
3. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2012.
4. Halliday, D., Resnick, R. and Walker, J., "Principles of Physics", Wiley, 2015.

References:

Reference Books:

1. Arthur Beiser, "Concepts of Modern Physics", Tata McGraw Hill, 2017.
2. Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers". Cengage Learning,
3. 2010.
4. Tipler, P.A. &Mosca,G. "Physics for Scientists and Engineers with Modern Physics'.2007
5. Pandey, B.K. &Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2012.
6. C. Kittel, Introduction to Solid State Physics, John Wiley (1996)
7. A. J. Dekker, Solid State Physics, Macmillan (1986)

Journals:

1. Journal of the Mechanical Behavior of Biomedical Materials.
2. The Journal of Magnetism and Magnetic Materials

Video References:

1. https://www.youtube.com/watch?v=YKpvYF0hVDE
2. https://www.youtube.com/watch?v=_JOchLyNO_w
3. https://www.youtube.com/watch?v=h6FYs_AUCsQ
4. https://www.youtube.com/watch?v=K0VY9_hB_WU .
5. https://www.youtube.com/watch?v=0Eokkhdppg E

MOOC/SWAYAM/NPTEL Courses:

1. https://www.youtube.com/watch?v=p0cPzZWvDfc
2. https://archive.nptel.ac.in/courses/104/104/104104085/
3. https://www.youtube.com/watch?v=fHsGYj1ZP1k

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4. Course Outcomes:

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

CO. No.	Course Outcome
U23PH283.1	Infer the importance of the mechanical properties of solids and fluids in diverse engineering applications.
U23PH283.2	Demonstrate foundational knowledge in electrical and thermal properties of materials.
U23PH283.3	Interpret the properties of wave motion, principles and types of lasers.
U23PH283.4	Analyze and classify magnetic and superconducting materials and their applications in various engineering aspects.
U23PH283.5	Assess the principles of basic science concepts in evaluating and predicting matter at nano scale.

U23CS351	Problem Solving using C Laboratory	L	T	P	J	C
		0	0	4	0	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 **60 Periods**

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

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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 a 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.
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

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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
U23CS351.1	Design solutions for real-world problems with programming constructs
U23CS351.2	Solve complex programming problems with arrays and functions
U23CS351.3	Implement dynamic memory addressing techniques with Pointers
U23CS351.4	Implement various error-handling techniques for file operations
U23CS351.5	Implement complex data structures such as structures and unions in C to manage and organize data effectively

U23GE351	Engineering Practices Laboratory	L	T	P	J	C
		0	0	2	0	1

1. Course Description:

The course encompasses a comprehensive set of practical units aimed at providing hands-on experience in Computer Science, Mechanical, Electrical and Electronics Engineering fields.

Computer Science and Engineering Practices:

The students will be engaged in Computer assembly and disassembly, honing troubleshooting skills for both hardware and software issues.

Mechanical Engineering Practices:

The students will be delving into Mechanical Engineering practices which include plumbing, basic machining operations and rapid prototyping with 3D printing. The exploration extends to the assembly of a centrifugal pump, hands-on exercises involving pump/motor, submersible pump sets and refrigeration & air-conditioning systems.

Electrical Engineering Practices:

The students will be focusing on Electrical Engineering practices which involve UPS connections, domestic wiring, safety precautions and the design of solar PV systems.

Electronics Engineering Practices:

The students will be focusing on Electronics Engineering practices which include soldering techniques, a study of smartphone components and practical projects in home automation.

Through this multifaceted course, students gain a well-rounded understanding of essential skills in Computer Science, Mechanical, Electrical & Electronics preparing them for diverse applications in those fields.

2. Course Objectives:

1. To impart knowledge on computer assembling, disassembling and troubleshooting.
2. To provide exposure to the students with rapid prototyping with 3D printing and plumbing operations.
3. To gain practical experience in UPS connections, domestic house wiring and solar PV systems.
4. To expose the students to understanding home automation, smartphone operation and soldering and desoldering techniques.

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3. Syllabus	30 Periods
Unit-I: Computer Science and Engineering Practices	**(7)**
1. Troubleshooting Desktops and PCs 2. Disassembly and Assembly of Desktops and PCs 3. Setting up Basic Computer Networks 4. Demonstration of AR/VR Technologies and Their Applications in Engineering Design, Simulation, and Training	
Unit-II: Mechanical Engineering Practices	**(8)**
1. Hands-on exercise on plumbing connection of a residential building involving minor troubleshooting 2. 3D Printing of simple engineering objects without a support structure 3. 3D Printing of simple engineering objects with support structure 4. Hands-on exercise on basic connections and maintenance with minor troubleshooting of Refrigeration System (Study)	
Unit-III: Electrical Engineering Practices	**(7)**
1. UPS Connection - Hands-on exercise on basic electrical connections with UPS Connection 2. Domestic Wiring - Hands-on exercise on basic domestic wiring 3. Safety Precautions - Hands-on exercise on electrical earthing and safety precautions 4. Renewable Energy - Design of Solar PV System for Residence (Study)	
Unit-IV: Electronics Engineering Practices	**(8)**
1. Manual soldering of electronic components onto PCB 2. Analyse Smartphone component integration, design choices and their effects on performance. 3. Design and Building of Simple Home Automation System	

4. Course Outcomes:

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

CO. No.	Course Outcome
U23GE351.1	Perform the basic troubleshooting of the PC including assembly and disassembly.
U23GE351.2	Carry out minor plumbing troubleshooting in a residential building & print 3D components with or without support materials.
U23GE351.3	Carry out minor troubleshooting and maintenance tasks in a Refrigeration System.
U23GE351.4	Perform basic domestic wiring of a residential building with provision of inverter and safety measures and Design solar PV System for residence.
U23GE351.5	Execute basic home automation projects.

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U23EM751	Soft Skills	L	T	P	J	C
		0	0	2	0	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:

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: **30 Periods**

Unit-I: Personality and Professional Development Skills **(6)**

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 **(6)**

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 **(6)**

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 **(6)**

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 **(6)**

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

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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 Book, 2015.

Magazine References:

1. The IUP Journal of Soft Skills
2. https.//iupindia.in/softskills.asp
3. Soft Skills Personality Development for Life Success
4. 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
U23EM751.1	Understand and apply interpersonal skills to enhance professional interactions and goal-setting.
U23EM751.2	Demonstrate clear and effective communication in reports and presentations to showcase professional skills.
U23EM751.3	Utilize advanced communication techniques to improve verbal and written effectiveness.
U23EM751.4	Analyze team dynamics and personal skills to enhance individual and group performance.
U23EM751.5	Create accurate and concise technical documents to uphold high standards in engineering journalism

U23MC901	தமிழர் மரபு / Heritage of Tamils	L	T	P	J	C
		1	0	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

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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: **15 Periods**

Unit-I / அலகு-I: Language And Literature / மொழி மற்றும் இலக்கியம் **(3)**

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

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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 (3)

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 (3)

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 (3)

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.

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.

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Unit-V/ அலகு-V: Contribution of Tamils to Indian National Movement and Indian Culture / இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு (3)
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. Ke̱eladi - 'Sangam City Civilisation 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 Civilisation Indus to Vaigai - R. Balakrishnan, Published by: RMRL. 2. Porunai Civilisation (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
U23MC901.1	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.
U23MC901.2	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
U23MC901.3	Understand the significance of folklore and martial arts. நாட்டுப்புறவியல் மற்றும் தற்காப்புக் கலைகளின் முக்கியத்துவத்தைப் புரிந்து கொள்வது.
U23MC901.4	Learn the Sangam literature, Sangam age and overseas conquest of Cholas. சங்க இலக்கியம், சங்க காலம் மற்றும் சோழர்களின் வெற்றிகள் ஆகியவற்றைக் கற்றுக்கொள்வது.
U23MC901.5	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.

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SEMESTER II

U23MA206	Complex Variables and Partial Differential Equations	L	T	P	J	C
		3	1	0	0	4

1. Course Description:

This course provides students with a rigorous understanding of complex variables, which extends the concepts of real numbers to the complex plane. It provides the fundamental knowledge and problem-solving abilities needed to comprehend and analyze a wide range of physical events, making it a vital part of engineering. Gaining expertise in applying transforms to many domains like engineering, physics, and applied mathematics will help us to solve differential equations, evaluate signals and solve problems.

2. Course Objectives:

1. The various methods of complex analysis can be used for efficiently solving the problems that occur in various disciplines.
2. To develop the knowledge of integral of complex functions defined along the curves in the complex plane.
3. To impart the knowledge of Laplace transform, required to solve linear mathematical models for a physical system.
4. To acquaint the student with Fourier series and Fourier transform techniques used in wide variety of situations.
5. To introduce the effective mathematical techniques for the solutions of partial differential equations that model several physical processes.

3. Syllabus **45 +15 = 60 Periods**

Unit-I: Complex Differentiation **(9+3)**

Analytic functions: Cauchy-Riemann equations excluding proof, properties of analytic function, construction of analytic function by Milne Thomson method; Conformal mapping: w=z+c, cz, 1/z; Bilinear transformation.

Unit-II: Complex Integration **(9+3)**

Integral theorems: Cauchy 's integral theorem, Cauchy 's integral formula, Cauchy 's integral formula for derivatives, Cauchy residue theorem; Taylor series, Laurent's series; Singularities, zeros.

Unit-III: Laplace Transform **(9+3)**

Existence conditions, linearity, shifting, transforms of derivatives and integrals; Periodic function; Inverse Laplace transform: Partial fraction method, convolution theorem; Application: Method of solving second order ordinary differential equations.

Unit-IV: Fourier Series and Fourier Transform **(9+3)**

Fourier series: Odd and even functions, half range sine series, half range cosine series; Fourier transform pair.

Unit-V: Partial Differential Equationsand its Application **(9+3)**

Linear homogeneous partial differential equations of second and higher order with constant coefficients;Solutions of one-dimensional wave equation and heat flow equation using Fourier series.

Text Books:

1. Dennis G Zill "Advanced Engineering Mathematics", Jones and Bartlett India P Ltd., New Delhi, 2017.
2. Erwin Kreyszig, "Advanced Modern Engineering Mathematics", 10th Edition, John Wiley and Sons (Asia) Ltd, Singapore, 2017.

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References:
Reference Books: 1. Mathews J. H. and Howell R. W "Complex Analysis for Mathematics and Engineering", Narosa Publishing House, New Delhi, 2012. 2. Wylie C. R. and Barrett L. C "Advanced Engineering Mathematics", Tata McGraw-Hill., New Delhi, 2019. 3. Dean G Duffy "Advanced Engineering Mathematics with MATLAB", CRC., USA, 2017. **Journals:** 1. International Journal of Partial Differential Equations and Applications 2. International journal of differential equations and applications. **Web Resources:** https://www.khanacademy.org/...fourier-series/.../ee-fourier-series-i https://www.youtube.com/watch?v=vQLH7qTeJRM/ https://www.youtube.com/watch?v=fH76Wo_JresNPTEL Courses **MOOC/ NPTEL / Online Courses:** https://onlinecourses.nptel.ac.in/noc23_ma22/ https://archive.nptel.ac.in/courses/111/103/111103070/

4. Course Outcomes:

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

CO. No.	Course Outcome
U23MA206.1	Construct analytic functions and bilinear transformations to determine the image under the given conformal mapping.
U23MA206.2	Utilize the concepts of integration for complex functions in the specified regions.
U23MA206.3	Apply Laplace transform and inverse transform to various functions and solve differential equations.
U23MA206.4	Determine functions expressed in trigonometric terms to represent periodic physical phenomena.
U23MA206.5	Identify mathematical principles to solve partial differential equations.

U23CS302	Data Structures and Algorithms	L	T	P	J	C
		3	0	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, trees, and graphs. 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. To build and work with linear and nonlinear data structures like arrays, linked lists, stacks, queues, trees, and graphs.

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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 implement and analyze sorting, searching, and hashing techniques to optimize data retrieval and manipulation in various contexts
5. To familiarize and working with algorithms, including traversal, shortest paths, and network flow, to solve complex problems

3. Syllabus	**45 periods**

Unit-I: Linked Lists **(9)**

Array vs Linked List - Types of Linked List: Singly - Doubly - Singly Circular - Doubly Circular– Operations on Linked List: Insertion-Deletion - Find Reverse – Modifying Linked List - Floyd's cycle finding algorithm (Slow pointer and Fast pointer) – XOR Linked List

Unit-II: Stacks and Queue **(9)**

Stack: Implementation using array and linked list- Queue: Implementation using array and linked list – Priority Queue- Infix to Postfix Conversion - Postfix expression evaluation- Processing Function Calls – Call log management - Monotonic Stack and Queue

Unit-III: Trees and Graphs **(9)**

Terminologies - Binary Trees: Implementation – Traversals - Expression Trees - Binary Search Trees: Construction-Insertion-Deletion – Searching - Find Min - Find Max – Graph : Representation – Types - Traversals: Depth First Search (DFS)-Breadth First Search (BFS) – Minimum Spanning Tree (Prim'sand Kruskal's algorithm) - Finding Shortest Path : Dijkstra's algorithm

Unit-IV: Sorting and Searching Techniques **(9)**

Sorting: Internal Sorting - Bubble Sort - Insertion Sort - Quick Sort - Searching: Linear Search - Binary Search -Fundamentals of Algorithmic Problem Solving – Time complexity - Space complexity – Worst case – Average case – Best case

Unit-V: Algorithmic Techniques **(9)**

Algorithmic techniques - Brute Force : Travelling Salesman Problem - Divide and Conquer: Mergesort - Dynamic programming: Knapsack Problem - Backtracking: n-Queen problem

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
3 Anany Levitin, —Introduction to the Design and Analysis of Algorithmsl, Third Edition,Pearson 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.

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Video References:

1. https://www.geeksforgeeks.org/data-structures
2. https://www.javatpoint.com/data-structure-tutorial
3. https://www.udemy.com/course/datastructurescncpp/
4. https://www.javatpoint.com/daa-tutorial
5. https://www.geeksforgeeks.org/design-and-analysis-of-algorithms/

MOOC/NPTEL /SWAYAM Courses:

1. https://in.coursera.org/learn/data-structures?action=enroll
2. 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 Outcome
U23CS302.1	Apply the concepts of linked lists by demonstrating and understanding of their implementation and usage to solve given problems
U23CS302.2	Construct stacks and queues using arrays and linked lists and apply these structures to appropriate scenarios
U23CS302.3	Implement tree data structures and their operations to enhance data management and retrieval systems
U23CS302.4	Understand the importance of designing strategies, time and space complexity
U23CS302.5	Apply brute force and divide and conquer strategies in solving problems

U23ME401	Engineering Mechanics	L	T	P	J	C
		3	1	0	0	4

1. Course Description:

Engineering Mechanics is a foundational course designed to introduce students to the principles governing the equilibrium and motion of bodies under the influence of forces. The course encompasses statics and dynamics, laying the groundwork for further studies in various engineering disciplines. Topics covered include vector analysis, force systems, equilibrium, friction, kinematics, dynamics, energy, and the application of these principles to analyse and solve engineering problems. Moreover, this course providing knowledge to students in the analytical tools and problem-solving skills necessary for success in more advanced engineering courses and in professional engineering practice.

2. Course Objectives:

1. Demonstrate a thorough understanding of action forces, reaction forces, and resultant forces in static bodies using both scalar and vector approaches to ensure comprehensive knowledge.
2. Develop expertise in solving moments and couples for various loads and supports in statically determinate structures, using both scalar and vector approaches, through guided practice and feedback.
3. Acquire knowledge of the properties of surfaces and solids through clear explanations, examples, and visual aids to facilitate understanding.
4. Exhibit a solid grasp of friction concepts and dynamics of forces in rigid bodies through engaging lectures, discussions, and problem-solving activities.

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3. Syllabus	60 Periods
Unit-I: Statics of Particles	**(9+3)**
Introduction to Mechanics: Units and Dimensions, Laws of Mechanics, Lami's theorem, Parallelogram and Triangular Law of forces; Vectorial representation of forces: Additions, Subtraction, Dot product, Cross product; System of forces: Coplanar forces, Forces in space, Rectangular components; Equilibrium of a particle: Equilibrium of a particle in space, Equivalent systems of forces, Principle of transmissibility. Computer Aided Simulation: Newton's law simulation, Forces and motion.	
Unit-II: Equilibrium of Rigid Bodies	**(9+3)**
Equilibrium of Rigid bodies in two dimensions: Free body diagram, Types of supports, Action and reaction forces, Single equivalent force, Stable equilibrium; Moments and Couples: Moment of a force about a point and about an axis, Varignon's theorem, Scalar components of a moment; Vectorial representation of moments and couples: Equilibrium of Rigid bodies in three dimensions. Computer Aided Simulation: Simulation in beams and couples.	
Unit-III: Properties of Surfaces and Solids	**(9+3)**
Centroids and centre of mass; Centroids of lines and areas: Rectangular, circular, triangular areas by integration; T section, I section, Angle section, Hollow section by using standard formula; Theorems of Pappus; Area moments of inertia of plane areas: Rectangular, circular, triangular areas by integration; T section, I section, Angle section, Hollow section by using standard formula; Parallel axis theorem and perpendicular axis theorem; Principal moments of inertia of plane areas; Principal axes of inertia; Mass moment of inertia; mass moment of inertia: prismatic, cylindrical and spherical solids from first principle; Relation to area moments of inertia. Computer Aided Simulation: Methods of finding centre of gravity of an irregular body; Model a situation for centre of gravity and create an interactive simulation.	
Unit-IV: Dynamics of Particles	**(9+3)**
Relationships: Displacements, Velocity and acceleration; Relative motion; Rectilinear Motion; Curvilinear motion; Newton's laws of motion; Kinetics of Particles: D'Alembert's principle, Work Energy Equation, Impulse and Momentum Principle. Computer Aided Simulation: Falling under the influence of gravitational acceleration only; Air drag: Influence of air drag of a falling object.	
Unit-V: Friction	**(9+3)**
Introduction: Frictional force, Mechanism of friction, Laws of Coulomb friction; Types of friction: Simple contact friction, Ladder friction, Wedge Friction, Belt friction, Screw Jack, Rolling resistance. Computer Aided Simulation: Screw jack simulation.	
Text Books:	
1. Beer, F.P and Johnson, E.R, Vector Mechanics for Engineers, Statics and Dynamics, 11th edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2017. 2. Kottiswaran, N, Engineering Mechanics-Statics and Dynamics, 5th edition, Vikas Publishing House Pvt. Ltd., New Delhi, 2017.	
References:	

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Reference Books:

1. Bansal, R.K, Engineering Mechanics, 2nd edition, Laxmi Publications Pvt. Ltd., New Delhi, 2009.
2. Young, D.H and Timashenko, S, Engineering Mechanicsl, 4th edition, McGraw Hill Publishing Co. Ltd., New Delhi, 2006.
3. Jivan Khachane, Ruchi Shrivastava, Engineering Mechanics: Statics and Dynamics, 1st edition, ANE Books, 2006.
4. Irving, H. Shames, G, Krishna Mohana Rao, Engineering Mechanics - Statics and Dynamics, 4th edition, Pearson Education Asia Pvt. Ltd., 2014.
5. Arthur P. Boresi, Richard J. Schmidt, Engineering Mechanics Statics and Dynamics, 1st edition, Cengage Learning, 2008.

Journals:

1. Journal of Mechanical Science and Technology-https://link.springer.com/journal/12206
2. Engineering Science And Technology: An International Journal-https://www.sciencedirect.com/journal/engineering-science-and-technology-an-international-journal

Video References:

1. https://youtu.be/6nguX-cEsvw
2. https://youtu.be/ISsVb6bzQ_I
3. https://youtu.be/k8-JBgT1_Tg

MOOC/ NPTEL/SWAYAM Courses:

1. Engineering mechanics-https://archive.nptel.ac.in/courses/112/106/112106286/
2. Engineering mechanics-https://onlinecourses.nptel.ac.in/noc20_me46/preview

4. Course Outcomes:

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

CO. No.	Course Outcome
U23ME401.1	(Apply) Solve the behavior of particles in equilibrium conditions by scalar and vector approach.
U23ME401.2	(Apply) Determine the moments and couples in the statics of rigid bodies by scalar and vector approach.
U23ME401.3	(Analyze) Calculate centroids and moments of inertia for the different shapes and use these properties in engineering analysis.
U23ME401.4	(Analyze) Analyze the kinematics and kinetics of mechanical systems by the concepts of engineering mechanics.
U23ME401.5	(Analyze) Determine the frictional force and its effects by using laws of friction.

U23NCC01	NCC Credit Course Level I	L	T	P	J	C
		2	0	0	0	2

1. Course Description:

The NCC Course is designed to instil discipline, leadership, and a sense of social responsibility in participants. Through a blend of theory and practical activities, students learn to respect cultural diversity, manage time effectively, and handle stress efficiently. They develop teamwork skills and engage in social service initiatives, fostering a well-rounded approach to personal and community development.

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2. Course Objectives:	
1. Provide a comprehensive understanding of the NCC's structure and objectives. 2. Foster national integration and the NCC's role in nation-building. 3. Develop leadership and personality development skills. 4. Encourage active participation in social service and community development. 5. Enhance awareness of safety protocols and key government initiatives.	
3. Syllabus:	**30 Periods**
Unit-I: NCC General	**(5)**
Aims, Objectives & Organization of NCC - Incentives - Duties of NCC Cadet - NCC Camps: Types & Conduct	
Unit-II: National Integration and Awareness	**(5)**
National Integration: Importance & Necessity - Factors Affecting National Integration - Unity in Diversity & Role of NCC in Nation Building - Threats to National Security	
Unit-III: Personality Development	**(6)**
Self-awareness, Empathy, Critical & Creative Thinking, Decision-making and Problem-Solving - Communication Skills - Group Discussion: Stress & Emotions, Time Management, Team Work – Career Counseling, SSB Procedure & Interview Skills – Public Speaking	
Unit-IV: Leadership	**(7)**
Traits, Indicators, Motivation, Moral Values, Honour code - Case Studies: Shivaji, Jhansi Ki Rani, APJ Abdul Kalam, Tippu Sultan, Rabindranath Tagore, Ratan Tata	
Unit-V: Social Service and Community Development	**(7)**
Basics - Rural Development Programmes, NGOs, Contribution of Youth – Swachh Bharat Abhiyan – Drug Abuse, Tree Plantation Traffic Awareness, Digital Awareness, Beti Padhao Beti Bachao, Women Health & Sanitation - Protection of Children and Women Safety - Road / Rail Travel Safety - New Initiatives - Cyber and Mobile Security Awareness	
Text Book:	
1. National Cadet Corps "Cadets Hand Book – Army(Common Subjects)"	
Web Reference:	
https://indiancc.nic.in/	

4. Course Outcomes:

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

CO. No.	Course Outcome
U23NCC01.1	Demonstrate the conduct of NCC cadets, exhibiting discipline and leadership qualities, respect and appreciate the diversity of Indian culture, and fostering a sense of unity amidst differences.
U23NCC01.2	Conduct a comprehensive SWOT analysis to identify personal strengths and weaknesses, and implement strategies to overcome weaknesses, enhancing overall performance.
U23NCC01.3	Utilize various strategies for stress management, ensuring mental well-being and resilience in challenging situations
U23NCC01.4	Collaborate effectively within a team, demonstrating teamwork skills to achieve common objectives.
U23NCC01.5	Engage in social service activities on different occasions, contributing positively to the community and fostering a sense of social responsibility

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U23HS581	Business English	L	T	P	J	C
		2	0	2	0	3

1. Course Description:

This course is designed to make the learners understand the importance and scope of Business Communication. The Learners will be introduced to a range of various situations, which will enable them to utilize the business terms profusely. It also enhances their competency to emerge successfully in the corporate world. Further, this course will enable them to do effective presentations by gathering relevant information, determining audience needs and defining presentation purpose.

2. Course Objectives:

1. Develop strategies and skills to enhance their ability to read and comprehend business communication.
2. Strengthen their listening skills which will help them to perform effectively in the business world.
3. Develop their speaking skills to analyze and respond appropriately.
4. Foster their ability to excel in written business communication.
5. Build their confidence to participate in business meetings and interviews.

3. Syllabus **30+30=60 Periods**

Unit-I: Introduction to Business Communication **(6)**

Basics of Business Communication - Types of Business Communication: Internal and External - The Communication Process and Barriers - Business Vocabulary: Common Terms and Phrases; Grammar: Sentence Structure and Types of Sentences - Punctuation in Business Writing; Listening: Listening to business conversations and identifying key information; Speaking: Role-play exercises simulating business meetings and phone calls; Reading: Analyzing business emails and memos; Writing: Drafting professional emails and business letters.

Unit-II: Business **(6)**

Writing Business Emails, Memos, and Letters - Writing Reports and Proposals - Creating Agendas and Minutes of Meetings; Grammar: Active and Passive Voice - Modal Verbs for Politeness and Formality; Listening: Listening to sample business discussions and note-taking; Speaking: Presenting ideas and reports in meetings; Reading: Reading and analyzing business proposals; Writing: Composing various forms of business correspondence.

Unit-III: Negotiation and Persuasion **(6)**

Techniques of Persuasion in Business - Negotiation Strategies and Tactics - Understanding Cultural Differences in Negotiation - Conflict Resolution and Handling Objections; Grammar: Conditional Sentences in Business Scenarios - Use of Conjunctions and Linking Words; Listening: Listening to negotiation dialogues and identifying key tactics; Speaking: Role-playing negotiation scenarios; Reading: Analyzing case studies on successful negotiations; Writing: Drafting negotiation emails and proposals.

Unit-IV: Presentations and Public Speaking **(6)**

Planning and Structuring Business Presentations - Using Visual Aids Effectively - Public Speaking Techniques - Handling Q&A Sessions; Grammar: Use of Cohesive Devices and Transitions - Clauses of Reason, Purpose, and Result; Listening: Listening to business presentations and taking notes; Speaking: Delivering business presentations; Reading:

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Reviewing presentation slides and materials; Writing: Preparing presentation scripts and speaker notes.

Unit-V: Business Reports and Documentation **(6)**

Writing and Structuring Business Reports - Writing Executive Summaries - Creating Business Plans - Documenting Processes and Procedures; Grammar: Complex Sentence Structures - Use of Passive Voice in Reports - Reported Speech in Business Contexts; Listening: Listening to report summaries and identifying main points; Speaking: Presenting a summary of a business report; Reading: Analyzing business reports and identifying key sections; Writing: Drafting business reports and executive summaries.

List of Exercises: **(30)**

1. Listening to business conversations and identifying key information. (CO 1)
2. Role-play exercises simulating business meetings and phone calls. (CO 2)
3. Listening to sample business discussions and note-taking. (CO 2)
4. Presenting ideas and reports in meetings. (CO 4)
5. Listening to negotiation dialogues and identifying key tactics. (CO 3)
6. Role-playing negotiation scenarios. (CO 3)
7. Listening to business presentations and taking notes. (CO 4)
8. Delivering business presentations. (CO 4)
9. Listening to report summaries and identifying main points. (CO 5)
10. Presenting a summary of a business report. (CO 5)

Text Books:

1. Business Communication: Building Critical Skills" by Kitty O. Locker and Stephen Kyo Kaczmarek, McGraw-Hill Education.
2. Business Communication Today" by Courtland L. Bovee and John V. Thill, Pearson.

References:

Reference Books:

1. Essentials of Business Communication" by Mary Ellen Guffey and Dana Loewy, Cengage Learning.
2. The Business Communication Handbook" by Judith Dwyer, Pearson Australia.
3. Technical Communication: A Reader-Centered Approach" by Paul V. Anderson, Cengage Learning.
4. Guide to Managerial Communication: Effective Business Writing and Speaking" by Mary Munter and Lynn Hamilton, Pearson.
5. Effective Business Writing: Strategies, Suggestions and Examples" by Maryann V. Piotrowski, HarperCollins Publishers.

Video References:

1. https://www.youtube.com/watch?v=V8uF1EoIneE
2. https://www.youtube.com/watch?v=moIucWGgvMc
3. https://www.youtube.com/watch?v=o9aVjBHEEbU

Web Resources:

1. https://learnenglish.britishcouncil.org/business-english
2. https://research.com/education/useful-links-for-learning-and-teaching-english-and-teaching
3. https://www.talaera.com/learn/

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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://onlinecourses.nptel.ac.in/noc22_hs05/preview
2. https://onlinecourses.nptel.ac.in/noc23_hs72/preview

4. Course Outcomes:

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

CO. No.	Course Outcome
U23HS581.1	Develop fundamental professional communication skills to effectively navigate and overcome barriers in business conversations.
U23HS581.2	Construct professional emails, memos, and letters, and draft formal business reports and proposals.
U23HS581.3	Develop skills in negotiation and persuasion, recognize cultural differences, and use conflict resolution strategies in business.
U23HS581.4	Plan and deliver well-structured business presentations with effective visual aids.
U23HS581.5	Build organized business reports, executive summaries, and documentation with precision and clarity.

U23HS501	Basic Japanese	L	T	P	J	C
		3	0	0	0	3

1. Course Description:

The primary objective of this course is to provide a solid foundation in speaking, listening, reading, and writing Japanese. Through interactive lessons and practical exercises, you'll learn essential vocabulary, grammar structures, and pronunciation. Additionally this course will introduce the various facets of the Japanese culture with cultural insights and real-life scenarios, thereby enhancing their awareness of the cultural subtleties inherent in the language.

2. Course Objectives:

1. Develop proficiency in basic Japanese language skills including speaking, listening, reading and writing to facilitate effective communication in everyday situations.
2. Acquire a solid understanding of the fundamental Japanese grammar structures, vocabularies and pronunciations to construct simple sentences and engage in basic conversations.
3. Enhance language proficiency through interactive activities, role-plays and real-life scenarios, fostering practical language usage and confidence in communication.
4. Build a foundation for further language study and cultural exploration, enabling the students to pursue advanced language proficiency and deeper cultural understanding.

3. Syllabus **45 Periods**

Unit-I: Introduction to Japanese Scripts and Basic Greetings (9)

Japanese Scripts (Hiragana & Katakana) – Daily greetings and expressions – Introduction to grammar particles – N1 wa N2desu - N1 wa N2ja arimasen – Phrase/Sentence ka – N1 mo N2desu - N1 no N2desu – Honorific suffixes (san, kun, chan) – Demonstrative words (Ko,

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So, A & Do series) – Soudesu – Soudesuka – Soudesune – Sou ja arimasen/Chigaimasu – S1 ka S2 ka - N1(noun) wa N2(place)desu – Numbers – Days of the week – Days of the month
Unit-II: Introduction to Concept of Time **(9)**
Ji, fun, pun – Ima wa nan ji desuka – Introduction to verbs (group I, group II, group III verbs) – Verb tense forms – V masu – V mashita – V masen – V masendeshita – N(time) ni V - N1 kara N2made - N1 to N2– N to V – S ne – N(place) e ikimasu/kimasu/kaerimasu – Doko(e) mo ikimasen/ikimasendeshita – itsu – S yo - Introduction to de particle – N(place) de V – N(vehicle) de ikimasu/kimasu/kaerimasu – N(tool) de V – N o V(transitive) – N o Shimasu – Usage of nan and nani – V masenka – V mashou, mashouka – Honorific prefixes(o/go) – "word/sentence" wa ~go de nan desuka – N(person) ni agemasu/moraimasu/kuremasu – V mou mashita.
Unit-III:Introduction to Adjectives **(9)**
I ending adjectives – na ending adjectives – forms of adjectives(negative form, past form) – I ending adjective →ku/Na ending adjective→ni narimasu – degrees of adjectives – S1 ga S2 – N ga adjective – N ga arimasu/wakarimasu – degrees of adverbs – degrees of quantity – S1 kara S2 – Doushite – N1(place) ni N2(noun) ga arimasu – N1(noun) wa N2(place) ni arimasu/imasu – N1(noun) no N2(position) – N1 ya N2 nado.
Unit-IV:Introduction to Counters **(9)**
Counters for objects – Counters for person – Ikutsu – nan+counter suffix – kurai and gurai – Quantifier(period) ni frequency counter(kai) – Quantifier/Noun+dake - N1 wa N2 yori "adjective" desu - N1 to N2to Dochira ga "adjective" desuka – N no naka de nani/doko/dare/itsu ga "adjective" desuka – Interrogatives ka/mo/demo.
Unit-V: Verb Conjugations and their Usages **(9)**
5.1: V masu form and its usages N ga hoshii desu – V masu form tai desu – V masu form ni ikimasu/kimasu/kaerimasu – V masu form mashouka. **5.2: V te form and its usages** V te form kudasai – V te form imasu – V te form mo iidesu – V te form wa ikimasen – shirimasu, shirimasen, shitte imasu – te form of adjectives – V1 te form kara V2 – douyatte – V te form agemasu/kuremasu/moraimasu **5.3: V nai form and its usages** V nai form de kudasai – V nai form kereba narimasen – V nai form to – V nai form kutemo iidesu – N(time) madeni V. **5.4: V dictionary form and its usages** V dictionary form koto ga dekimasu – Shumi wa N suru/V dictionary form koto desu – N no/Quantifier(time)/V1 dictionary form maeni V2 – nakanaka – zehi/zettai/mochiron – V dictionary form jikan/youji/yakusoku. **5.5: V ta form and its usages** V ta form koto ga arimasu – V ta ri, V ta ri Shimasu – usage of plain form and polite form – kedo – noun modification using V plain form – V plain form/N no toki ~. **5.6: If clause** V dictionary form to~ - V ta form ra~ - V te form/I adj→kute/Na adj→de/N de mo~ - moshi/ikura~.

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Text Books:

1. Minna no Nihongo, Japanese for Everyone: Elementary main textbook 1-1 & 1-2". 1st edition, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.
2. "Basic Kanji 320", published by Meguro Language Centre, Tokyo.

References

Reference Books:

1. Genki: An Integrated Course in Elementary Japanese, Eri Banno, Yoko Ikeda, and Yutaka Ohno, , The Japan Times, 2011.
2. Nihongo So-matome: JLPT N5 grammar" authored and published by Ask Publications, 2021 edition.

Web Resources:

1. www.japaneselifestyle.com
2. www.learn-japanese.info/
3. www.kanjisite.com/
4. www.learn-hiragana-katakana.com/typing-hiragana-characters/

4. Course Outcomes:

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

CO. No.	Course Outcome
U23HS501.1	Recognize and write the Japanese alphabet without errors
U23HS501.2	Extend the conversation using basic sounds in the Japanese language
U23HS501.3	Explain the concept of time by learning verbs, tenses and vocabularies.
U23HS501.4	Make use of the appropriate vocabulary required for simple conversations in the Japanese language.
U23HS501.5	Comprehend the conversation and give the correct meaning

U23HS502	Basic German	L	T	P	J	C
		3	0	0	0	3

1. Course Description:

This German language course offers a structured approach to learning German, spanning from basic introductions to more complex grammatical concepts and practical applications. Beginning with an introduction to German scripts and daily greetings, participants progress through units covering essential grammar topics, vocabulary expansion, and pronunciation exercises. Throughout the course, students engage in speaking activities, such as introducing themselves, ordering food, and describing their surroundings, while also focusing on listening comprehension and reading comprehension.

By the end of the course, participants will have gained proficiency in basic conversational German, acquired foundational knowledge of German grammar and vocabulary, and developed the skills necessary to navigate everyday situations in a German-speaking environment.

2. Course Objectives:

1. Basic German introduces learners to essential language components such as vocabulary, grammar, pronunciation, and basic conversational phrases.

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2. Through interactive lessons and practical exercises, students develop the ability to communicate in basic German for everyday scenarios including greetings, introductions, shopping, dining, and navigating daily life situations.
3. Additionally, learners become familiar with the German alphabet, basic sentence structure, and common expressions, facilitating basic reading and writing skills.

3. Syllabus	**45 Periods**

Unit-I: Basic Introduction to German Scripts **(9)**

Theme and Text (Introduction to German - German script, Deutsche Namen. Daily Greetings and Expressions) – Grammar ('wh' questions, das Alphabet)– Speak Action (Buchstabieren, sich und andere vorstellen nach Namen und Herkunft fragen, internationale Wörter auf Deutsch verstehen, jemanden begrüßen)– pronunciation (Buchstabieren J,V,W,Y, - Long vowels A,E,I,O,U - Pronunciation of Ä,Ü,Ö) – To learn (internationale Wörter in Texten finden, Wörter sortieren)

Theme and Text (Gespräche im caf'e, Getränkekarte, Telefon-buch, Namen, Rechnungen) – Grammar (Frägesatze mit wie, woher, wo, was Verben in präsens Singular und Plural, das Verb Sein, Personalpronomen und Verben)– Speak Action (eine Gespräch beginnen sich und andere vorstellen zählen, etwas bestellen und bezhalen Telefonnummern und verstehen)– pronunciation (Wortakzent in Verben und in Zahlen) – To learn (Grammatiktabelle ergänzen, mit einem Redemittelkasten arbeiten)

Unit-II: Numbers and Nominative Case **(9)**

Theme and Text (Numbers – 1 to 12 (Eins bis Zwolf) – 20, 30, 40, 90 (zwanzig-Neunzig) – All Numbers (1-10000) – German Currency (Euro) – Basic Mathematics (plus, Minus, Malen, Geteilt durch)) – Grammar (Introduction of verbs –Have Verb – To Come, To Speak, To Read, To Drive, To Fly, To write, To Eat, To sleep, To take etc.,)

Theme and Text (Communication in course) – Grammar (Singular and Plural, Artikel: der,das,die/ ein,eine, verneinung: kein, keine, Komposita: das Kursbuch) – Speak Action (Gegenständen fragen/ Gegenstände benennen im kurs:) – pronunciation (word accent Marking, Umlaute ö ä ü hören und sprechen) – To learn (Lernkarten schreiben, Memotipps, eine Regel selbst finden)

Theme and Text (City, Town, Language: Nachbar, Sprachen, Sehenswürdigkeiten in Europa) – Grammar (Past tense for Sein, W-Frage, Aussagesatz und Satzfrage) – Speak Action (about city and siteseeing) – pronunciation (Satzakzent in Frage- und Aussagesätzen) – To learn (eine Regel ergänzen, eine Grammatiktabelle erarbeiten, Notizen machen)

Unit-III:Akkusative Case and Prepositions **(9)**

Theme and Text (Menschen und Hauser, Furniture catalogue, E-Mail, House information) – Grammar (possesivartikel im Nominativ, Artikel im Akkusativ, Adjektive im satz, Graduierung mit zu)– Speak Action (Whonung bescreiben about perons and things)– pronunciation (consonant - ch) – To learn (wortschatz systematisch)

Theme and Text (Termine - Appointment and punctuality in Germany) – Grammar (questions with wann?, Preposition (am, um, von... bis), verneinung mit nicht, trennbare verben, präteritum von haben) – Speak Action (Daily plan making, time commitment, excuse for late coming) – pronunciation (consonants- p,b,t,d / k,g) – To learn (Rollenkarten arbeiten)

Theme and Text (orientation in the working area, go for work, floor plan city plan, office and computer) – Grammar (preposition: in,neben, unter, auf, vor, hinter, an, zwischen, bei und mit + Datic)– Speak Action (workplace, work, giving appointments)– pronunciation (consonants: f,w und v) – To learn (Making notice in the calendar)

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Unit-IV:Dativ Case and Prepositions	**(9)**
Theme and Text (Holiday and Party, holiday plan, party plan in Germany) – Grammar (regular and irregular verbs) – Speak Action (holiday speak, accident, Ich-Text schreiben) – pronunciation (lange und kurze vokale markieren) – To learn (Text Order)	
Theme and Text (organising an Excursion to Berlin through city orientation, Bus plan, City plan, postcard, Excursion programme) – Grammar (preposition: in, durch, über + Akkusativ: zu, an... vorbei + Dativ, Modalverb wollen) – Speak Action (Tourism, culture, postcard preparation, travel description) – pronunciation (r and l)– To learn (plaket making)	
Theme and Text (Beruf und all Tag, Visiten karten, wörterbuch) – Grammar – Speak Action (profession, statistic speaking) – pronunciation (n,ng and nk)– To learn (wörterbuch , text information in tabel)	
Unit-V: Adjectives and Pronunciation	**(9)**
Theme and Text (Haushaltstipp, kochrezept, maße und gewichte, Mahlzeiten und Gerichte) – Grammar (jeden Tag, manchmal, nie, Question - welche, Comparison – viel, gut, gern) – Speak Action (about eat, drink question and answers) – pronunciation (e,en,el,er) – To learn (Text auswerten und zusammenfassen)	
Theme and Text (Clothing , colour, weather) – Grammar (Adjecktive im Akkusativ, unbestimmer Artikel) – Speak Action (weather, dress and colour understanding) – pronunciation (e-o- ö and ie-u- ü) – To learn (wetter and Farben interkulturelle)	
Theme and Text (in supermarket,purchase, House Maintenance, Emotions, Sports, Body parts) – Grammar (Modal Verb) – Speak Action (Body parts) – To learn (Rollenkarten arbeiten)	
Text Books:	
1. Funk, Kuhn, Demme, "Studio D A1 Deutsch als Fremdsprache" Goyal Publishers and Distributors; 2016	
2. Hueber, "Fit for Goethe- Zertifikat A1 (Start Deutsch 1)" Goyal Publishers and Distributors; 2016	
References:	
Reference Books:	
1. Stefanie Dengler, "Netzwerk Deutsch Als Fremdsprache A1" by Goyal Publishers & Distributors Pvt Ltd	
2. Fran Martin, "Grammar Tables for Student of German" by Independently Published, 2017	
Web Resources:	
1. www.memrise.com/courses/english/german/	
2. www.deutsch-lernen.com/	
3. www.duolingo.com	

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4. Course Outcomes:

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

CO. No.	Course Outcome
U23HS502.1	Recognize and write the German alphabet
U23HS502.2	Speak using basic sounds of the German language
U23HS502.3	Apply appropriate vocabulary needed for simple conversation in the German language
U23HS502.4	Apply appropriate grammar to write and speak in the German language
U23HS502.5	Comprehend the conversation and give the correct meaning

U23CY281	Engineering Chemistry	L	T	P	J	C
		2	0	2	0	3

1. Course Description:

Engineering Chemistry is a fundamental course designed to provide Bachelor of Engineering students with a strong foundation in the principles and applications of chemistry relevant to engineering disciplines. This course integrates essential concepts of chemistry with engineering applications, aiming to equip students with the knowledge and skills necessary for various branches of engineering.

2. Course Objectives:

1. To study chemistry concepts and acquire engineering skills to become a perfect engineer.
2. To acquire knowledge of electrochemistry, polymer technology and water treatment which are essential for the Engineers and industry
3. To study new techniques and current information in chemistry that motivates students to express themselves and work effectively.
4. To learn about supercapacitors, energy production, electric field-based concepts of material behaviour, and environmental application in engineering and technology.
5. To explore the current technological development in chemistry in the engineering stream.

3. Syllabus **30+30=60 Periods**

Unit-I: Water Technology **(6)**

Introduction-Sources of natural water, Impurities; Hardness of water and its determination; Alkalinity of water: Types and Estimation-External treatment: Zeolite process-ion exchange method; Internal treatment method: Desalination – Reverse Osmosis.

Unit-II: Electrochemistry **(6)**

Electrochemical cells: EMF measurements-Nernst equation; Reference electrodes: Ion selective electrode; Electrochemical series-significance; Conductometric titration; Potentiometric titration.

Unit-III: Polymer Technology **(6)**

Polymers; definition-polymerization and its types-Free radical mechanism; Plastics-Classification- preparation, properties and uses of PVC, Teflon, Nylon-6,6, PET; Application and Limitations of polymers.

Unit-IV: Super Capacitors **(6)**

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Basics of electrochemical supercapacitors; Types of supercapacitors; Electrode and electrolyte interfaces and their capacitances-charge-discharge characteristics-Energy/power density; Coupling with batteries and fuel cells; Applications.

Unit-V: Energy Sources and Storage Devices **(6)**

Introduction-Nuclear reaction-Nuclear reactor; Sustainable energy; Batteries-Classification; Superconducting magnetic energy storage(SMES); Application of storage devices in smart grid and Electric vehicles (EV).

List of Experiments: **(30)**

1. Determination of total hardness of given water sample by rapid EDTA method. (CO 1)
2. Determination of alkalinity in a given water sample. (CO 1)
3. Estimation of chloride content in water by Argentometric method. (CO 1)
4. Conductometric titration between strong acid Vs strong base. (CO 2)
5. Conductometric titration between Mixture of acid Vs strong base. (CO 2)
6. Conductometric precipitation titration using Barium chloride and sodium sulphate. (CO 2)
7. Determination of strength of given hydrochloric acid using a pH meter. (CO 2)
8. Estimation of ferrous ion content of the given solution using a Potentiometer. (CO 2)

Text Books:

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

References:

Reference Books:

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

Journals:

1. https://pubs.rsc.org/en/content/articlehtml/2012/ra/c2ra20340e
2. https://www.sciencedirect.com/science/article/abs/pii/S0360319916309478
3. https://www.sciencedirect.com/science/article/abs/pii/S2211285518305755
4. http://www.electrochemsci.org/papers/vol11/111210628.pdf

Video References:

1. https://www.youtube.com/watch?v=ZLucc8DIVPs
2. https://www.youtube.com/watch?v=CWOJW4357Bg
3. https://www.youtube.com/watch?v=1U6Nzcv9Vws
4. https://www.youtube.com/watch?v=WUZqgAiKMJg

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5. https://www.youtube.com/watch?v=NVC9TwW11wg

MOOC/NPTEL/ SWAYAM Courses:

1. https://onlinecourses.nptel.ac.in/noc21_cy49/preview
2. https://onlinecourses.nptel.ac.in/noc24_cy10/preview
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
U23CY281.1	Use the principles of water characterization and treatment for portable and industrial purposes.
U23CY281.2	Utilize the laws of electrochemistry to explore its applications in vehicles and storage devices.
U23CY281.3	Show the understanding of polymer degradation during the processing and use of polymers.
U23CY281.4	Assess the components and performance of battery management systems and fuel cells coupled with supercapacitors.
U23CY281.5	Appraise and compare various energy sources and their applications towards sustainable development.

U23AD481	Python for AI	L	T	P	J	C
		2	0	2	2	4

1. Course Description:

This course equips students with essential skills in Python programming tailored for applications in Artificial Intelligence (AI). Through a combination of theoretical learning and hands-on practice, students will gain proficiency in leveraging Python's capabilities to address real-world challenges in various domains. The course covers fundamental concepts of Python programming, explores data structures, delves into object-oriented programming, and introduces scientific computing and Natural Language Processing (NLP) techniques.

2. Course Objectives:

1. To gain mastery in Python fundamentals tailored for AI applications.
2. To effectively employ various data structures within Python for AI tasks.
3. To adeptly apply object-oriented programming principles to the design and implementation of AI systems.
4. To proficiently analyze and extract insights from textual data through the application of NLP techniques within Python.
5. To develop the skills necessary to tackle real-world AI challenges using Python as the primary toolset.

3. Syllabus **30+30+30 = 90 Periods**

Unit-I: Introduction to Python **(6)**

Python basics: Introduction, IDE, identifiers, keywords; variables and expressions, literals, comments, I/O statements; Operators: arithmetic, relational, logical, assignment, bitwise, identity and membership operators; Conditional statements: if, else, and elif statements; Iteration: for, while, while-else; String operations: indexing, slicing, concatenation; File handling: open and close files, read, write and delete files.

Unit-II: Python Data Structures **(6)**

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Basic data-types, mutability; List: Introduction to list, accessing list, list operations, aliasing and cloning, list as arrays; Tuples: Introduction to tuple, accessing tuples, tuple operations; Dictionary: Introduction to dictionaries, operations and methods; Set: Creating sets, performing set operations: union, intersect and difference.

Unit-III: Functions and Object-Oriented Programming (6)

Python functions: Function definition, function call, variable scope, types, arguments, lambda functions. Recursive function; Object Oriented Programming: Class, object, attributes, methods, methods vs functions, constructor, encapsulation, inheritance, abstraction, polymorphism; exception handling.

Unit-IV: Scientific Computing with Numpy, Pandas, and Matplotlib(6)

Modules and packages: Introduction; Numpy Library: Numpy basics, indexing and slicing, shape manipulation, array iteration, array join and split, search, sort, filter; Pandas Library: Pandas introduction, series, dataframe, grouping, merging, filtering, list comprehension, concatenating and transforming data; Matplotlib Library: Line plot, scatter plot, histogram, bar plot and subplots.

Unit-V: Natural Language Processing (NLP) and Data Mining (6)

NLP: Introduction, NLTK, textblob, tokenization, stemming and lemmetization, stopwords, visualising word frequency using pandas and wordclouds, spaCy, applications; Data mining in Twitter: Overview, introduction to tweepy cursors, pre-processing, API, tweet sentiment analysis, geocoding and mapping.

List of Experiments: 30 Periods

1. Design a Python program that can perform basic arithmetic operations and scientific functions such as square root, exponentiation and trigonometric functions. (CO 1)
2. Apply Python's regular expressions to efficiently identify and tally the occurrences of targeted words within a provided text document, facilitating precise text parsing and analysis. (CO 1)
3. Develop a Python program using basic datatypes that manages a student database, allowing users to add, update, delete, and search for student records. (CO 2)
4. Analyze a dataset containing user preferences and identify common preferences among users using python sets. (CO 2)
5. Design a library management system in Python using classes to represent books, users, and transactions, and implement methods for borrowing and returning books. (CO 3)
6. Compare the performance of recursive and iterative solutions for calculating factorials in Python, and analyze the results in terms of execution time and memory usage. (CO 3)
7. Develop a Python tool for data analysis using Numpy to calculate statistical measures in a dataset. (CO 4)
8. Analyze historical stock market data using Pandas to identify trends and patterns, and visualize the trends using Matplotlib. (CO 4)
9. Develop a sentiment analysis tool in Python using NLTK to analyze the sentiment of product reviews and evaluate the accuracy of the classifier. (CO 5)
10. Design a Python program to generate a word cloud visualisation from a given text corpus, highlighting the most frequent words. (CO 5)
11. Develop a Python program that fetches tweets related to a specific topic using the Twitter API, performs sentiment analysis on the retrieved tweets, and visualizes the sentiment distribution. (CO 5)

Projects: 30 Periods

Projects in the area of data science and machine learning using Python for real time applications. (CO 1 to CO 5)

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Text Books:

1. Reema Thareja, "Python Programming Using Problem Solving Approach", Oxford University Press 2018.
2. Paul Deitel, Harvey Deitel,"Python for Programmers with introductory AI case studies", Pearson Education, 2019.
3. Anurag Gupta, G.P. Biswas, "Python Programming: Problem Solving, Packages and Libraries", McGrawHill, 2020.
4. John V. Guttag, "Introduction to Computation and Programming Using Python", 2nd edition, The MIT Press, 2016.
5. Guido van Rossum and Fred L. Drake Jr," An Introduction to Python - Revised and updated for Python 3.2", Network Theory Ltd., 2011.
6. Liang Y. Daniel, "Introduction to Programming Using Python",Pearson Education, 2017.

References:

Reference Books:

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", Second edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach", Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd., 2015.
4. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.
5. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus", Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, "Practical Programming: An Introduction to Computer Science using Python 3", Second edition, Pragmatic Programmers, LLC, 2013.

Web Resources:

1. https://www.coursera.org/learn/python-for-applied-data-science-ai
2. https://greenteapress.com/wp/think-python/
3. https://www.docs.python.org

MOOC/NPTEL/SWAYAM Courses:

1. https://nptel.ac.in/courses/106106212
2. https://nptel.ac.in/courses/110107129
3. https://nptel.ac.in/courses/106107220
4. https://nptel.ac.in/courses/106/106/106106182/

4. Course Outcomes:

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

CO. No.	Course Outcome
U23AD491.1	Apply the concepts of python programming for solving real-world problems.
U23AD491.2	Develop python programs that effectively utilize built-in data structures to address practical challenges encountered in various applications.
U23AD491.3	Analyze complex problems and develop modular and reusable solutions by applying python functions and classes.

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U23AD491.4	Analyze data and visualize trends Using Numpy, Pandas, and Matplotlib libraries.
U23AD491.5	Analyze textual data from social media platforms using advanced NLP techniques.

U23CS352	Data Structures and Algorithms Laboratory	L	T	P	J	C
		0	0	2	0	1

1. Course Description:

In this practical course students will immerse themselves 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, trees, and graphs. 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 searching approach for solving optimization problems.
5. Equip students with problem-solving strategies using backtracking and branch-and-bound techniques.

3. List of Experiments **30 Periods**

1. Implementation of Singly and Doubly linked list (CO1)
2. Implementation of Stack and Queue using Linked list (CO2)
3. Demonstration of applications of Stack (Infix to Postfix conversion) (CO2)
4. Implementation of Binary Search Tree operations and Traversal (CO3)
5. Implementation of Binary Search Tree Traversal (CO3)
6. Implementation of Graph Traversals (CO3)
7. Implementation of Dijkstra's algorithm for Shortest Minimum Path (CO3)
8. Implementation of Minimum Spanning Tree (Prim's and Kruskal's algorithm) (CO3)
9. Implementation of Sorting Algorithms (Bubble/Insertion/Quick) (CO4)
10. Implementation of Searching Techniques (Linear Search, Binary Search) (CO4)
11. Demonstration of Brute Force(Travelling Salesman Problem) (CO5)
12. Demonstration of Divide and Conquer(Merge sort) (CO5)
13. Demonstration of Dynamic programming(Knapsack Problem) (CO5)
14. Demonstration of Backtracking(n-Queen problem) (CO5)

References:

Reference Books:

1. Mark A.Weiss, "Data Structures and Algorithm Analysis in C", Second Edition, Pearson Education, 2010.

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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/
3. 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 Outcome
U23CS352.1	Apply the concepts of linked lists by demonstrating and understanding of their implementation and usage to solve given problems
U23CS352.2	Construct stacks and queues using arrays and linked lists and apply these structures to appropriate scenarios
U23CS352.3	Implement tree data structures and their operations to enhance data management and retrieval systems
U23CS352.4	Understand the importance of designing strategies, time and space complexity
U23CS352.5	Apply brute force and divide and conquer strategies in solving problems

U23EM752	Logical Thinking	L	T	P	J	C
		0	0	2	0	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 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 **30 Periods**

Unit-I: Fundamental Skills for Problem Solving **(6)**

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 **(6)**

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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 (6)
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 (6)
Fundamentals of statistics: Mean, Median and Mode, Real-life life application of statistics, Application of Ratios and Proportions in business problems, Partnerships; Geometry: 2D, 3D Visualisation.
Unit-V: Logical and Visual Reasoning (6)
Paradigm shift and its application: Syllogism, Cube 3D visualisation 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:

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

CO. No.	Course Outcome
U23EM752.1	Apply logical algorithms and mathematical methods to solve real-world problems.
U23EM752.2	Analyze and evaluate cost management strategies in various contexts.
U23EM752.3	Apply principles of time management and work efficiency in practical situations.
U23EM752.4	Use quantitative methods and interpret data to make informed decisions.
U23EM752.5	Create solutions to complex logical and visual reasoning problems by applying advanced reasoning techniques

U23MC902	Tamils and Technology / தமிழரும் தொழில்நுட்பமும்	L	T	P	J	C
		1	0	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.

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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: **15 Periods**

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 (3)

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

Unit-III: Manufacturing Technology / உற்பத்தித் தொழில் நுட்பம் (3)

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 evidence - 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.

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Unit-IV: Agriculture and Irrigation Technology / வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம் (3)

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 (3)

Development of Scientific Tamil - Tamil computing – Digitalisation 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).
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 Civilisation 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)

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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)
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:

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

CO. No.	Course Outcome / பாடநெறி முடிவுகள்
U23MC902.1	Describe about the weaving industry in sangam age and ceramic technology. சங்க காலத்தில் நெசவுத் தொழில் மற்றும் பீங்கான் தொழில்நுட்பம் பற்றி விரிவாக அறிந்து கொள்ளுதல்.
U23MC902.2	Observe the design of houses, sculptures and construction of temples. வீடுகளின் வடிவமைப்பு, சிற்பங்கள் மற்றும் கோவில்களின் கட்டுமானத்தைப் பற்றி தெரிந்து கொள்ளுதல்.
U23MC902.3	Relate the various manufacturing materials and stone types in Silappathikaram. சிலப்பதிகாரத்தில் உள்ள பல்வேறு உற்பத்திப் பொருட்கள் மற்றும் கல் வகைகளைப் பற்றி புரிந்து கொள்ளுதல்.
U23MC902.4	Understand the significance of agriculture and irrigation technology in the ancient period. பண்டைய காலத்தில் விவசாயம் மற்றும் நீர்ப்பாசன தொழில்நுட்பத்தின் முக்கியத்துவத்தை புரிந்து கொள்ளுதல்.
U23MC902.5	Explain the growth of scientific Tamil, Tamil computing and the digitization of Tamil books. அறிவியல் தமிழின் வளர்ச்சி, தமிழ்க் கணினி, தமிழ் நூல்களின் டிஜிட்டல் மயமாக்கல் ஆகியவற்றை விரிவாக தெரிந்து கொள்ளுதல்.

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SEMESTER III

U23MA208	Linear Algebra and Numerical Methods	L	T	P	J	C
		3	1	0	0	4

1. Course Description:

This course offers a comprehensive exploration of both Linear algebra and numerical techniques, providing students with a versatile skill set applicable to a wide range of scientific, engineering, and business disciplines. The course aims to develop a balanced understanding of algebraic analysis and numerical problem-solving, emphasizing their synergistic application in tackling real-world challenges.

2. Course Objectives:

1. Initiate the basic concepts in the vector space and its attributes.
2. Enhance the knowledge in linear transformations.
3. Impart the basic concepts in solving algebraic and transcendental equations.
4. Introduce the numerical techniques for differentiation, integration and interpolate the data.
5. Train the students in solving ordinary and partial differential equations numerically.

3. Syllabus **45+15 =60 Periods**

Unit-I: Vector Spaces **(9+3)**

Vector spaces: Subspaces; Linear system of equations: linear independence, linear dependence, basis, dimensions.

Unit-II: Linear Transformation and Diagonalization **(9+3)**

Linear transformation: Null spaces and ranges; Dimension theorem; Matrix representation of a linear transformations; Eigen values and eigen vectors; Diagonalizability.

Unit-III: Solution of Equations and Eigen Value Problems **(9+3)**

Solution of algebraic and transcendental equations: Newton Raphson method; Solution of system of linear equations: Gauss elimination method, Gauss-Jordan method, Gauss-Seidel method; Eigen values of a matrix by power method.

Unit-IV: Interpolation, Numerical Differentiation and Integration **(9+3)**

Interpolation: Lagrange's interpolation formula, Newton's forward interpolation formula, Newton's backward interpolation formula; Numerical differentiation: Newton's forward and backward interpolation formulae; Numerical integration for a single variable: Trapezoidal rule, Simpson's one third rule.

Unit-V: Solutions of Ordinary and Partial Differential Equations **(9+3)**

Solution of first order ordinary differential equations: Euler's modified method, Fourth order Runge -Kutta method; Solution of partial differential equations: Finite difference method, Solution of one- dimensional heat equation, Solution of one-diensional wave equation.

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List of Tutorials:

1. Working procedure, Basic commands and symbolic computation. (CO 1)
2. Solving several types of systems of linear equations. (CO 1)
3. Matrix Operations. (CO 1)
4. Shifting and scaling of vectors. (CO 1)
5. Eigen values and Eigen vector computation. (CO 2)
6. Solve the system of linear equations using Gauss – elimination and Jordan method. (CO 3)
7. Largest eigen value of a matrix by power - method. (CO 3)
8. Numerical differentiation using Newtons method. (CO 4)
9. Numerical integration using Trapezoidal and Simpsons rule. (CO 4)
10. Numerical solution of ordinary differential equations by Euler's method. (CO 5)
11. Numerical solution of ordinary differential equations by Runge - Kutta method. (CO 5)

Text Books:

1. Howard Anton and Chris Rorres, "Elementary Linear Algebra", 11th Edition, Wiley India, New Delhi, 2018.
2. Chapra, S. C and Canale, R. P. "Numerical Methods for Engineers", 7th Edition, Tata McGraw-Hill, New Delhi, 2017.

References:

Reference Books:

1. Lay, D.C., "Linear Algebra and its Applications", 5th Edition, Pearson Education, 2015.
2. Kolman, B. Hill, D.R., "Introductory Linear Algebra", 8th Edition, Pearson Education, New Delhi, First reprint, 2005.
3. Gerald C. F and Wheatley P.O, "Applied Numerical Analysis", 7th Edition, Pearson Education, New Delhi, 2015.
4. Ward Cheney and David Kincaid, "Numerical Mathematics and Computing", Cengage Learning, USA, 2018.

Journal References:

1. Mathematical Modelling and Numerical Analysis: https://www.scimagojr.com/journalsearch.php?q=25956&tip=sid&clean=0
2. International Journal for Numerical Methods in Engineering: https://www.scimagojr.com/journalsearch.php?q=12336&tip=sid&clean=0
3. Journal of Computational and Graphical Statistics: https://www.tandfonline.com/toc/ucgs20/current
4. Applied Numerical Mathematics: https://www.sciencedirect.com/journal/applied-numerical-mathematics/publish/guide-for-authors

Web Resources:

1. https://www.youtube.com/watch?v=YrHlHbtiSM0
2. https://www.khanacademy.org/math/linear-algebra/vectors-and-spaces/vectors/v/adding-vectors
3. https://www.khanacademy.org/math/linear-algebra/matrix-transformations/linear-transformations/v/linear-transformations
4. https://youtu.be/TIWRyzzFUYQ?si=NqG-j8G74qM1i8xI

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MOOC/NPTEL/SWAYAM Courses:
1. https://archive.nptel.ac.in/courses/111/106/111106135/ 2. https://nptel.ac.in/courses/122106033

4.Course Outcomes:

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

CO. No.	Course Outcome
U23MA208.1	Implement the principles of vector space and its characteristics to address real time problems.
U23MA208.2	Articulate the eigen values and eigen vectors of matrix representation of a linear transformation within a finite dimensional space.
U23MA208.3	Apply numerical techniques to obtain approximate solutions for algebraic, transcendental and system of linear equations.
U23MA208.4	Evaluate the initial value problem using numerical techniques for engineering applications.
U23MA208.5	Apply the numerical techniques for ordinary and partial differential equations.

U23ME402	Materials and Manufacturing - I	L	T	P	J	C
		3	0	0	0	3

1. Course Description:

Materials and Manufacturing is a comprehensive course designed to provide students with a foundational understanding of the relationship between materials properties and manufacturing processes. The course explores the principles of materials science and engineering, emphasizing the selection, processing, and application of materials in casting and forming industries.

2. Course Objectives:

1. To develop the knowledge on mechanical properties of materials
2. To familiarize with the properties and applications of ferrous, non-ferrous and advanced
3. engineering materials
4. To make understand mechanical behaviour of materials
5. Summarize applications of different types of manufacturing processes.
6. Explain merits and demerits of various manufacturing processes.

3. Syllabus **45 Periods**

Unit-I: Structure and Properties of Materials **(9)**

Introduction to Classification of materials; Introduction to Crystal structures: Unit Cells, Metallic Crystal Structures, Crystal Systems, Crystallographic Points, Crystallographic Directions, Crystallographic Planes, Linear and Planar Densities; Crystalline and Non-crystalline Materials: Single Crystals, Polycrystalline Materials; Imperfection in solids: Point, Line, Surface and Volume defects; Polymorphism and Allotropy; Various Properties of Engineering materials.

Unit-II: Ferrous & Non-Ferrous metals **(9)**

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Steel: Types of Steel; Properties and Applications: Silicon and Hadfield Manganese steel, HSS, Stainless steel, HSLA, TRIP; Cast iron: Overview, Types; Properties and application: White, Grey, Malleable and Nodular; Effect of alloying elements on properties of steel; Properties and Applications: Aluminum, Magnesium, Copper, Nickel, Titanium and their alloys.

Unit-III: Mechanical behavior of Materials **(9)**

Mechanism of Plastic deformation: Slip and twinning; Testing of Materials: Hardness measurements, Tensile properties of the materials, Impact tests; Fracture of metals: Ductile Fracture, Brittle Fracture, Ductile to Brittle Transition Temperature (DBTT); Computerized Image Processing Techniques.

Unit-IV: Metal Casting Processes **(9)**

Introduction: Manufacturing process; Sand Casting: Sand Mould, Type of patterns, Pattern Materials, Pattern allowances; Core; Molding sand: Properties, Testing; Cores: Types, Applications; Gating and riser System; Molding machines Types; Principle of special casting processes: Shell, investment, Ceramic mould; Pressure die casting; Centrifugal Casting; CO_2 process; Stir casting; Defects in Sand casting; Applications; Foundry Automation; Material Handling;

Unit-V: Metal Forming **(9)**

Hot working and cold working of metals; Forging processes; Open, Impression and Closed die forging; Forging operations: Types of Forging machines; Rolling of metals; Types of Rolling: Flat strip rolling, shape rolling operations; Defects in rolled parts; Principle of rod and Wire drawing; Tube drawing; Principles of Extrusion; Types: Hot and Cold extrusion; Applications

Text Books:

1. W.D. Callister, David G. Rethwisch, Materials Science and Engineering: An Introduction, 10th edtion., Wiley & Sons, 2020.
2. Hajra Chouldhary S.K and Hajra Choudhury. AK., Elements of Workshop Technology, volume I, 17th Edition, Media promoters and Publishers Private Limited, Mumbai, 2015

References:

Reference Books:

1. O. P. Khanna, Material Science and Metallurgyǁ, Edition-2016, Dhanpat Rai Publications.
2. U. C. Jindal, Material Science and Metallurgy, 1st Edition, Dorling Kindersley, 2012
3. Rao, P.N, Manufacturing Technology, Vol. 1, 5th Edition, Tata McGraw-Hill Publishing Company Limited, 2018.
4. Roy. A. Lindberg, Processes and Materials of Manufacture, 3rd Edition PHI / Pearson education, 2015
5. Sharma, P.C., A Text book of production Technology, S. Chand and Co. Ltd., 2022.

Journals:

1. Manufacturing Technology Journal - https://journalmt.com/ (Publisher : Elsevier)
2. The International Journal of Advanced Manufacturing Technology - (Publisher - Springer)

Video References:

1. https://www.youtube.com/watch?v=6ISddRRHAhA
2. https://www.youtube.com/watch?v=6ISddRRHAhA&list=PLSGws_74K01_y_JH5qBvFc-FkFknUILWl
3. https://in.coursera.org/courses?query=manufacturing%20process
4. https://www.udemy.com/topic/manufacturing/

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MOOC/ SWAYAM / NPTEL Courses:

1. Introduction to Material Science and Engineering - https://archive.nptel.ac.in/courses /113/102/113102080/
2. Principles of Physical Metallurgy - https://archive.nptel.ac.in/courses/113/105/113105024/
3. Properties of Materials - https://archive.nptel.ac.in/courses/113/104/113104096/
4. Metallurgy and Material science & Mining Engineering - https://onlinecourses.nptel.ac.in/ noc20_mm09/preview
5. Manufacturing Processes and Technology - https://onlinecourses.nptel.ac.in/ noc22_me28/preview

4. Course Outcomes:

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

CO. No.	Course Outcome
U23ME402.1	Proficient in analyzing and interpreting the crystal structures and properties for engineering materials
U23ME402.2	Identify and apply the effect of alloying elements, properties and applications in Ferrous and Non-ferrous metals
U23ME402.3	Comprehend plastic deformation mechanisms, material testing methods, and computerized image processing techniques to analyze voids and fractures
U23ME402.4	Apply the different metal casting processes
U23ME402.5	Apply the different metal forming processes

U23ME403	Engineering Thermodynamics	L	T	P	J	C
		3	1	0	0	4

1. Course Description:

This course provides an introduction to the most powerful engineering principles - Thermodynamics: the science of energy and its transformation from one form to another form. The subject is widely applicable in several branches of engineering and science. The objective of this course is to introduce systematic different tools needed to analyze energy systems from various daily lives to large scale engineering applications. More specifically, we will cover the topics of mass and energy conservation principles; first law analysis of closed and open systems; understanding second law of thermodynamics and entropy; exergy; properties of pure substances; power generation and refrigeration on thermodynamic cycles.

2. Course Objectives:

1. Exhibit a comprehensive understanding of the fundamental concepts and Laws of thermodynamics through engaging lessons and activities.
2. Develop problem-solving skills in work transfer and heat transfer through practice problems, examples, and case studies.
3. Demonstrate mastery in solving problems related to the second law of thermodynamics through regular assignments, quizzes, and feedback.

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4. Acquire knowledge of power plant cycles and their practical applications through lectures, discussions, and industry examples.
5. Achieve proficiency in solving problems related to refrigeration and air-conditioning through hands-on activities, group work, and assessments.

3. Syllabus **60 Periods**

Unit-I: Basic Concepts and Temperature Relations **(9+3)**

Basic concepts: concept of continuum, microscopic and macroscopic approach, System functions, Properties, total and specific quantities, System and their types; Thermodynamic Equilibrium State: path and process, quasi-static, reversible and irreversible processes; Heat and work transfer: definition and comparison, sign convention; Work Transfer: Displacement work and other modes of work, P-V diagram; Zeroth law of thermodynamics; Applications and concept of temperature and thermal equilibrium, relationship between temperature scales, new temperature scales.

Unit-II: First Law Thermodynamics **(9+3)**

First law of thermodynamics: applications to closed and open systems, uniform and non-uniform processes, steady state and unsteady state processes, general energy equation and applications to thermal equipment, Applications.

Unit-III: Second Law of Thermodynamics **(9+3)**

Second Law: Kelvin-Planck and Clausius statements, heat engines and heat pump, reversibility, Carnot cycle, Carnot theorem, Thermodynamic temperature scale, Deduction of the third law of thermodynamics, High- and low-grade energy; Available and non-available energy: finite body, Types of Irreversibility, I and II law Efficiency and its applications.

Computer based simulation (for demonstration Only): Carnot cycle simulation.

Unit-IV: Steam Power Cycles **(9+3)**

Rankine cycle: Ideal and actual cycle, Applications, Cycle efficiency, Simple Rankine cycle; Cycle Improvement methods: Superheat, Reheat, Regenerative, Economizer and Air preheater.

Unit-V: Psychrometry and Refrigeration System **(9+3)**

Psychrometric properties: Psychrometric charts, Property calculations of air vapour mixtures by using chart and expressions, Psychrometric process; Refrigeration: definition, terminology used, desirable properties of refrigerant, classification of refrigerants, selection of refrigerant, types of refrigeration systems, Ideal vapour compression refrigeration cycle, Vapour absorption refrigeration cycle, Brayton refrigeration cycle; Application of Psychrometry and various refrigeration systems.

Computer based simulation (for demonstration Only): Refrigeration and air conditioning simulation

Text Books:

1. Er.Rajput. R. K., "Thermal Engineering", tenth Edition, Lakshmi publication, 2015.
2. Kothandaraman.C.P., Domkundwar. S,Domkundwar. A.V., "A course in thermal Engineering", Fifth Edition, "Dhanpat Rai & sons , 2012.

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References:
Reference Books: 1. Ramalingam.K.K., Thermal Engineering, First Edition, Scitech publication Ind P LTD,2015. 2. Ganesan .V Internal Combustion Engines , Fourth Edition, Tata Mcgraw-Hill 2016 3. Sarkar. B.K. Thermal Engineering, First Edition, Tata McGraw-Hill Publishers, 2011 4. Rudramoorthy, R, Thermal Engineering, First Edition, Tata McGraw-Hill, New Delhi,2010 **Journals:** 1. The Journal of Chemical Thermodynamics- https://www.sciencedirect.com/journal/the-journal-of-chemical-thermodynamics/ (Publisher : Elsevier) 2. The International Journal of thermodynamics - https://dergipark.org.tr/en/pub/ijot **Video References:** 1. https://www.youtube.com/watch?v=rFDjZwdVr-U 2. https://www.youtube.com/watch?v=Z9nfbVh5Wzk **MOOC/ SWAYAM / NPTEL Courses:** 1. Engineering Thermodynamics- https://archive.nptel.ac.in/courses/112/106/112106310/ 2. Engineering Thermodynamics- https://onlinecourses.nptel.ac.in/noc23_me141/preview

4. Course Outcomes:

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

CO. No.	Course Outcome
U23ME403.1	Familiarize the principles of work and energy
U23ME403.2	Analyze the heat and work transfer in various thermodynamics process
U23ME403.3	Acquire knowledge about the fundamentals of thermodynamic laws, concepts and principles
U23ME403.4	Examine the Rankine cycle to determine the efficiency of the steam power systems
U23ME403.5	Evaluate the performance of various thermal systems based on the laws of thermodynamics

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U23EC381	ELECTRONICS AND MICROPROCESSOR	L	T	P	J	C
		3	0	2	0	4

1. Course Description:

This course offers an in-depth exploration of the fundamental concepts in semiconductor theory, diodes, and transistors. It features a detailed study of the 8085 microprocessor, where students will learn to write and implement assembly programs. Additionally, the course covers the 8051 microcontroller, focusing on its architecture, instruction set, and the principles of interfacing with peripheral devices. By the end of this course, students will have a comprehensive understanding of both microprocessors and microcontrollers, equipping them with the skills needed to excel in the field of electronics.

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 **45 + 30 = 75 Periods**

Unit-I: Diode and its Applications **(9)**

Intrinsic and extrinsic semiconductor; P type and N type semiconductor; PN junction diode: properties, biasing and VI characteristics; half wave rectifier and centre tap full wave rectifier; Zener diode; Zener diode as voltage stabilizer.

Unit-II: Transistors and Amplifiers **(9)**

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; MOSFET: types, circuit operation of D-MOSFET and E-MOSFET.

Unit-III: Introduction to 8085 Microprocessor **(9)**

8085 Hardware Architecture; 8085 Pin out; register organization; addressing modes; instruction set; programming 8085 (commonly used instructions only).

Unit-IV: Introduction to 8051 Microcontroller **(9)**

8051 architecture; memory organization; special function registers; port operation; timer/counters; serial interface; interrupts; operand addressing; instruction set.

Unit-V: Interfacing 8051 Microcontroller **(9)**

LCD & Keyboard Interfacing; ADC, DAC & Sensor Interfacing; External Memory Interface; Stepper Motor and Waveform generation.

List of Experiments **(30 Periods)**

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1. Develop the circuit of the P-N junction diode and plot the V-I characteristics to determine the knee voltage by varying the forward bias voltage and current in reverse biased condition due to minority carriers. (CO 1)
2. Analyze the breakdown mechanism of Zener diode for voltage regulation in a circuit with varying load currents and plot its VI characteristics. (CO 1)
3. Construct the circuit of BJT in Common Emitter Configuration and plot its input and output characteristic curves by varying the V_{BE} and V_{CE} and plotting the I_B and I_C. (CO 2)
4. Write assembly language programs using 8085 instructions for performing various arithmetic and logical operations and verify the same for various test cases. (CO 3)
5. Write assembly language programs using 8051 instructions for performing various arithmetic and logical operations and verify the same for various test cases. (CO 4)
6. Design of simple automation projects using 8051 Microcontroller. (CO 5)

Text Books:

1. V.K.Mehta and Rohit Mehta, "Principles of Electronics" S.Chand, 12edition, 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)

References:

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, 2edition, 2012

Journals:

1. IEEE Transactions on Electronics Devices
2. Microelectronics Journal

Magazines:

1. https://www.electronicdesign.com/
2. https://spectrum.ieee.org/

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/

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4. Course Outcomes:

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

CO. No.	Course Outcome
U23EC381.1	Differentiate between signal diodes, rectifiers, and Zener diodes based on their characteristics and applications.
U23EC381.2	Analyze BJT and FET symbol representations, internal structures, and biasing circuits.
U23EC381.3	Comprehend the architecture, instruction set and write assembly program for 8085 Microprocessor
U23EC381.4	Comprehend the architecture, instruction set and write assembly program for 8051Microcontroller
U23EC381.5	Interpret the working of peripherals and interface with 8051.

U23ME481	Fluid Mechanics and Machinery	L	T	P	J	C
		3	0	2	0	4

1. Course Description:

Fluid mechanics and machinery courses often involve solving complex problems related to fluid flow, pressure, and machine operation. Engaging with these challenges can enhance your problem-solving skills, a valuable asset in any engineering discipline. Understanding how machines work and the principles behind their operation is essential for engineers involved in the design, maintenance, and optimization of mechanical systems.

2. Course Objectives:

1. Faculty will deliver content that provides students with basic knowledge about the physical properties of fluids, such as density, viscosity, and compressibility, and understand their impact on fluid behavior.
2. Faculty will design and implement complex fluid mechanics problems and exercises that challenge students to apply analytical and problem-solving skills through the solution of complex fluid mechanics problems, encouraging critical thinking and application of learned concepts.
3. Faculty will guide students in applying Bernoulli's equation to analyze fluid flow problems, including its application to energy balance in pipes, nozzles, and other flow devices.
4. Faculty will provide instruction to the students on the use of mathematical models and computational methods to analyze fluid machinery systems, considering factors such as fluid flow, pressure losses, and efficiency.

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5. Faculty will educate students on the understanding of the working principles of pumps and turbines, including their classification, performance characteristics, and applications in various engineering systems.
3. Syllabus **45+30=75 Periods**
Unit-I: Fluid – Properties, Statics and Dynamics **(9)**
Fluid – Units and dimensions - Physical Properties of fluids -Fluid Statics- Pascal Law - Pressure Measurements by manometers. Fluid Dynamics - Continuity equation - energy or bernoullis equation - Momentum or Euler's Equation. **Computer based simulation (For Demonstration Only):** Introduction to hydraulics and pneumatics simulation
Unit-II: Flow through Pipes **(9)**
Laminar flow - Reynold's Experiment - Laminar flow through circular conduits - Turbulent Flow - Darcy Weisbach equation - Chezy's Equation - Friction factor and Moody diagram - Losses in Pipe Flow - Major and minor losses - Pipes in series and parallel. **Computer based simulation (For Demonstration Only):** ANSI representation of various fluid power components
Unit-III: Dimensional Analysis And Model Studies **(9)**
Fundamental dimensions - Dimensional homogeneity - Rayleigh's method and Buckingham Pi theorem - Dimensionless parameters - Similitude and model studies - Similarity Laws - Types of Models. **Computer based simulation (For Demonstration Only):** Circuit design using fluid power components.
Unit-IV: Pumps **(9)**
Classification of pumps - Centrifugal pumps - Working principle - Heads and efficiencies – Velocity triangles - Axial Flow Pump - Reciprocating pump working principle - Indicator diagram and it's variations - Rotary pumps.
Unit-V: Turbines **(9)**
Turbines - Classification of turbines – Working principles - Pelton wheel - Francis turbine - Kaplan turbine - Work done - Efficiencies - Draft tube - Specific speed - Performance curves for turbines - Governing of turbines
List of Experiments: **30 Periods**

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1. Determination of the Coefficient of discharge of using Orifice meter. (CO1)
2. Determination of the Coefficient of discharge of using Venturi meter. (CO1)
3. Calculation of the rate of flow using Rota meter. (CO1)
4. Determination of major energy loss for a given set of pipes. (CO2)
5. Conducting experiments and draw the characteristic curves of Centrifugal pump.(CO4)
6. Conducting experiments and draw the characteristic curves of Submergible pump. (CO4)
7. Conducting experiments and draw the characteristic curves of Reciprocating pump. (CO4)
8. Conducting experiments and draw the characteristic curves of Gear pump. (CO5)
9. Conducting experiments and draw the characteristic curves of Pelton wheel. (CO5)
10. Conducting experiments and draw the characteristics curves of Kaplan turbine. (CO5)
11. Conducting experiments and draw the characteristics curves of Francis turbine. (CO5)

Text Books:

1. Y.A.Cengel & J.M.Cimbala, "Fluid Mechanics: Fundamentals and Applications", McGraw Hill Education. 2010.
2. Streeter, V. L. and Wylie E. B., "Fluid Mechanics", McGraw Hill Publishing Co. 2010
3. Graebel. W.P, "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint, 2011
4. White, F.M., "Fluid Mechanics", Tata McGraw Hill, 5th Edition, New Delhi, 2003
5. Kumar K L, "Engineering Fluid Mechanics", S Chand and Company, 2010.

Reference Books:

1. Bansal, R.K., "Fluid Mechanics and Hydraulics Machines", 5th edition, Laxmi Publications Pvt. Ltd, New Delhi, 2008.
2. Modi P.N and Seth " Hydraulics and Fluid Mechanics including Hydraulic Machines", Standard Book House New Delhi. 2003

Journals:

1. Fluid Dynamics – Springer
2. Fluid Dynamics Research – IoP Science

MOOC/ SWAYAM / NPTEL Courses:

1. https://www.mooc-list.com/course/advanced-fluid-mechanics-1-fundamentals-edx
2. https://www.mooc-list.com/course/advanced-fluid-mechanics-2-navier-stokes-equations-viscous-flows-edx#google_vignette
3. https://www.youtube.com/watch?v=lJM4GuUd3Hk
4. https://www.edx.org/learn/fluid-mechanics/massachusetts-institute-of-technology-advanced-fluid-mechanics-1-fundamentals
5. https://www.fun-mooc.fr/en/courses/dynamics-fluid-interfaces/
6. Fluid Mechanics - https://onlinecourses.nptel.ac.in/noc22_ce85/preview
7. Advanced Concepts in Fluid Mechanics - https://onlinecourses.nptel.ac.in/noc19_me53/preview

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4. Course Outcomes:

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

CO. No.	Course Outcome
U23ME481.1	Analyze energy transfer within fluid systems, applying principles such as Bernoulli's equation
U23ME481.2	Apply principles of fluid dynamics to analyze and predict fluid flow in various engineering systems, including pipes, channels, and open channels.
U23ME481.3	Apply dimensional analysis techniques to analyze and solve engineering problems involving fluid flows.
U23ME481.4	Analyze the performance of pumps by considering efficiency and operational characteristics.
U23ME481.5	Evaluate the performance of turbines, considering factors such as efficiency, head losses, and power requirements.

U23ME451	Computer Aided Drafting and Modelling Laboratory	L	T	P	J	C
		0	0	2	0	1

1. Course Description:

This course provides an introduction to computer-aided drafting. Emphasis is placed on setup; creating and modifying geometry; storing and retrieving predefined shapes; placing, rotating, and scaling objects, adding text and dimensions, using layers, coordinate systems, and plot/print to scale.

2. Course Objectives:

1. Enable students to develop skills in using software to create 2D and 3D models.
2. Equip students to apply basic concepts to drawing, editing, dimensioning, hatching, and other techniques to develop 2D and 3D modeling skills.

3. Syllabus: **30 Periods**

List of Experiments

1. Study of capabilities of software for Drafting and Modeling – Coordinate systems (absolute, relative, polar, etc.) – Creation of simple figures like polygon and general multi-line figures. (CO1)
2. Drawing of a Title Block with necessary text and projection symbol. (CO1)
3. Drafting of given 2D drawings. (CO2)
4. Drawing of front view and top view of simple solids like prism, pyramid, cylinder, cone, etc, and dimensioning. (CO2)
5. Drawing front view, top view and side view of objects from the given pictorial views (eg. V-block, Base of a mixie, Simple stool, Objects with hole and curves). (CO3)

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6. Drawing isometric projection of simple objects. (CO4)
7. Creation of 3-D models of simple objects and obtaining 2-D multi-view drawings from 3-D model. (CO4)
8. Draw the Assembled Sectional views of Gib and Cotter using AutoCAD. (CO5)
9. Draw the Assembled Sectional views of screw jack using AutoCAD. (CO5)
10. Draw the Assembled Sectional views of Machine Vice using AutoCAD. (CO5)

Text Books:

1. George Omura, Mastering in Autocad 2005 and Autocad LT 2005– BPB Publications, 2008

References:

Reference Books:

1. Engineering graphics with Auto CAD- R.B. Choudary/Anuradha Publishes

Video References:

1. https://www.youtube.com/watch?v=LJAg9a0sd2g

4. Course Outcomes:

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

CO. No.	Course Outcome
U23ME451.1	(Apply) Draw the title block and curves like parabola, involutes and solids for given experiments.
U23ME451.2	(Apply) Apply fundamental knowledge and basic skill to draft and model for given 2D drawings
U23ME451.3	(Apply) Develop 2D representations of 3D objects using CAD software
U23ME451.4	(Analyze) Analyse and develop 2D and 3D models in relevance to given drawings using CAD Software
U23ME451.5	(Create) Create part drawings, sectional views and assembly drawings as per standards for the given components

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U23ME452	Manufacturing Technology Laboratory	L	T	P	J	C
		0	0	2	0	1

1. Course Description:

The purpose of the Manufacturing Technology Laboratory course is to enhance theoretical understanding by providing practical training in a range of manufacturing processes and procedures.

This course allows students to apply theoretical principles from the classroom to practical production situations, thereby improving their comprehension and skill in manufacturing technology.

The Manufacturing Technology Laboratory course offers students important experiential learning and practical expertise that are crucial for achieving success in the manufacturing industry.

By actively engaging in laboratory activities, students will cultivate self-assurance, enhance their capacity for critical thinking, and acquire problem-solving expertise that is in great demand among companies in the manufacturing sector.

2. Course Objectives:

1. To enable students to understand various machining operations in special purpose machines and their real-world applications in manufacturing industrial components.
2. To engage students practically in various operations that can be performed on lathe, shaper, drilling, and milling machines.
3. To provide students with hands-on practice in various operations conducted on special purpose machines and others, equipping them with the practical knowledge required in core industries.

3. List of Experiments **30 Periods**

1. Study on classification of materials, polymers, ceramics, composites, electronic materials, energy and other smart materials (CO1)
2. Create the component as per the given diagram using the operations of Turning, Facing, chamfering, step turning, taper turning and knurling (CO2)
3. Build the component as per the given diagram performing with Turning, Grooving, Thread Cutting (External) operations (CO2)
4. Create the component as per the given diagram using Turning, Drilling and Eccentric turning operations (CO2)
5. Build the component as per the given drawing using Turning, Boring and internal thread cutting operations (CO2)
6. Develop and perform Square & Hexagonal Head Shaping in the Shaping machine as per given drawing (CO3)
7. Develop and perform the Spur gear hobbing operation as per the given drawing. (CO3)
8. Machine the workpiece in Surface grinding & Shaft grinding as per the given drawing. (CO2)
9. Build the slot in the given workpiece in Slotting machine as per given diagram (CO3)

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10. Perform the Contour milling using vertical milling machine as per given diagram (CO4)
11. Study of green sand moulds for the given drawing. (CO4)
12. Create Welding of butt joints and lap joints by using Arc Welding as per the given drawing (CO5)

Text Books:

1. Sharma, P.C., "A Text book of production Technology", S.Chand and Co. Ltd., 2009.
2. Rao, P.N. "Manufacturing Technology " Tata McGraw-Hill Publishing Company Limited, 2008

References:

Reference Books:

1. Hajra Chouldhary S.K and Hajra Choudhury. A K., "Elements of workshop Technology", volume I and II, Media promoters and Publishers Private Limited, Mumbai, 2014
2. Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India Edition, 2013

Web References:

1. http://mtl.mech.ntua.gr/
2. https://vignanits.ac.in/production-technology-lab/
3. http://vlabs.iitkgp.ac.in/psac/newlabs2020/vlabiitkgpAM/
4. http://vlabs.iitkgp.ac.in/psac/newlabs2020/vlabiitkgpAM/
5. https://www.vlab.co.in/broad-area-mechanical-engineering
6. https://nitkkr.ac.in/?page_id=1317

4. Course Outcomes:

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

CO. No.	Course Outcome
U23ME452.1	Understand various engineering materials and select appropriate materials for specific manufacturing applications.
U23ME452.2	Create the work piece as per given drawing using Lathe / shaper / Slotter / Grinder
U23ME452.3	Create gear as per given drawing using gear hobbing machine
U23ME452.4	Use different moulding tools, patterns to prepare sand moulds.
U23ME452.5	Use fabrication tools to join and fabricate the structures using Welding / Forming / Bending / Carpentry tools

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U23EM753	Advanced Logical Thinking	L	T	P	J	C
		0	0	2	0	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: **30 Periods**

Unit-I: Inductive Reasoning through Permutations & Combination **(6)**

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 **(6)**

Introduction to Probabilities, Application of Probability; Power of Compounding: Case Studies.

Unit-III: Strategical techniques in Time, Speed and Distance **(6)**

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 **(6)**

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 **(6)**

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:

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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

Web 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
U23EM753.1	Develop the ability to use inductive reasoning to solve complex problems involving permutations and combinations.
U23EM753.2	Understand probability theory to make informed decisions under uncertainty.
U23EM753.3	Utilize strategic techniques to solve problems related to time, speed, and distance.
U23EM753.4	Apply logical reasoning to solve problems involving mixtures and allegations.
U23EM753.5	Enhance logical reasoning skills to tackle a variety of analytical problems.

U23MC904	Universal Human Values	L	T	P	J	C
		1	0	0	0	NC

1. Course Description:

Universal Human Values explores fundamental ethical principles and humanistic values across cultures. The course encourages critical reflection on compassion, integrity, respect, and empathy, fostering personal growth and societal responsibility. Through interdisciplinary readings and discussions, students gain insights into the universal aspects of human dignity and moral conduct.

2. Course Objectives:

1. Understand what value education is and explore how personal reflection can help achieve happiness and prosperity in life.
2. Learn how to distinguish between the needs of the mind and body, and develop practices for maintaining balance and health.
3. Recognize the importance of trust and respect in relationships, and understand how to foster harmony within families and communities.
4. Understand the interconnectedness of all living things and how to promote mutual fulfillment within nature.
5. Learn the principles of professional ethics, including human values and the role they play in fostering a just and harmonious society.

3. Syllabus **15 Periods**

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Unit-I: Introduction to Value Education (3)
Understanding Value Education, Self – exploration as the process for Value Education, Continuous Happiness and Prosperity - the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, method to fulfil the Basic Human Aspirations
Unit-II: Harmony in the Human Being (3)
Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health
Unit-III: Harmony in the Family and Society (3)
Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order
Unit-IV: Harmony in the Nature/Existence (3)
Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence
Unit-V: Implications of the Holistic Understanding – A Look at Professional Ethics (3)
Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition
Text Books:
1. R R Gaur, R Asthana, G P Bagaria, A Foundation Course in Human Values and Professional Ethics, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034- 47-1 2. R R Gaur, R Asthana, G , The Teacher"s Manual for A Foundation Course in Human Values and Professional Ethics, 2019.
References: **Journals:** 1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantak, 1999. 2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004. 3. Annie Leonard, The Story of Stuff (Book), 2019. 4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi, 2021. **Video References:** 1. https://www.uhv.org.in/uhv-ii 2. http://uhv.ac.in 3. http://www.uptu.ac.in 4. http://www.storyofstuff.com 5. https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw 6. https://fdp-si.aicte-india.org/8dayUHV_download.php 7. https://www.youtube.com/watch?v=8ovkLRYXIjE 8. https://www.youtube.com/watch?v=OgdNx0X923I 9. https://www.youtube.com/watch?v=nGRcbRpvGoU 10. https://www.youtube.com/watch?v=sDxGXOgYEKM

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4. Course Outcomes:

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

CO. No.	Course Outcome
U23MC904.1	Compare values and skills, review value education guidelines and content, and evaluate the societal context of happiness and prosperity today.
U23MC904.2	Distinguish between the Self and the Body; comprehend the meaning of Harmony within the Self and the Co-existence of Self and Body.
U23MC904.3	Identify the importance of trust, respect, and positive emotions in relationships and their role in fostering a harmonious society.
U23MC904.4	Demonstrate the harmony in nature and existence, and develop ways to ensure mutually fulfilling participation within nature.
U23MC904.5	Distinguish between ethical and unethical practices, and begin developing a strategy to create a harmonious environment in any workplace.

SEMESTER IV

U23MA209	Probability and Statistics	L	T	P	J	C
		3	1	0	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. The curriculum encompasses both theoretical principles and practical applications, enabling students to analyse data, draw meaningful inferences, and make informed decisions in uncertain situations.

2. Course Objectives:

1. Familiarize the students on outcomes of random occurrences.
2. Enhance them in various distributions and its applications.
3. Impart the knowledge of correlation and regression and interpret the linear regression equation.
4. Inculcate inference about the population on the basis of a random sample.
5. Train them to approximate the value of a population parameter on the basis of sample statistics.

3. Syllabus **45 +15 = 60**
Periods

Unit-I: Random Variables **(9+3)**

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

Unit-II: Standard Probability Distributions **(9+3)**

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Discrete distributions: Binomial distribution, Poisson distribution; Continuous distributions: Uniform distribution, exponential distribution, normal distribution.

Unit-III: Two Dimensional Random Variables **(9+3)**

Joint probability distributions; marginal and conditional distributions; covariance; correlation and regression for discrete case.

Unit-IV: Testing of Hypothesis **(9+3)**

Introduction, Critical region and level of significance; Types of Errors; Large sample tests: Z-test for single mean and difference of means; Small sample tests: Student's t-test for testing significance of single mean and difference of means; F-test for comparison of variances; Chi-square test: Test of goodness of fit, Test of independence of attributes.

Unit-V: Design of Experiments **(9+3)**

Analysis of variance, One way classification: Completely randomized design; Two way classification: Randomized block design; Three way classification: Latin square design.

List of Tutorials :

1. Using statistical software R data numerically to perform data analysis. (CO 1)
2. Introduction: Understanding Data types; importing/exporting data. (CO 1)
3. Generation of Poisson and uniform random variables. (CO 1)
4. Generation of Gaussian and exponential random variables. (CO 2)
5. Computation of the probability distributions. (CO 2)
6. Fitting of Normal distribution. (CO 2)
7. Estimation of mean and variance. (CO 2)
8. Implementation of various statistical measures like mean, median, mode. (CO 2)
9. Applying correlation and simple linear regression model to real dataset. (CO 3)
10. Testing of hypothesis for large sample tests. (CO 4)
11. Applying the t-test for independent and dependent samples. (CO 4)
12. Testing of hypothesis for Small Sample tests for F-test. (CO4)
13. Applying Chi-square test Contingency test to real dataset. CO 4)
14. Performing ANOVA for real dataset for one way, two way and three way classifications. (CO 5)

Text Books:

1. Douglas C. Montgomery and George C. Runger, "Applied Statistics and Probability for Engineers", 3rd Edition, John Wiley and Sons Inc, 2005.
2. Walpole R. E., Myers S.L. and Keying Ye, "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education Inc, 2012.

References:

Reference Books:

1. Johnson R. A., Miller and Freund's, "Probability and Statistics for Engineers", 8th Edition, Pearson Education, Delhi, 2015.
2. Devore. J. L., "Probability and Statistics for Engineering and the Sciences", 8th Edition, Cengage Learning, New Delhi, 2014.

Journals:

1. International journal of probability and statistics:
   http://www.sapub.org/Journal/articles.aspx?journalid=1119

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2.	International Journal of Experimental Design and Process Optimisation: https://www.inderscience.com/jhome.php?jcode=ijedpo

Web Resources:

1. https://www.youtube.com/watch?v=KzfWUEJjG18
2. https://www.youtube.com/watch?v=bpKarwfDRIk
3. https://www.youtube.com/watch?v=32CuxWdOlow
4. https://www.youtube.com/watch?v=zJ8e_wAWUzE
5. https://www.youtube.com/watch?v=iYiOVISWXS4
6. https://www.youtube.com/watch?v=I_dhPETvll8

MOOC/NPTEL/SWAYAM Courses:

1. https://archive.nptel.ac.in/courses/117/105/117105085/
2. https://nptel.ac.in/noc/courses/noc22/SEM1/noc22-ma30/
3. https://onlinecourses.nptel.ac.in/noc22_mg31/

4. Course Outcomes:

CO. No.	Course Outcome
U23MA209.1	Formulate and solve problems involving random variables.
U23MA209.2	Analyze the basic concepts of random variables and find an appropriate distribution for an experiment.
U23MA209.3	Apply statistical methods like correlation, regression analysis in analysing, interpreting experimental data.
U23MA209.4	Analyze the concept of various test statistics used in hypothesis testing for mean and variances of large and small samples.
U23MA209.5	Evaluate the factors controlling the value of a parameter through conducting, planning, analysing and interpreting the data.

U23ME404	Materials and Manufacturing - II	L	T	P	J	C
		3	0	0	0	3

1. Course Description:

Materials and Manufacturing-II is an interdisciplinary field those studies manufacturing processes and heat treatment processes. Students learn about Joining processes, Sheet metal processes, advanced machining processes, Phase diagrams and Heat treatment methods in this subject.

2. Course Objectives:

1. To develop the knowledge on phase diagrams and constitution of alloys
2. To give insight in to heat treatment methods
3. Summarize applications of different types of manufacturing processes.
4. Explain merits and demerits of various manufacturing processes.
5. Explain different types of defects.

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3. Syllabus	45 Periods
Unit-I: Phase Diagrams & Constitution of Alloys	**(9)**
Phases: Gibbs's Phase rule, lever rule, Solubility and Solid Solutions; Phase diagrams: Cooling curves, Binary phase diagrams, Eutectic, Eutectoid and Peritectic phase diagrams; Iron and iron carbide phase diagram - Invariant reactions, Evolution of Microstructure; Phase transformations: TTT and CCT diagram.	
Unit-II: Heat Treatment and Surface Hardening	**(9)**
Heat treatment: Overview, Objectives, Annealing and types, Normalizing, Quenching, Austempering and Martempering; Hardenability: Jominy End Quench; Surface hardening processes: Carburizing, Nitriding, Cyaniding and Carbonitriding, Induction and Flame hardening, Strengthening mechanisms: Solid solution strengthening, Dispersion hardening and Precipitation hardening.	
Unit-III: Joining Processes	**(9)**
Fusion welding processes: Gas welding, Types, Flame characteristics; Manual metal arc welding, Filler, Flux materials; Electrodes: Coated electrode designation for manual metal arc welding; Gas Tungsten arc welding; Gas metal arc welding; Submerged arc welding; Electro slag welding; Resistance welding; Plasma arc welding; Thermit welding; Electron beam welding; Ultrasonic welding; Laser Beam welding; Friction, Friction Stir Welding; Brazing and soldering; Weld defects; Applications.	
Unit-IV: Sheet Metal Processes	**(9)**
Sheet metal characteristics; shearing, bending and drawing operations; Stretch forming operations: Formability of sheet metal; Presses for sheet metal working; Types of die; Special forming processes: Hydro forming, Rubber pad forming, Metal spinning, Explosive forming, magnetic pulse forming, peen forming, Super plastic forming, Micro forming; Applications.	
Unit-V: Advanced Machining Processes	**(9)**
Introduction to Computer Numerical Control Machines (CNC); Features and construction, Electrical Discharge Machining, Wire EDM, Electro Chemical Machining, Laser Beam, Plasma Arc Machining.	
Text Books: 1.. Avner, S.H., Introduction to Physical Metallurgy, 4th Edition, McGraw Hill Book Company, 2017. 2. Kalpakjian. S, Manufacturing Engineering and Technology, 7th Edition Pearson Education India Edition, 2018 **References:** **Reference Books** 1. O. P. Khanna, Material Science and Metallurgy, Edition-2016, Dhanpat Rai Publications.	

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2. U. C. Jindal, Material Science and Metallurgy, 1st Edition, Dorling Kindersley, 2012

3. Rao, P.N, Manufacturing Technology, Vol. 1, 5th Edition, Tata McGraw-Hill Publishing Company Limited, 2018.

4. Roy. A. Lindberg, Processes and Materials of Manufacture, 3rd Edition PHI / Pearson education, 2015

5. Groover, Fundamentals of modern Manufacturing Materials process, and systems, 6th Edtion Wiley India Pvt. Ltd., 2022

Journals:

1. Manufacturing Technology Journal - https://journalmt.com/ (Publisher : Elsevier)

2. The International Journal of Advanced Manufacturing Technology - (Publisher - Springer)

Videos references:

1. https://www.youtube.com/watch?v=6ISddRRHAhA

2.https://www.youtube.com/watch?v=6ISddRRHAhA&list=PLSGws_74K01_y_JH5qBvFc-FkFknUILWl

3. https://in.coursera.org/courses?query=manufacturing%20process

4. https://www.udemy.com/topic/manufacturing/

MOOC/NPTEL/SWAYAM Courses:

1. Introduction to Material Science and Engineering - https://archive.nptel.ac.in/courses/113/102/113102080/
2. Principles of Physical Metallurgy - https://archive.nptel.ac.in/courses/113/105/113105024/
3. Properties of Materials - https://archive.nptel.ac.in/courses/113/104/113104096/
4. Metallurgy and Material science & Mining Engineering - https://onlinecourses.nptel.ac.in/noc20_mm09/preview
5. Manufacturing Processes and Technology - https://onlinecourses.nptel.ac.in/noc22_me28/preview

4. Course Outcomes:

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

CO. No.	Course Outcome
U23ME404.1	Interpret the phase diagram and demonstrate the stages in microstructure of steels
U23ME404.2	Analyse various heat treatment methods by which selecting suitable method for engineering applications
U23ME404.3	Illustrate the various metal joining processes and its defects
U23ME404.4	Apply the various sheet metal forming process
U23ME404.5	Recognize the, types and principle of advanced machining processes

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U23ME482	Strength of Materials	L	T	P	J	C
		3	0	2	0	4

1. Course Description:

The Strength of Materials course provides a fundamental understanding of the behaviour of materials under various loads and deformations. Through comprehensive exploration, students understands the principles of stress, strain, and deformation of materials for various engineering applications.

2. Course Objectives:

1. Equip students to understand and apply fundamental concepts in mechanics of materials, including stress, strain, principal stresses, and principal planes, to Analyze and solve practical problems.
2. Enable students to calculate and Analyze shearing forces and bending moments in determinate beams with external loads.
3. Equip students with the knowledge to calculate stresses and deformation in circular shafts and helical springs under torsion, and apply this understanding to real-world problems.
4. Develop students' skills in computing slopes and deflections in determinate beams using various methods. to enhance their analytical and problem-solving abilities.
5. Prepare students to Analyze complex structural components, such as pressure vessels, pipes, and cylinders, by understanding the underlying principles of stress and deformation.

3. Syllabus **75 Periods**

Unit-I: Stress, Strain and Deformation of Solids **(9)**

Rigid bodies and deformable solids; Tension, Compression and Shear Stresses; Theories of Failure; Deformation of simple and compound bars; Thermal stresses; Elastic constants; Volumetric strains; Stresses on inclined planes: principal stresses and principal planes; Mohr's circle of stress.

Computer Aided Simulation (for demonstration Only): Stress, Strain analysis in simple plates, bars

Unit-II: Transverse Loading on Beams and Stresses in Beam **(9)**

Beams: types; transverse loading on beams; Shear force and bending moment in beams: Cantilevers, simply supported beams and over hanging beams; Theory of simple bending; bending stress distribution; Load carrying capacity; Proportioning of sections; Flitched beams; Shear stress distribution.

Computer Aided Simulation (for demonstration Only): Bending stress analysis for different type's beams, supports and load

Unit-III: Torsion & Springs **(9)**

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Torsion formulation stresses and deformation in circular and hollows shafts; Stepped shafts; Deflection in shafts fixed at the both ends; Stresses and Deflection in helical springs, Laminated Leaf springs.

Unit-IV: Deflection of Beams **(9)**

Computation of slopes and deflections in beams: Double Integration method, Macaulay's method, Area moment method, Conjugate beam; Strain energy; Maxwell's reciprocal theorems.

Computer Aided Simulation (for demonstration Only): Simulation of beams subjected to transverse load

Unit-V: Columns and Cylinders **(9)**

Euler's column theory; critical load for prismatic columns with different end conditions; Effective length; limitations; Rankine-Gordon formula; Eccentrically loaded columns; middle third rule; core of a section; Thin cylindrical and spherical shells; stresses and change in dimensions; thick cylinders; Compound cylinders; shrinking on stresses.

Computer Aided Simulation (for demonstration Only): Buckling load simulation for columns

List of Experiments: **30 Periods**

1. Conduct a tensile test to observe and plot stress-strain behaviour of given specimen under load. Discuss. (CO1)
2. Conduct an experiment to calculate the ultimate shear strength of the given specimen under double shear load. Discuss. (CO1)
3. Perform the hardness test to identify the indentation diameter and height on the given specimens with Brinell and Rockwell hardness setup. (CO1)
4. Conduct the suitable test to determine the toughness of the given specimen by applying sudden load in izod and charpy test. (CO1)
5. Effect of hardening- Improvement in hardness and impact resistance of steels. (CO1)
6. Tempering - Improvement Mechanical properties – Comparison (i) Unhardened specimen (ii) Quenched Specimen and (iii) Quenched and tempered specimen(CO1)
7. Calculate the section modulus of the simply supported beam to compute the bending stress and young's modulus for the given specimen. (CO2)
8. Torsion test on circular shaft –compute the shear stress and modulus of rigidity(CO3)
9. Tests on springs – compression - load deformation characteristics, stiffness, shear stress, Shear Modulus, energy(CO3)
10. Strain measurement using Rosette Strain Gauge. (CO4)

Text Books:

1. Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2017
2. Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2007
3. Rajput R.K. "Strength of Materials (Mechanics of Solids)", S.Chand& company Ltd., New Delhi, 7th edition, 2018.
4. Rattan S.S., "Strength of Materials", Tata McGraw Hill Education Pvt .Ltd., New Delhi, 2017.

References:

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Reference Books:

1. Egor. P.Popov "Engineering Mechanics of Solids" Prentice Hall of India, New Delhi, 2001
2. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, 2007.
3. Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2007
4. Ferdinand P. Been, Russell Johnson, J.r. and John J. Dewole "Mechanics of Materials", Tata McGraw Hill Publishing 'co. Ltd., New Delhi, 2005.

Web Resource:

1. www.forum.jntuworld.com

Video References:

1. https://www.youtube.com/nptel/som
2. https://www.youtube.com/nptel/iitm
3. www.freevideolectures.com/courses/2361/som/
4. www.youtube.com/watch?v=GKFgysZC4VC

4.Course Outcomes:

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

CO. No.	Course Outcome
U23ME482.1	(Create) Create Stress- Strain model for any Mechanical Component
U23ME482.2	(Apply) Apply the fundamental principles to estimate bending stress and shear stress at various points in beams
U23ME482.3	(Analyze) Analyze stress and deformation induced in circular shafts due to torsion
U23ME482.4	(Apply) Calculate slope and deflection in beams using different methods.
U23ME482.5	(Analyze) Analyze stresses and deformation of columns and thin shells for applied pressures.

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U23ME483	Thermal Engineering	L	T	P	J	C
		3	0	2	0	4

1. Course Description:

Thermal engineering is a core field of engineering which examines and applies the theory of thermodynamic heat transfer, and fluid mechanical foundations to the design, analysis, and optimised operation of thermal systems. This course provides students an in-depth knowledge of the principles that monitor the functioning of different thermal systems and their components.

2. Course Objectives:

1. Students will be able to design, analyse, and develop thermal components and systems for various applications, applying fundamental principles and concepts.
2. Students will develop expertise in optimizing thermal system efficiency and performance using advanced engineering techniques.
3. Students will gain hands-on experience conducting experiments and simulations to investigate thermal phenomena and validate designs.
4. Students will develop effective teamwork, communication, and presentation skills to convey complex thermal engineering concepts and solutions.

3. Syllabus **75 Periods**

Unit-I: Gas Power Cycles **(9)**

Air Standard Cycles: otto cycle, diesel cycle, dual cycle, applications, cycle Analysis; Performance Analysis: Air standard efficiency, Mean Effective Pressure; Comparison: otto cycle, diesel cycle, dual cycle;

Unit-II: Air Compressors **(9)**

Air compressors: Working of reciprocating compressors, the effect of clearance & volumetric efficiency, adiabatic, isothermal, mechanical efficiencies, multistage compressor, intercooler, and its effects; Rotary air compressor: classification, working principle, Centrifugal and axial flow compressors;

Unit-III: Internal combustion engines **(9)**

Internal combustion engines: Working principles of Spark ignition engines and compression ignition engines. Working of 4S engine & 2S engine, Combustion phenomenon in S.I & C.I. engines, Testing and performance of IC engines;

Unit-IV: Gas Turbines systems **(9)**

Gas turbine cycle analysis: open & closed cycle; Performance and its improvement: Regenerative, Intercooled, Reheated cycles & combinations methods; Materials for Turbines;

Unit-V: Nozzle and Turbines **(9)**

Nozzles: types, shapes, Flow pattern; Critical pressure ratio; Mass flow; Pressure ratio; Effect of friction; Metastable flow; Turbines: Impulse & reaction turbine, principles, velocity diagrams, work done, efficiency; Performance analysis: Optimal operating conditions, Multi-staging, compounding, governing;

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List of Experiments: **30 Periods**

1. Analysis of Flammability Limits in Specified Oil Sample (CO1)
2. Assessment of Fluidity Characteristics in Specified Oil: Kinematic and Dynamic Viscosity (CO1)
3. Timing Analysis of Valve and Port Events in Internal Combustion Engines (CO3)
4. Assessment of Diesel Engine Performance: 4-Stroke Engine Test (CO3)
5. Quantification of Heat Losses and Heat Transfer in a 4-Stroke Diesel Engine (CO3)
6. Performance analysis of reciprocating air compressor (CO2)
7. Analysis of Coefficient of Performance in Refrigeration and HVAC Systems (CO4)
8. Study of Diesel Powered Steam generated boiler and turbine system. (CO5)

Text Books:

1. Kothandaraman.C.P., Domkundwar. S,Domkundwar. A.V., "A course in Thermal Engineering", Fifth Edition, "Dhanpat Rai & sons , 2-12.
2. Er.Rajput. R. K., "Thermal Engineering", tenth Edition, Lakshmi publication, 2-15.
3. Cengel Y. A. & Boles M. A. "Thermodynamics - an Engineering Approach", 9/e, Tata McGraw Hill, 2-19

Reference Books:

1. Ramalingam.K.K., "Thermal Engineering", First Edition, SciTech publication (Ind) (p) LTD, 2-15.
2. Ganesan. V "Internal Combustion Engines" , Fourth Edition, Tata McGraw-Hill 2-16
3. Sarkar. B.K,"Thermal Engineering", First Edition, Tata McGraw-Hill Publishers, 2-11
4. Rudramoorthy, R, "Thermal Engineering ", First Edition, Tata McGraw-Hill, New Delhi,2-1-
5. Sonntag R. E., Borgnakke C. & Van Wylen, G. - 'Fundamentals of Thermodynamics', 1-/e John Wiley and Sons , 2-19

Journals:

1. Journal of Applied Thermal Engineering — ScienceDirect
2. International Journal of Thermal Engineering –Springer

MOOC/NPTEL/SWAYAM Courses:

1. Advanced Thermodynamics and Combustion - https://onlinecourses.nptel.ac.in/noc24_me135/preview
2. Thermodynamics & its Application - https://onlinecourses.swayam2.ac.in/nou24_me07/preview
2. https://nptel.ac.in/courses/112106133
3. https://archive.nptel.ac.in/courses/112/103/112103262/
4. https://archive.nptel.ac.in/content/storage2/courses/112104117/ui/Course_home-lec18.html

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4. Course Outcomes:

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

CO. No.	Course Outcome
U23ME483.1	(Apply) Employ the air standard cycle to estimate the air standard efficiency and mean effective pressure.
U23ME483.2	(Apply) Examine the operational efficiency of air compressors.
U23ME483.3	(Analyze) Analyze the performance metrics of Internal Combustion engines
U23ME483.4	(Apply) Implement optimization strategies to enhance the efficiency and performance of Rankine and Brayton cycle systems.
U23ME483.5	(Analyze) Analyze the operational characteristics of the steam nozzle and steam turbine.

U23NCC02	Ncc Credit Course Level II	L	T	P	J	C
		2	0	2	0	3

1. Course Description:

NCC Course Level II designed by UGC as a general elective course, equips students with essential skills for emergency response, fieldwork, and military activities. Students acquire expertise in disaster management, including coordinating relief efforts and managing various disaster scenarios. They also enhance their communication and navigation skills, mastering map reading and compass usage. This course provides a foundational understanding of the Armed Forces while advancing the field and battle skills of students. Overall, cadets enhance their physical fitness, agility, and discipline through rigorous training, culminating in a remarkable improvement in their overall agility and readiness.

2. Course Objectives:

1. Equip students with the necessary skills to maintain health and safety standards, respond effectively to medical emergencies, and manage patient care during crises
2. Instruct students in the principles of disaster management, enabling them to respond effectively to emergencies, collaborate with relevant authorities, and support relief efforts.
3. Develop students' proficiency in communication and map reading, including interpreting various map features, using navigation tools, and understanding geographic orientation.
4. Educate students on the structure and roles of the armed forces, pathways for entry, and the significance of military honors and awards.
5. Train students in essential field and battle craft skills, focusing on distance estimation, terrain analysis, camouflage, and effective communication.

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3. Syllabus	30 + 30 = 60 Periods
Unit-I: Health & Hygiene	**(6)**
Hygiene & Sanitation, Cleanliness, Water supply and its purification, Physical and Mental Health, First Aid: Common Medical Emergencies, Dressing of Wounds, Fracture & Treatment, Evacuation of Casualties, Methods of Carrying a Patient.	
Unit-II: Disaster Management	**(6)**
Civil Defence Organizations, Natural Disaster Management Authority (NDMA), National Disaster Responsive Force (NDRF), Types of Disaster, Fire Fighting, Traffic Control, Methods of NCC Assistance, Relief Camp, Collection & Distribution of Aid Material	
Unit-III: Communication & Map Reading	**(6)**
Communication, Introduction to types of maps & conventional signs, Scales & Grid System, Relief, Contours & Gradients, Cardinal points & Types of North, Types of Bearing, Service Protractor, Prismatic Compass.	
Unit-IV: Armed Forces	**(6)**
Basic organization of Armed forces & Army, Modes of Entry to Army, Honours & Awards, Concept of Integrated Defence staff.	
Unit-V: Field Craft & Battle Craft	**(6)**
Introduction to FC&BC, Judging Distance, Description of ground, Observation camouflage & concealment, Field Signal, Section Formation, Fire Control Orders, Fire & Movement.	
List of experiments:	**(30)**
1. Evaluate basic drill exercises to enhance discipline, coordination, and teamwork among cadets 2. Provide cadets with basic weapon handling skills, safety procedures, and marksmanship fundamentals. 3. Analyse the basics of map reading, including understanding map symbols, using a compass, and determining coordinates, to enhance their navigation skills. 4. Demonstrate the fundamentals of firing, including safety procedures, weapon handling, and marksmanship, to enhance their shooting skills and discipline. 5. Enhance physical fitness, agility, and confidence among cadets by training them to overcome various obstacles training.	
Text Book:	
1. National Cadet Corps "Cadets Hand Book – Army (Common Subjects)".	
Web Reference: 1. https://indiancc.nic.in/	

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4. Course Outcomes:

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

CO. No.	Course Outcome
U23NCC02.1	Evaluate various health and hygiene practices, including first aid techniques, to optimize community health and emergency response efforts and develop effective disaster management plans.
U23NCC02.2	Analyze the organizational structure and operational strategies of Civil Defence Organizations and the strategic plans for career entry into the Armed Forces
U23NCC02.3	Understand the advanced map reading and communication skills to accurately interpret navigational tools
U23NCC02.4	Demonstrate teamwork strategies and physical training through advanced drills and obstacle courses, enhancing coordination and discipline.
U23NCC02.5	Analyse and implement advanced techniques in weapon handling, safety, and navigation,

U23EC391	**Real Time Systems and IoT**	**L**	**T**	**P**	**J**	**C**
		2	**0**	**2**	**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: **30 + 30 = 60 Periods**

Unit-I: Embedded System Architecture **(6)**

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Introduction to Embedded systems; application areas; categories; overview; specialities; recent trends; hardware architecture; software architecture; application software; communication software; process of generating executable image.

Unit-II: Embedded System Development **(6)**

Development process: requirements engineering, design, implementation, integration and testing; Architecture of Kernel; Tasks and task scheduler; Interrupt service routines; timers; memory management; Debugging Tools for Embedded Systems.

Unit-III: IoT Architecture and Embedded Hardware **(6)**

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; Interfacing HC-05 and Arduino.

Unit-IV: GSM, Cloud Computing and IoT **(6)**

Introduction to GSM; Interfacing GSM with Arduino Uno; Calling; Messaging using GSM; Controlling an LED using GSM; Introduction to Cloud Computing; Data communication protocols in IoT; Cloud types; Basics of Cloud architecture and Cloud Services.

Unit-V: Product Building and Miniaturization **(6)**

NodeMCU in a nutshell; ESP32 in a nutshell; Raspberry Pi in a NutShell; Headless Setup of Raspberry Pi; Realtime projects with IoT; Accident Impact Detection; Driver Drowsiness Detection System; Advanced Driver Assist System.

List of Experiments **(30)**

1. Study of Embedded system lifecycle and development process. (CO 1 & CO 2)
2. Interfacing Arduino with Servo motor and Stepper motor. (CO 3)
3. Interfacing Arduino with Analog/Digital sensors. (CO 3)
4. Write a program to interface LED/Buzzer with Arduino and to turn ON LED for 1 second after every 2 seconds. (CO 3)
5. Write a program to interface Digital sensor PIR with Arduino and to turn ON LED when motion is detected. (CO 3)
6. Write a program to interface DHT22 sensor with Arduino and display temperature and humidity readings. (CO 3)

List of Projects **(30)**

1. Develop a project to interface LCD with Arduino/NodeMCU/Raspberry Pi and print temperature and humidity readings on it. (CO 4)
2. Develop a project to interface a flame/smoke sensor with Arduino/NodeMCU/Raspberry Pi and give an alert message when flame/smoke is detected. (CO 4)
3. Develop a solution for a real time problem using Arduino/NodeMCU/Raspberry Pi and the concepts of Embedded system and IoT. (CO 5)

Text Books:

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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)
3. Internet of Things, 2ed, Shriram K Vasudevan, Abhishek S Nagarajan, RMD Sundaram, ISBN: 9789388991018, Wiley India. (Unit IV, V)

References:

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
U23EC391.1	Analyze and synthesize the architecture of Embedded Systems, delineating its constituent components.
U23EC391.2	Utilize conceptual understanding to apply the design process of Embedded Systems
U23EC391.3	Apply advanced cognitive skills to conceptualize the architecture of IoT systems and develop basic applications employing embedded hardware.
U23EC391.4	Apply higher-order cognitive abilities to implement Cloud services in IoT applications
U23EC391.5	Generate innovative solutions by integrating NodeMCU and Raspberry Pi boards to design IoT applications

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U23ME453	CAD/CAM Laboratory	L	T	P	J	C
		0	0	2	0	1

1. Course Description:

This laboratory deals with the detailed engineering of 3D models and/or 2D drawings of components using CAD software. Computer-aided design (CAD) is the use of computer systems to assist in the creation, modification, analysis, or optimization of a design. CAD software is used to increase the productivity of the designer, improve the quality of design, improve communications through documentation, and to create a database for manufacturing. Computer-aided manufacturing (CAM) is the use of computer software to control machine tools and related machinery in the manufacturing of workpieces.

2. Course Objectives:

1. To equip students with the skills to create and interpret 2D drafting and 3D modeling representations, enabling accurate visualization and design communication.
2. To enable students to comprehend the fundamentals of CNC Machine Tools, including their operation, capabilities, and limitations, for effective application in manufacturing.
3. To empower students to understand and program modern control systems, such as Fanuc and Siemens, for efficient CNC machining.
4. To expose students to the capabilities and applications of various CNC machines, including CNC lathe, Vertical Machining Centre, EDM, and wire-cut, and Rapid Prototyping techniques, facilitating informed decision-making in design and manufacturing.

3. Syllabus **30 Periods**

List of Experiments

1. 3D GEOMETRIC MODELLING (CO1-CO3)

List of Experiments

1. Introduction of 3D Modelling software
2. Creation of 3D assembly model of following machine elements using 3D Modelling software
3. Oldham's Coupling
4. Plummer Block
5. Screw Jack
6. Lathe Tailstock
7. Universal Joint
8. Machine Vice
9. Stuffing box
10. Crosshead
11. 1-. Safety Valves
12. Non-return valves
13. Connecting rod
14. Piston
15. Crankshaft

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2. MANUAL PART PROGRAMMING (CO4)

1. Part Programming - CNC Machining Centre a) Linear Cutting. b) Circular cutting. c) Cutter Radius Compensation. d) Pocket milling.
2. Part Programming - CNC Turning Centre a) Straight, Taper and Radius Turning. b) Thread Cutting. c) Rough and Finish Turning Cycle. d) Drilling and Tapping Cycle

3. COMPUTER AIDED PART PROGRAMMING (CO5)

1. CL Data and Post process generation using CAM packages. f) Application of CAPP in Machining and Turning Centre.

Text Books:

1. Gopalakrishna K.R., "Machine Drawing", 22nd Edition, Subhas Stores Books Corner, Bangalore, 2-13

References:

Reference Books:

1. Junnarkar, N.D., "Machine Drawing", 1st Edition, Pearson Education, 2--4
2. P.S.G. Design Data Book
3. Luzadder,Warren.J., and Duff, Jon.M. "Fundamentals of Engineering Drawing", Prentice Hall India Pvt. Ltd., Eastern Economy Edition, Eleventh Edition,
4. Chang, T. C., Wysk, R.A., Wang, H. P, "Computer aided Manufacturing," Prentice Hall, Third Ed.

4. Course Outcomes:

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

CO. No.	Course Outcome
U23ME453.1	Understand and interpret machine manufacturing drawings
U23ME453.2	Develop 2D and 3D models using high end modelling software's
U23ME453.3	Apply engineering drawing standards as per BIS conventions
U23ME453.4	To analyze and generate part programs for CNC Machining for to produce given parts drawings with precision and accuracy
U23ME453.5	Prepare CNC part programming and perform manufacturing

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U23ME651	Project with Design Thinking (Product/ Software Development Life Cycle)	L	T	P	J	C
		0	0	0	2	1

1. Course Description:

Design Thinking for Innovative Projects is an immersive, hands-on course that teaches students a human-centered approach to problem-solving. Students will empathize with end-users to identify and define problems, use tools to gain insights, and engage in creative brainstorming to generate ideas. They will evaluate solutions based on feasibility, desirability, and viability, transform ideas into prototypes, and iterate based on feedback. Working in interdisciplinary teams, students will apply design thinking to real-world projects, progressing from technology formulation (TRL 2) to scalable prototypes (TRL 5), creating solutions aligned with the UN's Sustainable Development Goals (SDGs).

2. Course Objectives:

1. Enable students to develop empathy with end-users to accurately identify and define complex problems.
2. Equip students with empathy tools and techniques to gain a deep understanding of user needs and pain points.
3. Instruct students to evaluate and prioritize ideas based on criteria such as feasibility, desirability, and viability.
4. Develop students to create prototypes to materialize and test design concepts.
5. Educate students to validate design solutions through user testing and feedback.

3. Syllabus **30 Periods**

The student embarks on identifying problems within the mechanical engineering field through comprehensive literature reviews or industry surveys, starting with the **Empathize** phase. Leveraging modern engineering tools, the student then progresses to the **Define** phase, formulating a clear problem statement.

In the **Ideate** phase, the student brainstorms and explores potential solutions. Moving to the **Prototype** phase, the student develops a working model, design, or simulation to address the identified problem. This prototype is then rigorously evaluated and refined in the **Test** phase.

Each student is required to compile and submit a detailed report, which includes background information, literature survey findings, problem statement, methodology, and the application of modern tools. This submission must adhere to the stipulated deadline. Throughout the project, students will receive guidance and support from institute faculty members, ensuring alignment with academic and industry standards.

Text Books:

1. Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School - IdrisMootee.

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4. Course Outcomes:

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

CO. No.	Course Outcome
U23ME651.1	Evaluate and select ideas based on criteria such as feasibility, desirability, and viability.
U23ME651.2	Conduct iterative testing to gather feedback and refine prototypes based on user input.
U23ME651.3	Apply critical thinking skills to analyze complex problems and identify innovative solutions.
U23ME651.4	Create visual and verbal representations to communicate design concepts.
U23ME651.5	Develop a reflective mindset to assess the effectiveness of the design thinking process.

U23MC903	Environmental Science	L	T	P	J	C
		1	0	0	0	NC

1. Course Description:

Environmental Science for Engineering Students offers a focused exploration of key environmental concepts tailored to the needs and interests of engineering students. This course provides a comprehensive understanding of environmental issues relevant to engineering practice, emphasizing the application of scientific principles and engineering solutions to address environmental challenges. Students will develop the knowledge, skills, and perspectives necessary to integrate environmental considerations into engineering design, planning, and decision-making processes.

2. Course Objectives:

1. To impart knowledge on the principle of environmental science and engineering.
2. To make students understand the ecosystems and natural resources.
3. To enable students understand the various causes for environmental degradation.
4. To create awareness on pollution, value education, population growth and social issues.
5. To enhance the current opportunities in sustainability and its solution in environmental aspects.

3. Syllabus **15 Periods**

Unit-I: Environment and Ecosystem **(3)**

Scope and importance; concept of sustainability and sustainable development: concept of an ecosystem, structure and function of an ecosystem; producers, consumers and decomposers; Energy flow in the ecosystem, food chains and food webs.

Unit-II: Environmental Pollution and Analysis **(3)**

Environmental pollution: types, causes, effects and controls, Air, Water, soil and noise Pollution, Role of individual in control of pollution; Nuclear hazards and human health risks.

Unit-III: Natural Resources **(3)**

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Land resources and land use change: Land degradation, soil erosion and desertification; Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations; Water: Use and over-exploitation of surface and ground water.

Unit-IV: Social Issues and Environmental Polices (3)

Environmental Issues; Environmental ethics; Climate change: global warming, ozone layer depletion and acid rain; Environment Laws: Environment Protection Act, Air (Prevention & Control of Pollution) Act, Water (Prevention and Control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act.

Unit-V: Human Population and the Environment (3)

Population growth: variation among nations, Population explosion, Family Welfare Programmes; Environment and human health: Human Rights, Value Education; Women and Child Welfare; Role of Information Technology in Environment and Human Health.

Text Books:

1. Gilbert M. Masters, Introduction to Environmental Engineering and Science, 2nd Edition, Pearson Education, 2004.
2. Dr. A. Ravikrishnan, Environmental Science and Engineering, Sri Krishna Hi-Tech Publishing Company Pvt. Ltd., 10th Edition, 2014.
3. M. Davis, S. Masten, Principles of Environmental Engineering and Science, Mcgraw hill publisher, 3rd Edition, 2013.
4. G.M. Masters, W. Ela, Introduction to Environment Engineering and Science, Prentice Hall Publisher, 2008.

Reference Books:

1. R. K. Trivedy and P. K. Goel, An Introduction to Air Pollution, BS Publications, 2003.
2. G. Tyler Miller and Scott E. Spoolman, Environmental Science, 15th Edition, Cengagelearning, 2016.
3. Miller T. G. and Spoolman S. E., "Environmental Science", Cengagelearning16th Edition, 2017.
4. Sinha J., "Environmental Science", Galgotia Publications, 2nd Edition, 2011.
5. P. J. Vesilind, J. J. Peirce, R.F. Weiner, Environmental Pollution and Control. Butterworth-Heinemann, USA, 1990.
6. S. Divan, A. Rosencranz, Environmental Law and Policy in India: Cases, Materials and Statues (2nd edition). Oxford University Press, 2002.

Journals:

1. RSC Advances (https://pubs.rsc.org/en/content/articlehtml/2012/ra/c2ra20340e)
2. International journal of Hydrogen Energy (https://www.sciencedirect.com/science/article/abs/pii/S0360319916309478)
3. Nano Energy journal (https://www.sciencedirect.com/science/article/abs/pii/S2211285518305755)
4. International Journal of Electrochemical Science. (http://www.eleetrochemsci.org/papers/vol11/111210628.pdf)

Video References:

1. https://www.youtube.com/watch?v=Y5B1nWYle40

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2. https://study.com/academy/lesson/what-is-environmental-science-definition-and-scope-of-the-field.html
3. https://www.youtube.com/watch?v=CXCT2R1K6Ts
4. https://www.youtube.com/watch?v=89B9IT0Tl-Q
5. https://www.youtube.com/watch?v=p-lSPDDdVtc

MOOC/ SWAYAM/ NPTEL Courses:

1. https://onlinecourses.nptel.ac.in/noc23_hs155/preview
2. https://onlinecourses.nptel.ac.in/noc19_ge22/preview
3. https://onlinecourses.nptel.ac.in/noc20_ge16/preview

4. Course Outcomes:

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

CO. No.	Course Outcome
U23MC903.1	Outline the structure and functions of an eco system
U23MC903.2	Categorize the different types of pollution and its preventive measures
U23MC903.3	Interpret the importance of natural resources in environment
U23MC903.4	Identify the social issues and to utilize the environmental policies
U23MC903.5	Apply role of IT in human population and environment

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