Meenakshi Sundararajan Engineering College

(An Autonomous Institution)

Managed by I.I.E.T Society, Approved by AICTE, New Delhi,
Affiliated to Anna University, Chennai,
Accredited by NAAC with 'A' grade and NBA for programs applied,
Recognized by UGC with 2(f) & 12(B) status

B.E. MECHANICAL ENGINEERING CURRICULUM AND SYLLABUS REGULATIONS 2024

CHOICE BASED CREDIT SYSTEM

Powered by

Meenakshi Sundararajan Career Development Cell

Achievers Excellence Program

Meenakshi Sundararajan Innovation and Incubation Centre

MSEC JAPANESE CLUB

Institutions' Innovation Council

Societal Beneficial Innovation

MATLAB Enabled Campus

363, Arcot Road, Kodambakkam, Chennai - 600 024.
www. msec.edu.in

Meenakshi Sundararajan Engineering College

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Prof. K. R. Sundararajan, a well-known educationalist, established the Indian Institute of Engineering Technology (I.I.E.T) society in the year 1947 in Chennai. The total area of 14 acres was purchased with enormous hardship and was donated to the IIET Society for the cause of education. The society's main objective is to provide quality education and it has been ensured since 1951.

The IIET Society has the following to its credit :-

- An uninterrupted and continuous education since 1951 in its premises
- All Colleges run by the institution are ranked among the top 5 – top 10 programs in Tamil Nadu
- 350 KW Solar Power Plant Generating upto 70% of its electricity needs
- Significant portion of the students are first generation learners
- Campus holds approximately 7000 plus students from the ages of 4 to 35 plus.
- Large Green Campus in the heart of the city of Chennai, Tamil Nadu
- In existence since 1947 – Completed 75 years
- Targeting to be Carbon Neutral from the end of the year 2025

The society currently has the following institutions :-

- **Meenakshi Sundararajan Engineering College(MSEC)** - established in 2001 & affiliated to Anna University offering engineering programs with about 2000 plus students.
- **Meenakshi Sundararajan School of Management(MSSM)** - established in 2000 & affiliated to University of Madras offering MBA programs with about 100 plus students.
- **The NEST School (TNS)**- established in 2022 offering IB (International Baccalaureate) & CAIE (Cambridge) boards.

All of the institutions have earned an enviable name and are rated as one among Top 10 colleges in the Tamil Nadu state in their respective programs. Efforts are on to make the campus carbon neutral in 2 years (end of 2025) by using our community of staff and students.

Meenakshi Sundararajan Engineering College (MSEC) was established by the IIET Society in 2001. MSEC is defined by two keywords "Industry Ready" & "Vibrancy". Creating a new generation of self- actualized learners is our raison d'etre. If children are our future, then education is the key to their future. When education is shaped around them, and not the other way around, we are laying the foundation for a future/world where creativity, diversity and caring, independent-thinkers thrive. Our curricula thrive on continuous learning while interacting with and incorporating real-world situations and challenges.

MSEC's Hallmark of Quality

- Affiliated to Anna University, Chennai
- Approved by AICTE, New Delhi
- Accredited by NBA for programs in:
  - Civil Engineering
  - Computer Science and Engineering
  - Electronics and Communication Engineering
  - Mechanical Engineering
  - Electrical and Electronics Engineering
  - Information Technology
- Accredited by NAAC with a prestigious "A" grade
- Declared under Section 2(f) and 12(B) of the UGC Act
- Conferred with Autonomous status for 10 years (2024-25 to 2033-34) by the University Grants Commission (UGC) on February 1, 2024
- Meenakshi Sundararajan Innovation and Incubation Centre (MSIIC)
- Meenakshi Sundararajan Career Development Cell (MSCDC)
- MSEC Research Centre (MSEC RC)
- Center of Excellence – Industry Tie Up in Specialized Labs
- Industry MOU's – 200 Plus

Vision of the Institute

To impart state-of-the-art technical education, including sterling values and shining character, producing engineers who contribute to nation building thereby achieving our ultimate objective of sustained development of an unparalleled society, nation and world at large.

Mission of the Institute

Meenakshi Sundararajan Engineering college, Chennai constantly strives to be a Centre of Excellence with the singular aim of producing students of outstanding academic excellence and sterling character to benefit the society, our nation and the world at large.

To achieve this, the college ensures

- Continuous upgradation of its teaching faculty to ensure a high standard of quality education and to meet the ever-changing needs of the society
- Constant interaction with its stakeholders
- Linkage with other educational institutions and industries at the national and international level for mutual benefit
- Provision of research facilities and infrastructure in line with global trends
- Adequate opportunities and exposure to the students through suitable programs, to mould their character and to develop their personality with an emphasis on professional ethics and moral values.

We offer following courses:

S.No	Course	Intake
	Undergraduate courses in B.E / B. Tech	
01	B.E Civil Engineering	60
02	B.E Computer Science and Engineering	120
03	B.E Electronics and Communication Engineering	120
04	B.E Electrical & Electronics Engineering	60
05	B.E Mechanical Engineering	60
06	B. Tech Information Technology	120
07	B. Tech Artificial Intelligence & Data Sciences	120
	Postgraduate courses in M.E / M. Tech	
08	M.E. Construction Engineering and Management	18
09	M.E. Computer Science and Engineering	18
10	M.E. Embedded System Technologies	18
11	M.E Energy Engineering	18

DEPARTMENT OF HUMANITIES AND SCIENCE

The H&S Department stands out for its commitment to providing a well-rounded academic experience for first-year students. Covering key subjects like Physics, Chemistry, Mathematics, English, and Tamil. The department boasts a high pass percentage in semester exams, a testament to the hard work and dedication of the faculty. This year, the department enhanced offerings with industry and alumni talks, foreign language courses, engaging games, and specialized coaching for AEP and ICS. Additionally, the department introduced an industry-oriented and department-specific syllabus to better prepare students for future challenges and opportunities

DEPARTMENT OF CIVIL ENGINEERING

The Civil Engineering Department at our college, established in 2002, is a beacon of academic excellence and research innovation. Offering both undergraduate program and postgraduate program in M.E. Construction Engineering and Management, the department is committed to integrating advanced technologies and sustainable practices into its curriculum. The department boasts state-of-the-art laboratories and strong industry collaborations. Graduates of the department have made significant contributions to civil engineering, both nationally and internationally, and continue to shape the future of the discipline through unwavering commitment to excellence.

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

The Department of Computer Science and Engineering was established in 2001. It has its mission to inculcate innovative thinking and analytical abilities in addition to imparting quality education in the theory and application of Computer Science and Engineering. The department offers UG and PG programmes with State-of-the-art Computer laboratories equipped with high end hardware and software packages provided with high-speed leased line connectivity. The department takes pride in its academic excellence and outstanding placement records. It has consistently produced 68 university rank holders till 2023 batch and accredited by National Board of Accreditation.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

The Electrical and Electronics Engineering Department, established in 2003, is expanding its offerings to M.E. program in Embedded System Technologies from the 2024-25 academic year. With a focus on knowledge - based training, the department faculty empowers students with a deep understanding of concepts and industry - ready skills. The department forged partnerships with 22 companies through MOUs, facilitating collaboration and knowledge exchange.

The Electrical Technocrats Association (ETA) is a vibrant platform for technical activities, including the publication and showcasing of newsletters by staff and students every fortnight. Our mission is to drive technological advancements, foster research, and address industry needs.

DEPARTMENT OF MECHANICAL ENGINEERING

Meenakshi Sundararajan Engineering College inaugurated the Department of Mechanical Engineering in the academic year 2011-12. The department has well qualified faculties with excellent teaching, training and industrial experience. It has state-of-the-art laboratories which include VMC, CNC Wire Cut, Spark Erosion, 3D CMM etc catering to academic, consultancy and research requirements. The department's endeavor is to develop its students to be industry ready when they graduate. Students of mechanical engineering department gain industrial exposure and are prepared to face future challenges by carrying out their Final Year Project work in various PSU/Private sectors as per their field of interest relevant to their program. The department has a memorandum of understanding with various Institutions, Industries and Research organizations for collaborative research and development work. There is a huge potential in the department for Consultancy as well as Technology and Product incubation.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

The Department of Electronics and Communication Engineering, established in 2001, has grown significantly increasing its sanctioned intake from 60 to 120 in 2010. With NBA accreditation, the department is committed to delivering quality education, producing graduates who excel technically, socially, and professionally. Its state-of-the-art infrastructure, featuring ICT-enabled classrooms and advanced laboratories with cutting-edge tools like Cortex M4, Spartan 6, IoT kits, MATLAB, Cadence and PSPICE that supports academic excellence.

The Department's industry linkages with renowned organizations including ISRO, DRDO, NLTVC, and Ericson enhance students' technical skills through interactive events.

The Department's achievements include academic excellence, impressive placement records, and students' accomplishments in sports, arts, and culture, with alumni globally represented in top companies like Intel, Yahoo, and Apple.

DEPARTMENT OF INFORMATION TECHNOLOGY

The department of Information Technology was started in the year 2001 with an intake of 60 students focusing on the area. The department has won laurels to to the college. The department constantly strives with the singular aim of producing students with outstanding academic excellence and sterling character to benefit the society, our nation and the world at large. The department's commitment to high academic standards and successful student placements. It has consistently produced 65 university rank holders till 2023 batch and accredited by National Board of accreditation. Campus Agreement has been signed with leading software and hardware giants like Microsoft, IBM, Adobe and HP. The department has received a certificate partnership as a "Center of Excellence" with Virtusa Technology.

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

The Department of Artificial Intelligence & Data Science was established in 2021 with an initial intake of 60 students, which was subsequently increased to 120 in 2024. Our department boasts a team of highly qualified, experienced, and competent faculty members and features spacious infrastructure with modern amenities, including six well-equipped computer laboratories with backup and internet facilities. We emphasize continuous knowledge enrichment through seminars, guest lectures, workshops, and skill enhancement programs for both students and faculty, and engage in meticulous academic planning to ensure a well-structured approach to each semester. Additionally, our student-driven club, serves as an incubation center, nurturing innovative ideas and fostering creativity.

INTERNAL QUALITY ASSURANCE CELL (IQAC)

MSEC established the Internal Quality Assurance Cell (IQAC) in 2016 to develop and implement quality standards and benchmarks in key performance areas. In alignment with the National Education Policy (NEP) 2020 and subsequent reforms, the IQAC has been further strengthened to ensure compliance with the new policy directives.

Through IQAC, the institute strive to:

- Maintain and enhance the quality of education and services
- Align with our institution's vision and mission
- Foster a culture of continuous improvement and excellence
- Ensure accountability and transparency in institutional functioning
- Promote innovative practices in teaching, learning, and research
- Develop and implement effective quality benchmarks and parameters
- Facilitate student-centered learning and feedback mechanisms
- Enhance faculty development and capacity building
- Strengthen industry-academia partnerships and collaborations
- Ensure efficient governance and administrative processes
- Promote a culture of sustainability and social responsibility
- Facilitate accreditation and ranking processes
- Identify and mitigate quality assurance risks

CONTROLLER OF EXAMINATION

The institution, granted autonomous status by UGC and Anna University from the academic year 2024-2025, has established the Controller of Examinations (COE) office to oversee assessment processes with confidentiality, ensuring quality and standards. The COE conducts fair examinations, declares results, and manages examination activities for Internal Assessment Tests (IATs) and Semester End Examinations (SEE). Their yearly schedule includes planning, coordinating, conducting, evaluating, and reviewing exams, as well as issuing certificates and transcripts. The COE ensures smooth conduct, maintains exam integrity, and coordinates with stakeholders, adapting to the institution's specific needs and exam cycle.

MEENAKSHI SUNDARARAJAN RESEARCH CENTRE(MSRC)

The MSEC Research Centre has a steadfast commitment to fostering a strong research culture. It empowers students and faculties in their intellectual exploration and discovery. The center aims to advance knowledge, drive neoteric innovation, and contribute to the broader academic and industrial fraternity ultimately aimed at uplifting humankind.

THE MEENAKSHI SUNDARARAJAN CAREER DEVELOPMENT COMMITTEE (MSCDC)

The Meenakshi Sundararajan Career Development Committee (MSCDC) is a strategic group dedicated to fostering students' professional growth and development. Our mission is to support students in achieving their career goals, fostering a culture of professional growth and development.

The MSCDC plays a vital role in aligning individual career goals through various initiatives, including:

1. Career Pathways
2. Specialised Expert Talk & Guidnace on Different Career Pathways
3. Higher Education – Awareness Sessions on various Geographical Locations
4. University Fairs
5. Training / Coaching Programs for different Competitive Exams
6. Repository / Text Books for various Competitive Exams

By providing a career pathway, we help students understand the opportunities available to them and what is required to achieve their career goals. We encourage students as they navigate their professional journey, providing them with the tools, knowledge, and opportunities needed for successful career development.

OFFICE OF STUDENTS AFFAIRS

Our mission is to create a supportive and inclusive educational environment that empowers students to succeed in their academic, personal, and professional lives. We achieve this by:

- Providing individualized support and responding to student needs
- Fostering a culture of academic integrity and excellence
- Promoting personal hygiene, cleanliness, discipline and sprucing
- Encouraging a moral code of conduct and respect for others
- Cultivating a sense of campus decency and decorum
- Modeling exemplary behavior and attitudes

By fulfilling these responsibilities, the institution aims to inspire students to become responsible, successful, and compassionate individuals who make a positive impact in their communities.

COLLEGE COUNSELING SERVICES

College counseling services are essential in supporting students' overall well-being and academic success. These services often encompass various areas, including healthy mind well-being, career guidance, and academic counseling. Here's a breakdown of the typical counseling services available for college students in the institution:

Individual Counseling: One-on-one sessions with RCI registered counselors or psychologists to address personal issues such as stress, anxiety, depression, relationship problems, and any other psychological concerns.
Group Counseling: Support groups where students with similar issues can share experiences and strategies for coping in a safe and supportive environment.
Crisis Intervention: Immediate support for students in distress, trauma response, and any emergency psychological concerns.

TRAINING AND PLACEMENT CELL

Meenakshi Sundararajan Engineering College training and placement cell is committed to providing exceptional placement opportunities for its students. The Placement Cell takes meticulous efforts to ensure that students are recruited by top-notch companies in the industry.
The training pathway is established starting from the first semester with 180 Hours of Placement training which includes Communications Skills, Aptitude Training. Specialised Programming, Guidance on Certifications, Projects, Competitions, Grooming, Etiquette, Group Discussion and Mock Interviews.

The Placement Cell functions under the leadership of Placement Officer, Faculty representatives and Coordinators from each department. The Cell's ultimate aim is to achieve 100% placement. Its Other Functions include

1. Implementation of the training pathway at appropriate semesters
2. Industry Talks
3. Alumni Talks
4. Arranging Internships & Projects
5. Centers of Excellence with Industry
6. Industry Specialised training & guidance

This comprehensive training empowers students to face the campus interviews with confidence through enhancing their employability skills for a successful future.

DEPARTMENT OF PHYSICAL EDUCATION

Our college campus boasts an array of sports facilities, including

- Basketball Court
- Badminton Court
- Pickle Ball Court
- Volleyball
- Cricket / Foot Ball / Athletics Ground
- Tennis Court
- Kho Kho

The institution is much dedicated in nurturing the talent through specific college sports teams :

- Expert coaching and mentorship
- Formation of new sports teams
- Dedicated Sports Hour (1 hour/week)
- Regular Sports Day events - that are meticulously planned for maximum student participation.

DEPARTMENT OF SAFETY AND SECURITY

MSEC's Safety Department include the Chief Security Officer (Retd. Lt. Col), Trained & Certified Safety Officers (18) and Chief Safety Officer.

The department ensures a secure and hazard-free environment within the campus through:

- Monitoring all areas of the campus to ensure a secure environment
- Conducting daily reviews and maintaining a register to track and address any safety issues
- Performing maintenance tasks such as securing compound walls, replacing damaged fencing, and ensuring proper drainage
- Educating the community through regular safety awareness programs and training sessions
- Organizing fire drills and evacuation procedures to prepare for emergencies
- Identifying and mitigating potential hazards to prevent accidents
- Developing and implementing comprehensive safety policies to guide the community
- Continuously monitoring CCTV cameras to quickly respond to any security incidents

The department's proactive approach helps to prevent accidents, minimizes risks, and fosters a culture of safety among students, staff, and faculty members.

MEENAKSHI SUNDARARAJAN INNOVATION AND INCUBATION CENTRE (MSIIC)

Meenakshi Sundararajan Innovation and Incubation Centre (MSIIC) is a dynamic and forward-thinking organization dedicated to fostering innovation, entrepreneurship, and skill development etc. Our center serves as a catalyst for a transformative change - providing aspiring entrepreneurs with the resources, mentorship, and support that is needed to turn their ideas into successful ventures. MSIIC is dedicated to promoting entrepreneurship and an innovative mindset among students and entrepreneurs at institutions. Through mentorship MSIIC helps to develop talents and support their initiatives, provide knowledge on market access and funding, and empower individuals to identify opportunities, take risks, and create positive change. The institution solely believes in entrepreneurship as a catalyst for innovation and societal impact, providing resources and a supportive environment for individuals to thrive and make a difference in their communities and beyond. Its activities include

1. Managing the 100 Seat Innovation & Incubation Center
2. Guidance to both Internal & External Start-ups from Ideation to Funding
3. Competitions – Identification & Mentoring
4. Conducting Competitions :- 30 Hour Hackathons, All India Hackathons etc.
5. Managing Student Clubs
6. Art & Music Festival
7. Skill Development / Value Added Courses
8. Societal Beneficial Projects

MSEC STUDENTS CLUBS

MSEC Students Clubs were initiated with the objective to provide a platform for students to discover, showcase and improve their interests, strengths and passion. There are 7 clubs in our college namely, AI Epoch Club, Eco Design Club, Adyant Coding Club, Renewables Club, Nodenova IOT Club, Dev Dynasty Web App Development Club and Product Development Club. Clubs foster vibrant student community in the campus by conducting variety of events and activities which include workshops, seminars, technical and non-technical events, campus benefit projects, long term projects such as SAE Baja etc that cater to diverse interests. Clubs help the students to collaborate with different disciplines and exchange knowledge with peer groups.

Meenakshi Sundararajan Engineering College

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Department : Mechanical Engineering, R2024, CBCS

Vision of the department	Mission of the department
To equip the students with a strong foundation in Core mechanical principles, fostering innovation and producing well-rounded engineers capable of solving complex challenges to address the evolving needs of society and industry.	• Quality education and knowledge updates provide a strong foundation to meet the complex challenges. • Adopt world-class technology, through digital education for fostering innovations. • Imparting ethical principles to solve the evolving needs of the society and industry.

PROGRAM OUTCOMES (PO) and PROGRAM SPECIFIC OUTCOMES (PSO)

PO1	Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
PO2	Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
PO3	Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
PO4	Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
PO5	Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
PO6	The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO7	Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
PO9	Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
PO10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
PO11	Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments
PO12	Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change
PSO1	Application of core subjects namely, Design, Manufacturing, Thermal Engineering and Fluid Mechanics to Mechanical engineering Problems
PSO2	Familiarization of modern Design and Analytical software such as AutoCAD, CREO, NASTRAN, ADAMS, CADEM, FluidSim, Lab view and MATLAB for analyzing problems of Mechanical Engineering
PSO3	Incorporate design and implementation of mechanical systems in societal and environmental issues

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Department : Mechanical Engineering, R2024, CBCS

Curriculum for I to VIII Semesters

SEMESTER I								
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**TCP**	**PERIODS PER WEEK**			**CREDITS**
					L	**T**	**P**	
	U24IP101	Induction Program -Universal Human Values						
THEORY								
1	U24EN101	Technical English	HSMC	30	2	0	0	2
2	U24MA101	Mathematical Foundation for Engineers	BSC	60	3	1	0	4
3	U24PH105	Physics for Mechanical Engineering I	BSC	45	3	0	0	3
4	U24CY105	Chemistry for Mechanical Engineering	BSC	45	3	0	0	3
5	U24TA101	தமிழர்மரபு / Heritage of Tamils	HSMC	15	1	0	0	1
THEORY CUM PRACTICAL (TCP)								
6	U24CS101	Programming in C	ESC	90	2	0	4	4
7	U24EE105	Basics of Electrical and Electronics Engineering	ESC	75	3	0	2	4
PRACTICAL								
8	U24BS101	Physics and Chemistry Laboratory	BSC	60	0	0	4	2
9	U24TP110	Communication Skill Lab - I	HSMC	30	0	0	2	1
10	U24ED111	Design Thinking -Building Innovation & Solutioning Mindset	EDIC	15	0	0	1	0.5
TOTAL				**465**	**17**	**1**	**13**	**24.5**

Meenakshi Sundararajan Engineering College

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Department : Mechanical Engineering, R2024, CBCS

SEMESTER II								
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**TCP**	**PERIODS PER WEEK**			**CREDITS**
					L	**T**	**P**	
	U24IP201	Biology for Mechanical Engineers		24				
THEORY								
1	U24EN201	Professional English	HSMC	30	2	0	0	2
2	U24MA205	Fourier Series, Complex Analysis and Calculus	BSC	60	3	1	0	4
3	U24PH205	Physics for Mechanical Engineering II	BSC	45	3	0	0	3
4	U24TA201	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	HSMC	15	1	0	0	1
5	U24CY201	Green and Sustainable Chemistry	BSC	30	2	0	0	2
THEORY CUM PRACTICAL								
6	U24CS201	Python Programming	ESC	90	3	0	3	4.5
7	U24CE205	Engineering Graphics for Mechanical Engineering	ESC	75	3	0	2	4
PRACTICAL								
8	U24ME101	Engineering Practices Laboratory	ESC	60	0	0	4	2
9	U24TP210	Communication Skill Lab - II	HSMC	30	0	0	2	1
10	U24ED211	Design Thinking - Decoding Innovation Opportunity	EDIC	15	0	0	1	0.5
TOTAL				**450**	**17**	**1**	**12**	**24**

Meenakshi Sundararajan Engineering College

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Department : Mechanical Engineering, R2024, CBCS

SEMESTER III								
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**TCP**	**PERIODS PER WEEK**			**CREDITS**
					L	**T**	**P**	
		VAC		30				
THEORY								
1	U24MA305	Statistics and Numerical Methods for Mechanical Engineers	BSC	60	3	1	0	4
2	U24ME301	Engineering Mechanics	ESC	45	3	0	0	3
3	U24ME302	Engineering Thermodynamics	PCC	45	3	0	0	3
4	U24ME303	Manufacturing Processes	PCC	45	3	0	0	3
5	U24ME304	Engineering Materials and Metallurgy	PCC	45	3	0	0	3
6	U24MC313	Foreign Language (Japanese / French / German)	MC#	30	2	0	0	0
THEORY CUM PRACTICAL								
7	U24ME305	Fluid Mechanics and Machinery	PCC	75	3	0	2	4
PRACTICAL								
8	U24ME306	Computer Aided Machine Drawing	ESC	45	0	0	3	1.5
9	U24TP310	General Aptitude & Logical Reasoning	EEC	30	0	0	2	1
10	U24ED311	Innovation Tool Kits	EDIC	15	0	0	1	0.5
11	U24RM312	Introduction To Problem Solving	RMC	15	0	0	1	0.5
TOTAL				**450**	**20**	**1**	**9**	**23.5**

#Mandatory Course is a Non-Credit Course.

Meenakshi Sundararajan Engineering College

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Department : Mechanical Engineering, R2024, CBCS

SEMESTER IV								
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**TCP**	**PERIODS PER WEEK**			**CREDITS**
					L	**T**	**P**	
		VAC		30				
THEORY								
1	U24MC413	Indological Studies	MC#	30	2	0	0	0
THEORY CUM PRACTICAL								
2	U24ME401	Manufacturing Technology	PCC	75	3	0	2	4
3	U24ME402	Metrology and Measurements	PCC	75	3	0	2	4
4	U24ME403	Strength of Materials	PCC	75	3	0	2	4
5	U24ME404	Thermal Engineering	PCC	75	3	0	2	4
6	U24ME405	Hydraulics and Pneumatics	PCC	75	3	0	2	4
PRACTICAL								
7	U24TP410	Critical and Creative Thinking Skills	EEC	30	0	0	2	1
8	U24ED411	Idea & Simulation Lab	EDIC	15	0	0	1	0.5
9	U24RM412	Hypothesis	RMC	15	0	0	1	0.5
TOTAL				**465**	**17**	**0**	**14**	**22**

#Mandatory Course is a Non-Credit Course.

Meenakshi Sundararajan Engineering College

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Department : Mechanical Engineering, R2024, CBCS

SEMESTER V								
S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	TCP	PERIODS PER WEEK			CREDITS
					L	T	P	
		VAC		30				
THEORY								
1		Open Elective I	OEC	45	3	0	0	3
2		Professional Elective I	PEC	45	3	0	0	3
3		Professional Elective II	PEC	45	3	0	0	3
4	U24ME501	Design of Machine Elements	PCC	45	3	0	0	3
THEORY CUM PRACTICAL								
5	U24ME502	Theory of machines	PCC	75	3	0	2	4
6	U24ME503	Heat and Mass Transfer	PCC	75	3	0	2	4
PRACTICAL								
7	U24ME504	CAD /CAM LAB	PCC	60	0	0	4	2
8	U24TP510	Analytical and Logical Thinking Skills	EEC	30	0	0	2	1
9	U24ME505	Summer Internship*	EEC					1
10	U24ED511	Prototype & Market Validation	EDIC	15	0	0	1	0.5
11	U24RM512	Domain Specific Experiments/Methodology/Algorithms	RMC	30	0	0	2	1
12	U24MC513	Fitness for Life - Yoga, Food Nutrition	MC#	30	0	0	2	0
TOTAL				**495**	**18**	**0**	**14.5**	**25.5**

***Two weeks Summer Internship carries one credit and it will be done during IV semester summer vacation and same will be evaluated in V semester.**

#Mandatory Course is a Non-Credit Course.

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Department : Mechanical Engineering, R2024, CBCS

SEMESTER VI								
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**TCP**	**PERIODS PER WEEK**			**CREDITS**
					L	**T**	**P**	
		VAC		30				
THEORY								
1		Open Elective II	OEC	45	3	0	0	3
2		Professional Elective Ill	PEC	45	3	0	0	3
4		Professional Elective IV	PEC	45	3	0	0	3
3	U24ME601	Design of Transmission System	PCC	45	3	0	0	3
4	U24MG602	Project Management	HSMC	45	3	0	0	3
5	U24MC613	Integrated Disaster Management	MC#	30	2	0	0	0
THEORY CUM PRACTICAL								
7	U24ME602	Finite Element Analysis	PCC	75	3	0	2	4
PRACTICAL								
8	U24TP610	Employability Skills & Problem Solving Techniques	EEC	30	0	0	2	1
9	U24ED611	Building a Business Model, GTM & Startup Journey	EDIC	15	0	0	1	0.5
10	U24RM612	Technical Writing And Research Ethics	RMC	15	0	0	1	0.5
TOTAL				**390**	**20**	**0**	**6.5**	**21**

#Mandatory Course is a Non-Credit Course.

Meenakshi Sundararajan Engineering College

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Department : Mechanical Engineering, R2024, CBCS

SEMESTER VII								
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**TCP**	**PERIODS PER WEEK**			**CREDITS**
					L	**T**	**P**	
		VAC		30				
THEORY								
1		Open Elective III	OEC	45	3	0	0	3
2		Professional Elective V	PEC	45	3	0	0	3
3		Professional Elective VI	PEC	45	3	0	0	3
4	U24MG701	Engineering Economics and Finance Management	HSMC	45	3	0	0	3
5	U24ME701	Artificial Intelligence and Robotics for Mechanical Systems	PCC	45	3	0	0	3
6	U24MC713	Constitution of India	MC#	30	2	0	0	0
THEORY CUM PRACTICAL								
7	U24ME702	Mechatronics and IoT	PCC	75	3	0	2	4
PRACTICAL								
8	U24ME703	Summer Internship*	EEC					1
9	U24RM712	Data Collection, Analysis And Interpretation	RMC	15	0	0	1	0.5
TOTAL				**345**	**20**	**0**	**3**	**20.5**

***Two weeks Summer Internship carries one credit and it will be done during VI semester summer vacation and same will be evaluated in VII semester.**

#Mandatory Course is a Non-Credit Course.

Meenakshi Sundararajan Engineering College

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Department : Mechanical Engineering, R2024, CBCS

SEMESTER VIII								
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**TCP**	**PERIODS PER WEEK**			**CREDITS**
					L	**T**	**P**	
		VAC		30				
PRACTICAL								
1	U24ME801	Project Work	EEC	240	0	0	16	8
TOTAL				**240**	**0**	**0**	**16**	**8**
OVERALL TOTAL								**169**

Meenakshi Sundararajan Engineering College

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Department : Mechanical Engineering, R2024, CBCS

EDIC – Entrepreneurial Development and Innovation Courses

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	TCP	PERIODS PER WEEK			CREDITS
					L	T	P	
1	U24ED111	Design Thinking - Building Innovation and Solutioning Mindset	EDIC	15	0	0	1	0.5
2	U24ED211	Design Thinking - Decoding Innovation Opportunity	EDIC	15	0	0	1	0.5
3	U24ED311	Innovation tool kits	EDIC	15	0	0	1	0.5
4	U24ED411	Idea & simulation lab	EDIC	15	0	0	1	0.5
5	U24ED511	Prototype & Market Validation	EDIC	15	0	0	1	0.5
6	U24ED611	Business Management - Go To Market & Startup Journey	EDIC	15	0	0	1	0.5

Placement Training by EduTech

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	TCP	PERIODS PER WEEK			CREDITS
					L	T	P	
1	U24TP110	Communication Skill Lab - I	HSMC	30	0	0	2	1
2	U24TP210	Communication Skill Lab - II	HSMC	30	0	0	2	1
3	U24TP310	General Aptitude & Logical Reasoning	EEC	30	0	0	2	1
4	U24TP410	Critical and Creative Thinking Skills	EEC	30	0	0	2	1
5	U24TP510	Analytical and Logical Thinking Skills	EEC	30	0	0	2	1
6	U24TP610	Employability Skills & Problem Solving Techniques	EEC	30	0	0	2	1

RMC – Research Methodology Courses

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	TCP	PERIODS PER WEEK			CREDITS
					L	T	P	
1	U24RM312	Introduction To Problem Solving	RMC	15	0	0	1	0.5
2	U24RM412	Hypothesis	RMC	15	0	0	1	0.5
3	U24RM512	Domain Specific Experiments/Methodology/Algorithms	RMC	30	0	0	2	1
4	U24RM612	Technical Writing And Research Ethics	RMC	15	0	0	1	0.5
5	U24RM712	Data Collection, Analysis And Interpretation	RMC	15	0	0	1	0.5

Meenakshi Sundararajan Engineering College

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Department : Mechanical Engineering, R2024, CBCS

CATEGORY OF COURSES AND CREDIT DISTRIBUTION

S. No.	Subject Area	Credits per Semester								Total Credits
		1	2	3	4	5	6	7	8	
1	HSMC	4	4	0	0	0	3	3	0	14
2	BSC	12	9	4	0	0	0	0	0	25
3	ESC	8	10.5	4.5	0	0	0	0	0	23
4	PCC	0	0	13	20	13	7	7	0	60
5	PEC	0	0	0	0	6	6	6	0	18
6	OEC	0	0	0	0	3	3	3	0	9
7	EEC	0	0	1	1	2	1	1	8	14
8	MC			√	√	√	√	√		0
9	EDIC	0.5	0.5	0.5	0.5	0.5	0.5			3
10	RMC			0.5	0.5	1	0.5	0.5		3
Total		24.5	24	23.5	22	25.5	21	20.5	8	**169**

HSMC - Humanities, Social Sciences and Management Courses

BSC - Basic Sciences Courses

ESC - Engineering Sciences Courses

PCC - Professional Core Courses

PEC - Professional Elective Courses

OEC - Open Elective Courses

EEC - Employability Enhancement Courses

MC - Mandatory Courses / Non-Credit Courses

EDIC - Entrepreneurial Development and Innovation Courses

RMC - Research Methodology Courses

Meenakshi Sundararajan Engineering College

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Department : Mechanical Engineering, R2024, CBCS

U24IP101	INDUCTION PROGRAM
Modules	
1	**Universal Human Values I (UHV I)**
To help the student to see the need for developing a holistic perspective of life.	
To sensitize the student about the scope of life – individual, family (interpersonal relationship), society and nature/existence.	
Strengthening self-reflection.	
To develop more confidence and commitment to understand, learn and act accordingly.	
2	**Physical Health and Related Activities**
To understand the basic principles to remain healthy and fit.	
To practice them through exercise, games etc.	
Involving health center, staff, sports coaches, faculty, staff, students' sports team etc.	
3	**Familiarization of Department / Branch and Innovation**
To get a broad perspective about goals of institution, department/branch in the context of the world, the nation, the state, and region.	
To get an idea of how the institution operates to fulfill its goals through various disciplines of education, research, development, and practice.	
To get an idea of how students can connect /participate in it.	
4	**Visit to a Local Area**
For a student to relate to the social environment of the educational institution as well as the surroundings, a place wherein their most significant year's students will scribble some indelible memories, an absolute necessity is generated for city visits to let students understand the environment through interaction with the people, place and history.	
5	**Lectures by Eminent People**
Guest lectures are a great way to help the students gain a perspective on many different things in the world. Eminent personalities in different fields of expertise like academics, sports, industry, business etc. can share their story and talk about important subjects like career, entrepreneurship, government policies and technology	
6	**Proficiency Modules**
This module is to help fill the gaps in basic competency required for further inputs to be absorbed. It includes efforts to make the student proficient in interpersonal communication and expression.	
7	**Literature / Literary Activities**
To develop the clarity of humanistic culture and its expression through literature, students may be exposed to local, regional, national, or international literature. It will help them in understanding traditional and contemporary values and thought.	
8	**Creative Practices**
This module is to help develop the clarity of humanistic culture and its creative, joyful expression. The students can choose one skill related to visual arts or performing arts.	
9	**Extra-Curricular Activities**
Wellness Sessions	
10	**Extra Activities**
Anti-Ragging Briefing	
Informal Interactions, Club / Council / Committee/ Scholarship Briefings	

Meenakshi Sundararajan Engineering College

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Department : Mechanical Engineering, R2024, CBCS

U24EN101	TECHNICAL ENGLISH	L	T	P	C
		2	0	0	2

Course Objectives	
1	To improve the communicative competence of learners
2	To develop the basic reading and writing skills of first year engineering and technology students.
3	To improve understanding of key grammar concepts and apply those concepts in both reading and writing tasks.
4	To help learners use language effectively in professional contexts.
5	To equip students with the skills to write clearly and concisely in a variety of context.

UNIT 1 EFFECTIVE READING AND WRITING COMMUNICATION	**6**
Reading: Comprehension of short technical texts – Skimming and scanning **Writing:** Precis Writing, Email Writing **Grammar:** Tenses, Question types: Wh/ Yes or No **Vocabulary development:** Root words – Prefixes & Suffixes, Standard Abbreviations & Acronyms.	
UNIT 2 NARRATION AND SUMMATION	**6**
Reading: Reading biographies, travelogues, newspaper reports **Writing:** Paraphrasing, Formal and informal Letter **Grammar:** Prepositions, Subject-verb Agreement **Vocabulary development:** One-word substitution	
UNIT 3 LANGUAGE DEVELOPMENT	**6**
Reading: Reading reviews, advertisements **Writing:** Writing Instructions, Report writing (Industrial report, Survey report & Accident report) **Grammar:** Discourse Markers, Degrees of comparison **Vocabulary development:** Compound nouns, Homophones and homonyms	
UNIT 4 RECOMMENDATIONS AND TRANSCODING	**6**
Reading: Non-verbal communication (tables, pie charts etc.) **Writing:** Writing recommendations, Transferring information (chart, graph etc.) **Grammar:** Error corrections **Vocabulary development:** Fixed and semi fixed expressions	
UNIT 5 LANGUAGE FOR WORKPLACE	**6**
Reading: Reading Editorial columns **Writing:** Writing minutes of meeting **Grammar:** Simple, compound and complex sentences **Vocabulary development:** Verbal analogies	
TOTAL PERIODS	**30**

Course Outcomes	
At the end of the course, the student will be able to	
CO1	To use appropriate words in a professional context
CO2	To gain understanding of basic grammatical structures and use them in right context.
CO3	To read and infer the denotative and connotative meanings of technical texts
CO4	To write definitions, descriptions, narrations and essays on various topics
CO5	To expand vocabulary and technical language competency

TEXT BOOKS
English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2020 edition)
English for Science & Technology Cambridge University Press, 2021.
English for Science & Technology Cambridge University Press, 2021. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.
REFERENCES
Technical Communication – Principles And Practices By Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.
A Course Book On Technical English By Lakshminarayanan, Scitech Publications (India) Pvt. Ltd.
English For Technical Communication (With CD) By AyshaViswamohan, McGraw Hill Education, ISBN: 0070264244.
Learning to Communicate – Dr. V. Chellammal, Allied Publishing House, New Delhi, 2003.
Developing Communication Skills by Krishna Mohan, Meera Bannerji- Macmillan India Ltd. 1990, Delhi.

CO-PO, PSO Mapping
(3/2/1 indicates the strength of correlation) 3-Strong 2-Medium, 1-Weak
Program Outcomes (POs) and Program Specific Outcomes PSOs'

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	3	3	-	-	2	2	-
CO2	-	-	-	-	-	-	-	-	2	3	-	-	2	2	-
CO3	-	-	-	-	-	-	-	-	1	1	-	-	2	2	-
CO4	-	-	-	-	-	-	-	-	2	3	-	-	1	1	-
CO5	-	-	-	-	-	-	-	2	-	3	-	2	2	2	-
AVG	-	-	-	-	-	-	-	0.4	1.6	2.6	-	0.4	1.8	1.8	-

Meenakshi Sundararajan Engineering College

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Department : Mechanical Engineering, R2024, CBCS

U24MA101	MATHEMATICAL FOUNDATION FOR ENGINEERS	L	T	P	C
		3	1	0	4

Course Objectives	
1	To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
2	To familiarize the students with differential calculus.
3	To familiarize the student with functions of several variables. This is needed in many branches of engineering.
4	To make the students understand various techniques of integration.
5	To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.

UNIT 1 MATRICES	**9+3**
Introduction - characteristic equation - Eigenvalues and Eigenvectors of a real matrix –Properties of Eigenvalues and Eigenvectors (without proof) – Cayley - Hamilton theorem (statement and applications only) – Diagonalization of matrices by orthogonal transformation –Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms . MAT LAB: to find matrix operations addition,multiplication, transpose and inverse of the matrix and also to find eigen value and corresponding eigen vectors.	
UNIT 2 DIFFERENTIAL CALCULUS	**9+3**
Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules (sum, product, quotient, chain rules) - The equations of tangent line and normal line, velocity and acceleration - Interval of increasing and decreasing functions-Maxima and Minima of functions of one variable - Intervals of concavity and convexity. MAT LAB:To determine maxima and minima for one variable.	
UNIT 3 FUNCTIONS OF SEVERAL VARIABLES	**9+3**
Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Maxima and minima of functions of two variables - Lagrange's method of undetermined multipliers. MAT LAB: To determine maxima and minima for two variable.	
UNIT 4 INTEGRAL CALCULUS	**9+3**
Definite and Indefinite integrals - Substitution rule - Techniques of Integration : Integration by parts, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals. MAT LAB: To find the area using single integral.	
UNIT 5 MULTIPLE INTEGRALS	**9+3**
Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed byplane curves – change of variables from Cartesian to polar in double integrals - Triple integrals – Volume of solids. MAT LAB:To find the area and volume using double and triple integral.	
TOTAL PERIODS	**60**

Meenakshi Sundararajan Engineering College

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Department : Mechanical Engineering, R2024, CBCS

Course Outcomes	
At the end of the course, the student will be able to	
CO1	Use the matrix algebra methods for solving practical problems
CO2	Apply differential calculus tools in solving various application problems.
CO3	Able to use differential calculus ideas on several variable functions.
CO4	Apply different methods of integration in solving practical problems
CO5	Apply multiple integral ideas in solving areas, volumes and other practical problems

TEXT BOOKS

1.Veerarajan.T,"Engineering Mathematics,for semester I and II", Updated second Edition,Tata McGraw Hill Education , private Limited ,2019.

2.Grewal B.S and Grewel J.S .“Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 45th Edition, 2020.

3.Won Y.Yang,Young K.Choi,Jaekwon Kim,Man Cheol Kim, H.Jin Kim,Taeho lm, "Engineering Mathematics with MATLAB" CRC Press Publishers , I st Edition , 2017.

4. Engineering Mathematics: First year.Calculus and analytical geometry,volume 2,M.K.Venketaraman,National Publishing company,1965.

REFERENCES

1.Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016.

2.Kandasamy.P.,Thilagavathy.K and Gunavathy.K.,"Engineering Mathematics For First Year B.E/B.Tech,Seventh Edition 2008 S.Chand and Co.,New Delhi.

3.Bali. N.P and Manish Goyal, “A Textbook of Engineering Mathematics,semester-I”, Ninth Edition, Laxmi Publications Pvt. Ltd, 2016.

CO/PO, PSO Mapping

(3/2/1 indicates the strength of correlation) 3-Strong 2-Medium, 1-Weak

Program Outcomes (POs) and Program Specific Outcomes PSOs'

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	-	-	-	-	-	-	-	1	1	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-	1	1	-
CO3	3	3	3	1	-	-	-	-	-	-	-	-	1	1	-
CO4	3	2	2	-	-	-	-	-	-	-	-	-	1	1	-
CO5	3	3	3	1	-	-	-	-	-	-	-	-	1	1	-
AVG	3	3	3	1	1	-	-	-	-	-	-	-	1	1	-

Meenakshi Sundararajan Engineering College

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Department : Mechanical Engineering, R2024, CBCS

U24PH105	PHYSICS FOR MECHANICAL ENGINEERING I	L	T	P	C
		3	0	0	3

Course Objectives

1	Explore the elastic behavior of materials and the factors that affect their deformation under load, such as stress, strain, and elasticity modulus.
2	Enable learners to identify and apply the mechanical properties of materials relevant to their field of domain.
3	Introduce learners to the concept of heat energy, its measurement, and its transmission mechanisms.
4	Introduce learners to the principles of sound waves, including wave propagation, frequency, amplitude, and wavelength
5	Provide learners with a comprehensive understanding of lasers, including their principles of operation and applications.

UNIT 1 ELASTICITY — **9**

Elasticity – Stress, Strain - Hooke's law – Elastic moduli – Poisson's ratio – Beams – bending of beams – Expression for bending moment – Theory of uniform and non – uniform bending - Determination of young 's modulus by uniform and non- uniform bending methods -Application (Cantiliver)

UNIT 2 SURFACE TENSION AND VISCOSITY — **9**

Surface tension – definition – Molecular forces – Explanation of surface tension on kinetic theory – Surface energy – work done in increasing the area of a surface – Excess pressure inside a curved liquid surface – Excess pressure inside a liquid drop and soap bubble. Viscosity – Co efficient of viscosity – Streamlined and turbulent motion – critical velocity – Bernoulli's theorem – Proof – Applications – Venturimeter – Pitot tube

UNIT 3 THERMAL PHYSICS — **9**

Transfer of heat energy – Heat conduction in solids –Newton's law of cooling–Thermal conductivity of bad conductors-Lee's disc method: theory and experiment,Forbe'sMethod-rectilinear flow of heat - Conduction through compound media (series and parallel)

UNIT 4 ULTRASONICS — **9**

Ultrasonics, Properties of ultrasonic waves, Piezo-electric & magnetostriction effect, Production of ultrasonic waves by Piezo electric & magnetostriction oscillators, Detection of ultrasonic waves, acoustic grating, Applications of ultrasonic waves : SONAR, NDT.

UNIT 5 LASER &FIBER OPTICS — **9**

Characteristics of Lasers - Spontaneous and stimulated emission – Einstein's A&B coefficients- Population inversion – Pumping – Main components of lasers – Types of lasers: Nd:YAG and CO2 lasers – Industrial and medical applications of lasers.Light propagation in optical fibre - Numerical aperture and acceptance angle - Types of optical fibres – Losses in fibres: attenuation, dispersion, bending - Fibre optic Communication system - Active and passive sensors.

TOTAL PERIODS — **45**

Course Outcomes

At the end of the course, the student will be able to

CO1	Analyze rigid bodies in equilibrium, considering both external forces and internal reactions.
CO2	Gain insight into the elastic properties of materials, including elasticity, stiffness, and resilience.
CO3	Gain insights into the concepts of heat energy and its applications in thermal engineering.
CO4	Acquire knowledge about the sound waves and their usage relevant to engineering applications.
CO5	Develop an understanding of laser technology and its applications in communication systems

TEXT BOOKS
1. Mechanics: D.S. Mathur S. Chand & Co, Edition 2020
2. Elements of properties of matter – D.S. Mathur – S. Chand & Co., 2008
3. Properties of matter – R. Murugesan – S. Chand & Co., 2004.
4.. Lasers: Fundamentals and Applications, - K.Thyagarajan and A.Ghatak Laxmi Publications, (Indian Edition), 2019
REFERENCES
1. Mechanics Part I and Part II, Narayanamoorthy National Publishing Company, 2001
2. Fundamental of Physics, D. Hallidary , Resnick and J Walker, 6th Edition, Wiley, New York 2001
3. Properties of matter – Brijlal and Subramanian S. Chand & Co., 2006.
4.. Physics – Volume 1 & 2, Paul A. Tipler,CBS, (Indian Edition), 2004

CO/PO, PSO Mapping
(3/2/1 indicates the strength of correlation) 3-Strong 2-Medium, 1-Weak
Program Outcomes (POs) and Program Specific Outcomes PSOs'

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	-	-	-	-	-	-	1	1	-	1
CO2	3	2	2	-	-	-	-	-	-	-	-	1	1	-	1
CO3	3	2	2	-	-	-	-	-	-	-	-	1	1	-	1
CO4	3	2	2	-	-	-	-	-	-	-	-	1	1	-	1
CO5	3	2	2	-	-	-	-	-	-	-	-	1	1	-	1
AVG	3	2	2	-	-	-	-	-	-	-	-	1	1	-	1

Meenakshi Sundararajan Engineering College

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Department : Mechanical Engineering, R2024, CBCS

U24CY105	CHEMISTRY FOR MECHANICAL ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives

1	To make the students aware of various treatment processes of water for potable and industrial purposes.
2	To familiarize the knowledge about Thermodynamics and lubricants used in industries.
3	To recommend suitable energy propellant for engineering processes and applications.
4	To develop an understanding of the basic concepts of phase rule and Nanomaterials with its applications.
5	To make the students aware of the extended applications of polymeric materials.

UNIT1 WATER TECHNOLOGY — **9**

Introduction-Characteristics of water – Hardness – Types of hardness - Estimation by EDTA (problems on hardness) –Alkalinity – Determination (problems on alkalinity) – Boiler feed water – Requirements – Priming and foaming, Scales and sludges Caustic embrittlement and Boiler
corrosion – Application - External conditioning (Ion Exchange, zeolite) – Internal conditioning (Carbonate, phosphate, calgon, sodium aluminate conditioning) –– Brackish water treatment - Reverse osmosis.

UNIT2 CHEMICAL THERMODYNAMICS AND LUBRICANTS — **9**

Introduction - Thermodynamic process (isothermal, isobaric, isochoric and adiabatic processes) - Internal energy – first law of thermodynamics (Mathematical statement & limitation) - Enthalpy - Second law of thermodynamics - Entropy - Entropy change of an ideal gas & problems - Free
energy - work function - Gibbs Helmholtz equation (derivation & applications) - Van't Hoff isotherm.
Lubricants -Classification of lubricants: solid, semisolid and liquid lubricants with examples, Type of lubrications – Physical properties- viscosity, viscosity index, cloud point, pour point.

UNIT3 FUELS AND COMBUSTION — **9**

Introduction: Classification of fuels; Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process)-Knocking - octane number, diesel oil – cetane number- Application - Power alcohol and biodiesel. Combustion of fuels: Introduction: Calorific value - higher and lower calorific values(problems on C.V,)-Ignition temperature: spontaneous ignition temperature, Explosive range; Flue gas analysis - ORSAT Method

UNIT4 PHASE RULE AND NANOMATERIALS — **9**

Phase rule - Introduction, definition of terms - phase, components and degree of freedom - phase diagram- one component system -water system - reduced phase rule - thermal analysis and cooling curves - two component systems - lead-silver system. Nanomaterials-Classification-Properties and uses-. Synthesis–Top down method (Ball milling)and Bottom up methods –Laser Evaporation method -chemical vapour deposition, - Applications of nanomaterials - Application - A Case Study – Medicine, Agriculture, Industry and Electronics.

UNIT5 POLYMER CHEMISTRY — **9**

Polymers and Polymerization: Definition, classification - types of polymerization: addition and condensation –mechanism of addition polymerization (cationic, anionic, free radical and coordination polymerization)-Moulding of polymers into articles-injection-Properties: Glass Transition temperature.-Thermoplastic and thermosetting polymers-conducting polymers-definition, types and applications.

TOTAL PERIODS — **45**

Course Outcomes	
At the end of the course, the student will be able to	
CO1	Summarize the water quality parameters and their treatment techniques.
CO2	Understand the basic knowledge on concepts of thermodynamics and lubricants with its applications.
CO3	Illustrate the quality of fuel by its properties
CO4	Develop a deep knowledge on understanding of the basic concepts of phase rule and Nanomaterials with its applications.
CO5	Understand the basic principles and applications of Polymers.

TEXT BOOKS

1. P. C. Jain and Monica Jain, “Engineering Chemistry”, 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2018.

2. Sivasankar B., “Engineering Chemistry”, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.

3. S.S. Dara, “A Text book of Engineering Chemistry”, S. Chand Publishing, 12th Edition, 2018.

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1.Gareth Price, Thermodynamics of chemical processes, Oxford university press, 2019

2. O.G. Palanna, “Engineering Chemistry” McGraw Hill Education (India) Private Limited, 2nd Edition, 2017.

3. D Tabor, Gases, liquids and solids and other states of matter, Oxford University press, 2018

4.F.W. Billmayer, Textbook of Polymer Science, 3rd Edison, Wiley. N.Y. 1991.

5. O.V. Roussak and H.D. Gesser, Applied Chemistry-A Text Book for Engineers and Technologists, Springer Science Business Media, New York, 2nd Edition, 2013.

6.Solar Electricity Handbook- A simple ,Practical Guide to Solar energy Resources

CO/PO, PSO Mapping
(3/2/1 indicates the strength of correlation) 3-Strong 2-Medium, 1-Weak
Program Outcomes (POs) and Program Specific Outcomes PSOs'

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	1	-	-	-	-	-	-	-	-	-	1	-	1
CO2	3	1	-	-	2	2	1	-	1	-	-	1	1	-	1
CO3	3	2	-	-	2	1	1	-	1	-	-	1	1	-	1
CO4	3	2	1	1	1	2	-	-	1	-	-	2	1	-	1
CO5	3	2	2	1	2	1		-	1	-	-	3	1	-	1
AVG	3	1.8	0.8	0.4	1.4	1.5	0.4	-	0.8	-	-	1.4	1	-	1

Meenakshi Sundararajan Engineering College

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Department : Mechanical Engineering, R2024, CBCS

U24TA101	தமிழர்மரபு HERITAGE OF TAMILS	L	T	P	C
		1	0	0	1

அலகு I மொழிமற்றும்இலக்கியம் **UNIT I LANGUAGE AND LITERATURE**	**3**
இந்தியமொழிக்குடும்பங்கள் – திரொவிடமொழிகள் – தமிழ்ஒருசெம்மொழி – தமிழ்செல்விலக்கியங்கள் - சங்கஇலக்கியத்தின்சமயசார்பற்றதன்மை – சங்கஇலக்கியத்தில்பகிர்தல்அறம் – திருக்குறளில்மேலாண்மை கருத்துக்கள் – தமிழ்க்காப்பியங்கள், தமிழகத்தில் - சமணபௌத்தசமயங்களின்தாக்கம் - பக்திஇலக்கியம், ஆழ்வார்கள்மற்றும்நாயன்மார்கள் - சிற்றிலக்கியங்கள் - தமிழில்நவீனஇலக்கியத்தின்வளர்ச்சி - தமிழ்இளகியவளர்ச்சியில்பாரதியார்மற்றும்பாரதிதாசன்ஆகியோரின்பங்களிப்பு Language Families in India - Dravidian Languages – Tamil as aClassical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan	
அலகு II மரபு - பாறைஓவியங்கள்முதல்நவீனஓவியங்கள்வரை - சிற்பக்கலை **UNIT II HERITAGE - ROCK ART PAINTINGS TO MODERN ART - SCULPTURE**	**3**
நடுகல்முதல்நவீனசிற்பங்கள்வரை - ஐம்பொன்சிலைகள் - பழங்குடியினர்மற்றும்அவர்கள்தயாரிக்கும்கைவினைப்பொருட்கள், பொம்பைகள் - தேர்செய்யும்கலை - சுடுமண்சிற்பங்கள் - நாட்டுப்புறதெய்வங்கள் - குமரிமுனையில்திருவள்ளுவர்சிலை - இசைக்கருவிகள் - மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின்சமூகபொருளாதாரவாழ்வில்கோவில்களின்பங்கு 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	
அலகு III நாட்டுப்புறக்கலைகள்மற்றும்வீரவிளையாட்டுகள் **UNIT III FOLK AND MARTIAL ARTS**	**3**
தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான்கூத்து, ஒயிலாட்டம், தோல்பாவைக்கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின்விளையாட்டுகள் Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.	
அலகு IV தமிழர்களின்திணைக்கோட்பாடுகள் **UNIT IV THINAI CONCEPT OF TAMILS**	**3**
தமிழகத்தின்தாவரங்களும், விலங்குகளும் - தொல்காப்பியம்மற்றும்சங்கஇலக்கியத்தில்அகம்மற்றும்புறக்கோட்பாடுகள் - தமிழர்கள்போற்றியஅறக்கோட்பாடு - சங்ககாலத்தில்தமிழகத்தில்எழுத்தறிவும், கல்வியும் - சங்ககாலநகரங்களும்துறைமுகங்களும் - சங்ககாலத்தில்ஏற்றுமதிமற்றும்இறக்குமதி - கடல்கடந்தநாடுகளில்சோழர்களின்வெற்றி	

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	
அலகு V **இந்தியதேசியஇயக்கம்மற்றும்இந்தியபண்பாட்டிற்குத்தமிழர்களின் பங்களிப்பு** **UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE**	**3**
இந்தியவிடுதலைப்போரில்தமிழர்களின்பங்கு - இந்தியாவின்பிறபகுதிகளில்தமிழ்பண்பாட்டின்தாக்கம் - சுயமரியாதைஇயக்கம் - இந்தியமருத்துவத்தில், சித்தமருத்துவத்தின்பங்கு - கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்புத்தகங்களின்அச்சுவரலாறு 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.	
TOTAL PERIODS	**15**

TEXT BOOK CUM REFERENCE BOOKS

1. தமிழகவரலாறு - மக்களும்பண்பாடும் - கேகேபிள்ளை (வெளியீடு: தமிழ்நாடுபாடநூல்மற்றும்கல்வியியல்பணிகள்கழகம்)

2.கணினித்தமிழ் - முனைவர்இல. சுந்தரம் (விகடன்பிரசுரம்)

3.Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

4.Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies

5.Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies)

6.The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies)

7.Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by:Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

8.Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)

9.Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

10. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Meenakshi Sundararajan Engineering College

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Department : Mechanical Engineering, R2024, CBCS

U24CS101	PROGRAMMING IN C	L	T	P	C
		2	-	4	4

Course Objectives

1	To understand the structure and syntax of C Language
2	To develop C programs using arrays and strings
3	To develop modular applications in C using functions
4	To develop applications in C and apply the concept code reusability using pointers and structures
5	To do input/output and understand the basics of file handling mechanisms in C .

UNIT 1 BASICS OF C PROGRAMMING — **6+12**

Introduction to Problem Solving: Algorithm, Flowchart, Pseudocode. Programming Basics: Applications of C Language-Structure of C program -Identifiers-Data Types – Variables-Constants – Keywords – Operators – Input/output statements, Decision making statements - Looping statements - Expressions-Precedence and Associativity – Expressions Evaluation, Type conversions.

Practicals:

1.Algorithm, pseudocode, flowcharts for simple scientific and statistical problems
2.I/O statements, operators, expressions and decision-making constructs(if, if-else, break, continue
3.C Programming using Simple statements and expressions
4.Create Looping statements- for, while, do-while.

UNIT 2 ARRAYS AND STRINGS — **6+12**

Arrays: Introduction – Declaration of Arrays – Storing Values in Array – Accessing elements of the Array– Calculating the length of the Array – Operations on Array – one dimensional arrays – Two dimensional Arrays –String: Declaring, Initializing, Printing and reading strings, String input and output functions, String handling functions, Arrays of strings.

Practicals:

1.Create simple programs for one dimensional and two dimensional arrays.
2.Practice all string handling functions.

UNIT 3 FUNCTION AND STORAGE CLASS — **6+12**

Library functions: Math functions, other miscellaneous functions such as getchar(), putchar(), malloc(), calloc(). User defined functions - function definition, functions declaration, function call, scope of variables - local variables, global variables. Function parameters: Parameter passing- call by value & call by reference, function return values, Passing arguments to Functions. Recursive functions. Storage classes-auto, register, static, extern, scope rules.

Practicals:

1.Implementation of C Program using user defined functions (Pass by value and Pass by reference).
2.Implementation of Recursion Function

UNIT 4 STRUCTURES AND POINTERS — **6+12**

Basics of structures-structure data types, type definition, accessing structures, Structure operations, Complex structures-nested structures, structures containing arrays, Array of structures, Structures and Functions, Unions. Pointers: Understanding Computer Memory –Memory Management-Dynamic memory Allocation-Memory leaks- Introduction to Pointers – declaring Pointer Variables – Pointer Expressions and Pointer Arithmetic – Null Pointers – Generic Pointers - Passing Arguments to Functions using Pointer – Pointer and Arrays –Use of pointers in self-referential structures, notion of linked list

Practicals:

1.C Programming using Pointers.
2.Structures: Nested Structures, Pointers to Structures, Arrays of Structures and Unions.

UNIT 5 MACROS AND FILE PROCESSING	**6+12**

Preprocessor Directives: Introduction to preprocessor directives in Simple macros using `#define`, conditional macros using `#ifdef`, `#ifndef`, `#endif`, `#else`, and `#elif`. Files: Introduction to Files – Opening a file – Reading Data from Files – Writing Data to Files –
Detecting the End-of-file –Closing a file – Sequential access file-Random Access Files – Binary Files – Command line arguments.

Practicals:

1.Programming using macros and storage classes
2.Implementation of Command line Arguments like argc,argv
3.Files- reading and writing, file operations, random access
4.Develop an application for any one of the following scenarios : Student Management System /Stock Management System/ Banking Application / Ticket Reservation System

TOTAL PERIODS	**90**

Course Outcomes

At the end of the course, the student will be able to

CO1	Create simple applications in C using basic constructs
CO2	Create C programs using arrays and strings
CO3	Create modular applications in C using functions.
CO4	Create modular applications in C using structures and pointers.
CO5	Create applications using macros and file processing

TEXT BOOKS

1. Kernighan, B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Education, 2015.

2. ReemaThareja, “Programming in C”, Oxford University Press, Second Edition, 2016

REFERENCE BOOKS

1. Paul Deitel and Harvey Deitel, “C How to Program with an Introduction to C++”, Eighth edition, Pearson Education, 2018.

2. Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020

3. Byron S. Gottfried, “Schaum’s Outline of Theory and Problems of Programming with C”, McGraw-Hill Education, 1996.

4.. Pradip Dey, Manas Ghosh, “Computer Fundamentals and Programming in C”, Second Edition, Oxford University Press, 2013.

5. Anita Goel and Ajay Mittal, “Computer Fundamentals and Programming in C”, 1st Edition, Pearson Education, 2013.

CO/PO, PSO Mapping
(3/2/1 indicates the strength of correlation) 3-Strong 2-Medium, 1-Weak
Program Outcomes (POs) and Program Specific Outcomes PSOs'

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO2	2	2	-	-	-	-	-	-	-	-	-	1	-	-	-
CO3	2	2	2	2	-	-	-	1	-	1	-	1	-	-	-
CO4	2	2	2	-	1	1	-	-	1	-	1	1	-	-	-
CO5	2	-	2	2	1	1	-	1	1	1	1	1	-	-	-
AVG	2	2	2	2	1	1	-	1	1	1	1	1	-	-	-

Meenakshi Sundararajan Engineering College

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Department : Mechanical Engineering, R2024, CBCS

U24EE105	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	C
		3	0	2	4

Course Objectives	
1	To introduce the basics and its analysis of electric circuits
2	To impart knowledge in the basics of working principles and application of electrical machines
3	To introduce analog devices and their characteristics
4	To educate on the fundamental concepts of digital electronics
5	To introduce the functional elements and working of measuring instruments and transducers

UNIT 1 ELECTRICAL CIRCUITS	**9+6**
DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff's Laws –Independent and Dependent Sources – Simple problems- Nodal Analysis, Mesh analysis with Independent sources only (Steady state). Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor – Simple problems in RLC circuits.	
Practical	
1.Verification of Kirchhoff's Law.	
UNIT:2 ELECTRICAL MACHINES	**9+6**
Construction and Working principle, - DC Separately and Self Excited Generators, EMF equation of Dc machines. Working Principle of DC motors, Torque Equation, Types and Applications-. Construction, Working principle and Applications of Transformer - Three phase Alternator - Three Phase Induction Motor - BLDC motor	
Practical	
1.Load test on DC Shunt motor.	
2.Load test on Single Phase Transformer.	
Unit - 3 ANALOG ELECTRONICS	**9+6**
Semiconductor Materials: Silicon & Germanium – PN Junction Diodes, Zener Diode –Characteristics and Applications – Bipolar Junction Transistor, SCR, MOSFET, IGBT – Types, V-I Characteristics and Applications - Rectifier and Inverters.	
Practical	
1.Characteristics of PN , Zener Diode.	
2.Characteristics of BJT.	
3.Characteristics of SCR.	
4.Characteristics of MOSFET.	
5.Half wave and Full wave Rectifiers.	
UNIT: 4 DIGITAL ELECTRONICS	**9+6**
Review of number systems, Binary codes, Error detection and correction codes, Combinational logic - representation of logic functions-SOP and POS forms, K-map representations - minimization using K maps (Simple Problems only)	
Practical	
1.Study of Logic Gates.	

UNIT: 5 MEASUREMENTS AND INSTRUMENTATION	**9+6**
Functional elements of an instrument, Standards and calibration, Operating Principle, types- Moving Coil and Moving Iron meters, Measurement of three phase power, Energy Meter, Classification of transducers – Selection of transducers – Resistive, capacitive & inductive Transducers – Piezoelectric, Hall effect and optical transducers.	
TOTAL PERIODS	**75**

LIST OF EXPERIMENTS	
1	Verification of Kirchhoff's Law.
2	Load test on DC Shunt motor.
3	Load test on Single Phase Transformer.
4	Characteristics of PN , Zener Diode.
5	Characteristics of BJT.
6	Characteristics of SCR.
7	Characteristics of MOSFET.
8	Half wave and Full wave Rectifiers.
9	Study of Logic Gates.

Course Outcomes	
At the end of the course, the student will be able to	
CO1	Compute the electric circuit parameters for simple problems
CO2	Explain the working principle and applications of electrical machines
CO3	Analyze the characteristics of analog electronic devices
CO4	Explain the basic concepts of digital electronics
CO5	Explain the operating principles of measuring instruments and transducers.

TEXT BOOKS

1. Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", Second Edition, McGraw Hill Education, 2020

2.S.K. Bhattacharya "Basic Electrical and Electronics Engineering", Pearson Education, Second Edition, 2017.

3.Sedha R.S., "A text book of Applied Electronics", S. Chand & Co., 2017

4.A.K. Sawhney, Puneet Sawhney , "A Course in Electrical & Electronic Measurements & Instrumentation", Dhanpat Rai and Co, New Delhi, 19th edition 2019.

5.D.P Kothari, J.S Dhillon,"Digital Circuits & Design", Pearson India Education, 2015

REFERENCES

1.James A. Svoboda, Richard C. Dorf, "Dorf's Introduction to Electric Circuits", Wiley, 2018

2.Kothari DP and I.J Nagrath, "Basic Electrical Engineering", Fourth Edition, McGraw Hill Education, 2019.

3.Thomas L. Floyd, 'Digital Fundamentals', 11th Edition, Pearson Education,Tenth Impression 2023

4.Albert Malvino, David Bates, 'Electronic Principles, McGraw Hill Education; 7th edition, 2017

5.H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010

Meenakshi Sundararajan Engineering College

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Department : Mechanical Engineering, R2024, CBCS

	CO/PO, PSO Mapping **(**3/2/1 indicates the strength of correlation) 3-Strong 2-Medium, 1-Weak Program Outcomes (POs) and Program Specific Outcomes PSOs'														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	1	1	-	-	2	2	-	-	2	1	-	-
CO2	3	3	2	1	1	-	-	2	2	-	-	2	1	-	-
CO3	3	3	2	1	1	-	-	2	2	-	-	2	1	-	-
CO4	3	3	2	1	1	-	-	2	2	-	-	2	1	-	-
CO5	3	3	2	1	1	-	-	2	2	-	-	2	1	-	-
AVG	3	3	2	1	1	-	-	2	2	-	-	2	1	-	-

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Department : Mechanical Engineering, R2024, CBCS

U24BS101	PHYSICS & CHEMISTRY LABORATORY	L	T	P	C
		0	0	4	2
Course Objectives					
1	This session aims to provide the learners hands-on-training on the practical applications of the concepts learnt in the theoretical sessions on bending of beams,application of laser,. The course will also train the learner to observe good lab practices, record readings and analyse and interpret the results.				
2	This session aims to provide the learners hands-on-training on the practical applications of the concepts learnt in the theoretical sessions on water treatment, electrochemistry, lubricants, composites and nanomaterials using simple chemical methods. The course will also train the learner to observe good lab practices, record readings and graphically represent the results, as well as analyse and interpret the influence of reaction conditions on the results.				
LIST OF EXPERIMENTS					
PHYSICS LABORATORY					
1	Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of regular and irregular objects				
2	Simple harmonic oscillations of cantilever.				
3	Uniform bending – Determination of Young's modulus				
4	Laser- Determination of the wave length of the laser using grating				
5	Ultrasonic Interferometer-Determination of compressibility of given liquid				
6	a) Optical fibre -Determination of Numerical Aperture and acceptance angle b) Compact disc- Determination of width of the groove using laser.				
7	Non-uniform bending - Determination of Young's modulus				
CHEMISTRY LABORATORY					
	Any seven experiments				
1	Estimation of mixture of acids by conductometric titration				
2	Estimation of iron by potentiometric titration				
3	Conductometric titration of barium chloride against sodium sulphate (precipitation titration)				
4	Determination of alkalinity in a water sample				
5	Estimation of hardness of water by EDTA method				
6	Estimation of hydrochloric acid by pHmetric method				
7	Determination of chloride content of water sample by Argentometric method				
8	Determination of viscosity of a polymer using Ostwald's viscometer				
9	Estimation of iron content using spectrophotometer.				
	TOTAL PERIODS	**30**			
At the end of the course, the student will be able to					
CO1	Gain knowledge about torque and rigidity modulus of a material and understand the principles of simple harmonic motion and bending of beams				
	Estimate the strength of given mixture of acids using conductance measurements under the principle of conductometric titration and Estimate the strength of given iron using EMF measurements with the help of potentiometer and have a knowledge on redox reaction				
CO2	Comprehend the principles of stress,strain & elasticity of the given materials & Gain knowledge about diffraction of laser light.				
	Estimate the strength of given salt using conductance measurements under the principle of precipitation titration and Determine and estimate the amount of different types of alkalinities in water.				

CO3	Understand how sound waves are traveling in liquid medium and comprehend the light accepting power of given optical fibre and its transmission
	Employ complexometric titrations to estimate total hardness of a water sample and Determine the amount of chloride present in water using Argentometric method.

TEXTBOOKS

1. Mechanics Part I and Part II, Narayanamoorthy National Publishing Company, 2001

2. Optics -Dr.Murugesan

3. J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas and B. Sivasankar, Textbook of Quantitative Chemical Analysis.

REFERENCES

1. Engineering physics Visvesvaraya Technological University

2. Vogel's Textbook of Quantitative Chemical Analysis (2009)

CO/PO, PSO Mapping
(3/2/1 indicates the strength of correlation) 3-Strong 2-Medium, 1-Weak
Program Outcomes (POs) and Program Specific Outcomes PSOs'

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	2	-	-	-	-	-	-	-	-	3	1	-	-
CO2	3	-	2	-	-	-	-	-	-	-	-	3	1	-	-
CO3	3	-	2	-	-	-	-	-	-	-	-	3	1	-	-
AVG	3	-	2	-	-	-	-	-	-	-	-	3	1	-	-

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Department : Mechanical Engineering, R2024, CBCS

U24TP110	COMMUNICATION SKILLS LAB I	L	T	P	C
		0	0	2	1

Course Objectives	
1	To improve the communicative competence of learners
2	To help learners use language effectively in academic /work contexts
3	To develop various listening strategies to comprehend various types of audio materials like lectures, discussions, videos etc.
4	To use language efficiently in expressing their opinions via various media.
5	To build on students' English language skills by engaging them in listening and speaking activities that are relevant to authentic contexts.

UNIT I	**6**
Listening: Listening as a key skill- its importance -Listening for general information-specific details - Introduction to classmates – Audio / video (formal & informal) **Speaking:** Making telephone Calls, Introducing a friend, Making polite requests, polite offers and replying to polite requests - Understanding basic instructions for filling out a bank application	
UNIT II	**6**
Listening: Listen to a process information **Speaking:** Small talk on general topics and current scenario	
UNIT III	**6**
Listening: Listen to event narration and stories **Speaking:** Picture description- describing locations in workplaces	
UNIT IV	**6**
Listening: Listening to discussions and debates **Speaking:** Role Play	
UNIT V	**6**
Listening: Listening/watching documentaries **Speaking:** Formal and informal talk -making predictions- talking about a given topic-giving opinions	
TOTAL PERIODS	**30**

At the end of the course, the student will be able to	
CO1	To listen and comprehend complex academic texts
CO2	To speak fluently and accurately in formal and informal communicative contexts
CO3	To express their opinions effectively in both oral and written medium of communication
CO4	Ability to listen/view and comprehend different spoken discourses/excerpts different accents and to speak clearly in simple language
CO5	Ability to read and evaluate texts critically
List of experiments	
1	Self-Introduction / Introducing a friend
2	Small talk
3	Narrating an event or story
4	Discussion/debate on a given topic
5	Listening to TED Talks (Being an active listener: giving verbal and non-verbal feedback)

ASSESSMENT PATTERN
End Semester speaking & Writing will be conducted in the classroom
TEXT BOOKS
1. Brooks,Margret. Skills for Success. Listening and Speaking. Level 4 Oxford University Press, Oxford: 2011.
2. Richards,C. Jack. & David Bholke. Speak Now Level 3. Oxford University Press, Oxford: 2010
REFERENCES
1. Bhatnagar, Nitin and MamtaBhatnagar. Communicative English for Engineers and Professionals. Pearson: New Delhi, 2010
2. Hughes, Glyn and Josephine Moate. Practical English Classroom. Oxford University Press: Oxford, 2014
3. Ladousse, Gillian Porter. Role Play. Oxford University Press: Oxford, 2014
4. English and Soft Skills, Dr. S.P. Dhanavel, Orient BlackSwan, 2013
5. Vargo, Mari. Speak Now Level 4. Oxford University Press: Oxford, 2013.

CO/PO, PSO Mapping
(3/2/1 indicates the strength of correlation) 3-Strong 2-Medium, 1-Weak
Program Outcomes (POs) and Program Specific Outcomes PSOs'

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	2	3	-	3	2	2	-
CO2	-	-	-	-	-	-	-	-	2	3	-	3	2	2	-
CO3	-	-	-	-	-	-	-	-	2	3	-	3	2	2	-
CO4	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
AVG	-	-	-	-	-	-	-	-	1.2	3	-	1.8	1.2	1.2	-

Meenakshi Sundararajan Engineering College

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Department : Mechanical Engineering, R2024, CBCS

U24ED111	DESIGN THINKING - BUILDING INNOVATION SOLUTIONING MINDSET	L	T	P	C
		0	0	1	0.5

Course Objectives	
1	Expose the students to the fields of innovation and entrepreneurship and strengthen their interest in these fields.
2	To discuss the relevance and importance of innovation and entrepreneurship to the students to improve their everyday life and future careers.
3	Illustrate the macro perspective of innovation in entrepreneurship .
4	To Design the entrepreneurship process.
5	Develop innovation and entrepreneurship processes to improve students to the skill set .

UNIT 1	**1**
What is innovation - Why is innovation important -Types of innovation - The Innovation process	
UNIT 2	**2**
Introduction to Problem Solving-The role of problem - solving in innovation and product development -The importance of real-time problem statements- Problem Identification and Definition	
UNIT 3	**2**
What is entrepreneurship (and how is it different from innovation) -Types of entrepreneurship -The Human side of entrepreneurship	
UNIT 4	**2**
Misconceptions about entrepreneurship -The process of developing entrepreneurship - Module building entrepreneurship mindset- Developing a solution thinking mind set to identify tools and techniques	
UNIT 5	**8**

• 5 Hours: 60 Students * 5 Minutes Each – Team of Three Students (15 Minutes Per Team) – Collaborative Work To Research & Present 20 Case Studies:
  ○ Design Thinking (8 Case Studies),
  ○ Innovation (4 Case Studies) &
  ○ Entrepreneurship (8 Case Studies)
• 3 Hours: Faculty Facilitated `Design Thinking' Case Studies	

TOTAL PERIODS	**15**

Course Outcomes	
At the end of the course, the student will be able to	
CO1	Understand basic concepts in the fields of innovation and entrepreneurship
CO2	Understand what a business model is and the process of problem solving.
CO3	Summarize the learning in developing an entrepreneurial idea, formed through innovative practices.
CO4	Model the correct problem solving methodologies with tools and techniques.
CO5	Design innovative solutions for real time problems.

TEXTBOOKS

1 Lorraine Marchand,"The Innovation Mindset: Eight Essential Steps to Transform Any Industry",Columbia Business School Publishing (13 September 2022)

REFERENCES

1. Peter F. Drucker," Innovation and Entrepreneurship" .

2.Martha Corrales-Estrada "Innovation and Entrepreneurship: A New Mindset for Emerging Markets",Emerald Publishing Limited (27 September 2019)

CO/PO, PSO Mapping
(3/2/1 indicates the strength of correlation) 3-Strong 2-Medium, 1-Weak
Program Outcomes (POs) and Program Specific Outcomes PSOs'

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	2	-	1	1	1	-	-	-	2	2	-	1
CO2	2	1	1	-	1	-	1	-	-	-	2	2	2	-	1
CO3	2	1	1	2	-	-	-	1	-	-	-	2	2	-	1
CO4	-	1	1	2	2	-	-	-	-	-	-	2	2	-	1
CO5	-	1	1	2	3	1	-	-	1	1	2	2	2	-	1
AVG	2	1	1	2	2	1	1	1	1	1	2	2	2	-	1

Meenakshi Sundararajan Engineering College

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Department : Mechanical Engineering, R2024, CBCS

U24IP201	BIOLOGY FOR MECHANICAL ENGINEERS	L	T	P	C
		3	0	0	0

Course Objectives	
1	To introduce basic biological concepts and their significance in engineering applications.
2	To explore orthopaedics, biomechanics and the mechanical properties of biological systems.
3	To understand cardiology, biomechanics of heart function and fluid dynamics of blood flow in biological organisms.
4	To study biological sensors, feedback mechanisms, and their engineering applications.
5	To apply biological principles to real-world mechanical engineering challenges through case studies.

UNIT 1 INTRODUCTION TO BIOLOGY FOR ENGINEERS	**5**
Importance of Biology in Engineering -- Biological Structures: Cells, Tissues, and Organs -- Biomaterials: Natural Materials and Their Engineering Applications -- Systems Biology and Mechanical Analogs -- Bio-Inspired Design and Innovation in Engineering	
UNIT 2 ORTHOPAEDICS - BONES AND JOINTS	**5**
Introduction to Orthopaedics and Skeletal Structure - Biomechanics of Bones - Joint Mechanics and Movement - Bone Healing and Repair Mechanisms - Bio-Inspired Engineering Applications	
UNIT 3 CARDIOLOGY - HEART AS A PUMP	**5**
Introduction to Cardiovascular System and Heart Anatomy - Biomechanics of Heart Function - Fluid Dynamics of Blood Flow - Heart Valve Mechanics and Function - Bio-Inspired Engineering in Pump Design	
UNIT 4 BIOLOGICAL SENSING AND CONTROL SYSTEMS	**4**
Sensory Systems in Biology: Vision, Hearing, and Touch -- Biological Feedback and Control Mechanisms (e.g., Homeostasis) -- Bio-Inspired Sensors for Engineering Applications -- Neural Networks in Biological Systems and Their Engineering Analogs	
UNIT 5 Case Studies and Real-World Applications	**5**
Biomimicry in Architecture and Structural Design -- Bio-Inspired Robotics: Examples of Soft Robots and Drones -- Biomechanics in Sports Equipment Design -- Medical Devices Inspired by Biological Systems -- Sustainable Engineering Solutions Based on Natural Models	
TOTAL PERIODS	**24**

Course Outcomes	
At the end of the course, the student will be able to	
CO1	Understand and explain the relevance of biology to mechanical engineering.
CO2	Apply orthopaedics, biomechanics and the mechanical properties of biological systems.
CO3	Relate cardiology, biomechanics of heart frunction and fluid dynamics of blood flow in biological organisms.
CO4	Utilize biological inspiration for the design of sensors and control systems.
CO5	Analyze real-world case studies where biology and mechanical engineering intersect.

TEXT BOOKS	
1	Biomimicry: Innovation Inspired by Nature, Janine M. Benyus, Harper Collins, 2009
2	Biomechanics: Mechanical Properties of Living Tissues, Y. C. Fung, Springer New York, 2007

REFERENCES	
1	Biological Physics: Energy, Information, Life, Philip Nelson, Kevin Chen, Sarina Bromberg, Chiliagon Science, 2020
2	Introduction to Bioengineering - Volume 2 of Advanced series in biomechanics, Yuan-cheng Fung, Shu Chien, World Scientific, 2001
3	Nature's Machines: An Introduction to Organismal Biomechanics, David E. Alexander, Academic Press, 2017

Meenakshi Sundararajan Engineering College

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Department : Mechanical Engineering, R2024, CBCS

CO/PO, PSO Mapping

(3/2/1 indicates the strength of correlation) 3-Strong 2-Medium, 1-Weak

Program Outcomes (POs) and Program Specific Outcomes PSOs'

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	-	-	1	-	-	-	-	-	-	1	-	1
CO2	2	2	1	-	-	1	-	-	-	-	-	-	2	-	1
CO3	2	2	1	-	-	1	-	-	-	-	-	-	2	-	1
CO4	2	2	1	-	-	1	-	-	-	-	-	-	2	-	1
CO5	2	2	2	-	-	1	-	-	-	-	-	-	2	-	1
AVG	1.8	1.8	1.2	-	-	1	-	-	-	-	-	-	1.8	-	1

Meenakshi Sundararajan Engineering College

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Department : Mechanical Engineering, R2024, CBCS

U24EN201	PROFESSIONAL ENGLISH	L	T	P	C
		2	0	0	2

Course Objectives

1	To engage learners in meaningful language activities to improve their reading and writing skills.
2	To enhance learners' vocabulary with a focus on technical terms and enabling them to communicate more effectively in both technical and professional contexts.
3	To master key grammar concepts and apply those concepts to produce clear and correct written communication
4	To help learners understand the purpose, audience, contexts of different types of writing.
5	To demonstrate an understanding of job applications and interviews for internship and placements.

UNIT 1 APPLIED LANGUAGE SKILLS	**6**
Reading: Reading user manuals, brochures, posters, pamphlets **Writing:** Review Writing (Book Review and Movie Review) **Grammar:** Tenses, Prepositional phrases **Vocabulary Development:** Technical vocabulary (synonyms and antonyms)	
UNIT 2 PRACTICAL WRITING AND GRAMMAR SKILLS	**6**
Reading: Reading longer technical texts **Writing:** Writing response to a complaint letter **Grammar:** Active and passive voice, Infinitives and Gerunds **Vocabulary Development:** Sequence words, Misspelled words	
UNIT 3 PROFESSIONAL WRITING AND ANALYTICAL READING	**6**
Reading: Case Studies, Excerpts from literary texts, news reports etc. **Writing:** Letter to the Editor, Checklists **Grammar:** If Conditionals, Articles **Vocabulary Development:** Collocation, Cause and effect expression	
UNIT4 DEVELOPING WRITING AND LANGUAGE SKILLS	**6**
Reading: Reading for detailed comprehension, newspaper articles **Writing:** Essay writing **Grammar:** Reported speech, Modals **Vocabulary Development:** Conjunctions	
UNIT 5 LANGUAGE SKILLS FOR CAREER SUCCESS	**6**
Reading: Company profiles, Statement of purpose, an excerpt of interview with professionals **Writing:** Job / Internship application – Cover letter & Resume **Grammar:** Relative Clauses, Numerical adjectives **Vocabulary Development:** Single sentence definition	
TOTAL PERIODS	**30**

Course Outcomes

At the end of the course, the student will be able to

CO1	Read and comprehend various forms of technical and informational texts and extract the necessary information for application or analysis.
CO2	Improve vocabulary to articulate ideas clearly and effectively in professional and academic contexts.
CO3	Use grammar accurately in written communication.
CO4	Demonstrate proficiency in writing clear, structured responses, reviews, essays, and professional documents using appropriate tone, format, and language.
CO5	Create professional documents as well as communicate effectively in professional scenarios, ensuring success in job and internship applications.

TEXT BOOKS
English for Engineers & Technologists Orient Black Swan Private Ltd. Department of English, Anna University, (2020 edition)
English for Science & Technology Cambridge University Press, 2021.
English for Science & Technology Cambridge University Press, 2021. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.
REFERENCES
1. Raman. Meenakshi, Sharma. Sangeeta (2019). Professional English. Oxford university press. New Delhi.
2. Improve Your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, New Delhi
3. Learning to Communicate – Dr. V. Chellammal. Allied Publishers, New Delhi, 2003
4. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
5. Developing Communication Skills by Krishna Mohan, Meera Bannerji- Macmillan India Ltd. 1990, Delhi.

CO-PO, PSO Mapping
(3/2/1 indicates the strength of correlation) 3-Strong 2-Medium, 1-Weak
Program Outcomes (POs) and Program Specific Outcomes PSOs'

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	3	-	2	2	2	-
CO2	-	-	-	-	-	-	-	-	-	3	-	2	2	2	-
CO3	-	-	-	-	-	-	-	-	-	3	-	2	2	2	-
CO4	-	-	-	-	-	-	-	-	-	3	-	2	2	2	-
CO5	-	-	-	-	-	-	-	-	-	3	-	2	2	2	-
AVG	-	-	-	-	-	-	-	-	-	3	-	2	2	2	-

Meenakshi Sundararajan Engineering College

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Department : Mechanical Engineering, R2024, CBCS

U24MA205	FOURIER SERIES, COMPLEX ANALYSIS AND CALCULUS	L	T	P	C
		3	1	0	4

Course Objectives	
1	To introduce Fourier series analysis this is vital to many applications in engineering apart from its use in solving boundary value problems.
2	To Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.
3	To acquaint the knowledge of Analytic functions and conformal mapping.
4	To make the students to understand the methods of complex analysis be used for efficiently solving the problems that occur in various branches of engineering disciplines.
5	To familiarize the students with Gradient, divergence and curl of a vector point function and related identities

UNIT 1 FOURIER SERIES	**9+3**
Dirichlet's conditions – General Fourier series – Half range series – Complex form of Fourier series – Parseval's identity – Harmonic analysis.	
UNIT 2 APPLICATION OF PARTIAL DIFFERENTIAL EQUATION	**9+3**
Classification of Partial Differential Equations - Fourier series solutions of one dimensional wave equation - One dimensional heat equation - Steady state solution of two dimensional heat equation (Insulated edges excluded).	
UNIT 3 ANALYTIC FUNCTIONS	**9+3**
Analytic functions - Necessary and Sufficient conditions (excluding proofs) - Harmonic and orthogonal properties of analytic functions - Harmonic conjugate - Construction of analytic functions - Conformal mapping: w= z+c, cz, 1/z and bilinear transformation.	
UNIT 4 COMPLEX FUNCTION	**9+3**
Line integral - Cauchy's integral theorem - Cauchy's integral formula - Taylor's and Laurent's series - Singularities - Residues - Residue theorem - Application of residue theorem for evaluation of real integrals - Applications of circular contour and semicircular contour (with poles NOT on real axis).	
UNIT 5 VECTOR CALCULUS	**9+3**
Differentiation of vectors: Gradient, Divergence, Curl and Directional derivatives – Line, Surface and Volume Integrals - Statement of Green's, Gauss divergence and Stokes" theorem - Simple applications involving rectangular parallelepiped and cubes.	
TOTAL PERIODS	**60**

Course Outcomes	
At the end of the course, the student will be able to	
CO1	Evaluate Fourier series of periodic Functions
CO2	Apply the method of separation of variables to find the solution of heat and wave equations
CO3	Identify and construct analytic function and application of conformal mapping.
CO4	Apply complex integration to evaluate contour integrals.
CO5	Estimate vector identities and interpret some integral theorems in a vector field

TEXT BOOKS

1. Grewal.B.S. Higher Engineering Mathematics, 45th Edition, Khanna Publications, Delhi, 2020.

2. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley India, 2017.

3.Won Y.Yang,Young K.Choi,Jaekwon Kim,Man Cheol Kim, H.Jin Kim,Taeho lm, ""Engineering Mathematics with MATLAB"" CRC Press Publishers , Ist Edition , 2017

REFERENCES

1. Bali.N.P. and Manish Goyal, A Textbook of Engineering Mathematics, 10th Edition, Laxmi Publications Private Limited, 2018.

2. Jain.R.K. and Iyengar.S.R.K., Advanced Engineering Mathematics, 5th Edition, Narosa Publishing House Private Limited, 2016

3. Ramana B.V, Higher Engineering Mathematics, Tata Mc-Graw Hill Publishing Company, New Delhi, 2017.

4. Michael D .Greenberg, Advanced Engineering Mathematics, 2nd Edition, Pearson Education, 2021.

CO/PO, PSO Mapping
(3/2/1 indicates the strength of correlation) 3-Strong 2-Medium, 1-Weak
Program Outcomes (POs) and Program Specific Outcomes PSOs'

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	-	-	-	-	-	-	-	-	1	-	-
CO2	3	3	2	1	-	-	-	-	-	-	-	-	1	-	-
CO3	3	3	2	1	-	-	-	-	-	-	-	-	1	-	-
CO4	3	2	2	1	-	-	-	-	-	-	-	-	1	-	-
CO5	3	2	2	1	-	-	-	-	-	-	-	-	1	-	-
AVG	3	2	2	1	-	-	-	-	-	-	-	-	1	-	-

Meenakshi Sundararajan Engineering College

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Department : Mechanical Engineering, R2024, CBCS

U24PH205	PHYSICS FOR MECHANICAL ENGINEERING II	L	T	P	C
		3	0	0	3

Course Objectives	
1	Instill knowledge about the laws of gravity and gravitational force, as described by Isaac Newton's law of universal gravitation.
2	Provide learners with a comprehensive understanding of statics, including equilibrium, forces, and moments acting on bodies at rest.
3	Introduce learners to the concept of rigid bodies and their mechanical properties, such as mass distribution, center of gravity, and moments of inertia
4	Provide learners with insights into the fundamental laws governing linear motion, including Newton's laws of motion.
5	Enable learners to identify and apply the mechanical properties of materials relevant to their field or domain.

UNIT 1 GRAVITATION	**9**
Newton’s law of gravitation – Mass and density of earth – Acceleration due to gravity – Variation of g with altitude, depth and rotation of earth - Value of g at poles and equator. Gravitational field – Gravitational potential – Gravitational potential due to spherical shell	
UNIT 2 DYNAMICS OF SYSTEM OF PARTICLES	**9**
Multiparticle dynamics: Center of mass (CM) – CM of continuous bodies – motion of the CM - linear momentum of the system– law of conservation of linear momentum –Collision – Elastic and in elastic collision-kinetic energy of system of particles. Newton’s second law,-d'Alembert's principle.	
UNIT3 KINETICS OF RIGID BODY	**9**
Dynamics of rigid body - Centre of gravity-Moment of inertia – Theorems of perpendicular and parallel axes , MI of flywheel, angular velocity, angular momentum and K.E of rotation – – rotational dynamics of rigid bodies – conservation of angular momentum – rotational energy state of a rigid diatomic .Torque and angular acceleration – Relation between them – Expression for a acceleration of a body rolling down an inclined body without slipping.	
UNIT4 LAWS OF LINEAR MOTION	**9**
Newton’s laws of motion – Force, Forces in 1d,2d- Impulse of a force - – (Fundamental laws of impact) – Newton’s law of impact – coefficient of restitution – Impact of a smooth sphere on a fixed plane – Direct impact between two smooth spheres – Oblique impact between two smooth spheres – Calculation of final velocities of the spheres – Loss of K.E due to impact.	
UNIT 5 MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS	**9**
Mechanisms of plastic deformation, slip and twinning – Types of fracture – Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell), hardness tests, Impact test izod and charpy, fatigue and creep failure mechanisms-application(impact test)	

Course Outcomes	
At the end of the course, the student will be able to	
CO1	Gain insights into gravitational fields and their applications in engineering problems
CO2	Gain a foundational understanding of static forces, including concepts such as Newton's laws of motion, equilibrium, and the calculation of forces acting on stationary objects.
CO3	Learn to calculate and analyze dynamic forces exerted on rigid bodies in motion.
CO4	Acquire knowledge on the principles governing motion and the forces acting on bodies, including concepts such as velocity, acceleration, and the laws of motion.
CO5	Gain insight into the elastic properties of materials, including elasticity, stiffness, and resilience.

TEXT BOOKS
1. Mechanics: D.S. Mathur S. Chand & Co, Edition 2020
2. Elements of properties of matter – D.S. Mathur – S. Chand & Co., 2008
3.Engineering mechanics : Shankara Subramanian G and Rajasekaran S
4. Properties of matter – R. Murugesan – S. Chand & Co., 2004.
REFERENCES
1. Fundamental of Physics, D. Hallidary , Resnick and J Walker, 6th Edition, Wiley, New York 2001
2. Properties of matter – Brijlal and Subramanian S. Chand & Co., 2006.
3. Physiscs – Volume 1 & 2, Paul A. Tipler CBS, (Indian Edition), 2004
4.Mechanics Part I and Part II, Narayanamoorthy National Publishing Company, 2001

CO/PO, PSO Mapping
(3/2/1 indicates the strength of correlation) 3-Strong 2-Medium, 1-Weak
Program Outcomes (POs) and Program Specific Outcomes PSOs'

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	-	-	-	-	-	-	1	2	-	
CO2	3	2	2	-	-	-	-	-	-	-	-	1	2	-	
CO3	3	2	2	-	-	-	-	-	-	-	-	1	2	-	
CO4	3	2	2	-	-	-	-	-	-	-	-	1	2	-	
CO5	3	2	2	-	-	-	-	-	-	-	-	1	2	-	
AVG	3	2	2	-	-	-	-	-	-	-	-	1	2	-	

Meenakshi Sundararajan Engineering College

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Department : Mechanical Engineering, R2024, CBCS

U24CY201	GREEN AND SUSTAINABLE CHEMISTRY	L	T	P	C
		2	0	0	2

Course Objectives

1	To give the basic knowledge on role of chemistry to mitigate environmental and global challenges.
2	To understand the global climatic change and the necessity for the preservation of ecosystem.
3	To become familiar with the safe design of synthesis and to minimize the generation of hazardous substances.
4	To understand the need of various energy resources for sustainable development.
5	To integrate the chemistry with environment, technology and public health.

UNIT 1 ROLE OF CHEMISTRY - CURRENT CHALLENGES FOR SUSTAINABLE DEVELOPMENT	**6**
Role of chemistry in addressing the challenges for sustainable development and solving global issues. Nexus among biosphere environment, human and animal health. Introduction to bio-diversity-threats and conservation of bio-diversity. Millenium development goals (MDG) and sustainable development goals(SDG),clean development mechanism(CDM).	
UNIT 2 SUSTAINABLE ENVIRONMENTAL CHEMISTRY	**6**
Climate change – greenhouse effect - gobal warming - sea level rise - intrusion and inundation, ozone layer depletion, Elnino and LaNina – carbon credits, carbon trading, carbon foot print, legal provision for environmental protection, coastal zone management-soft and hard measures, Ecosystem – estuaries - corals, mangroves, wetlands, sand dunes etc.	
UNIT 3 PRINCIPLES OF SUSTAINABLE GREEN CHEMISTRY	**6**
Sources, reactions and effect of chemicals in environments – Factory effluent and treatment, Handling of Hazards-Design of green pesticides for agriculture.- Introduction to Biocides: types and applications, Organic Insecticides – Carbamates, Chlorinated hydrocarbons, cypermithrin, Pyrethrin,silica gel,rotenone- synthesis properties and practical applications. -reduction of toxicity, improved recycling and improved product performance.	
UNIT 4 SUSTAINABLE ENERGY	**6**
Present energy challenges and the possible energy solutions - Solar energy- Solar Panel-Solar water heater-solar heat collector and applications- Wind energy- Types – production - advantages and disadvantages-applications. Nuclear energy – production - advantages and disadvantages- applications. Geothermal energy – Production and applications – Bio fuels.	
UNIT 5 GOOD HEALTH AND WELL BEING -WATER-SOIL-AIR	**6**
Ground water contamination and contamination of water bodies. The role of chemistry in developing appropriate technological solutions for water treatment using Electrodialysis, Forward osmosis and advanced oxidation using photocatalysis and waste water treatment. Reclamation of soil. Current air pollution situation and trends. Factors responsible for air pollution. Air pollution assessment, monitoring and mitigation.	
TOTAL PERIODS	**30**

Course Outcomes	
At the end of the course, the student will be able to	
CO1	Understand the ability to face the current challenges across globe with the aid of chemistry.
CO2	Identify the climatic challenges and to contribute for sustainable transformation.
CO3	Understand the safe design of products with the principles of green chemistry.
CO4	Understand to analyze the energy challenges for sustainable resource management.
CO5	Integrate chemistry with environmental science and public health.

TEXT BOOKS

1.Anubha Kaushik and C.P.Kaushik's "Perspectives in Environmental Studies",6thEdition,NewAge International Publishers ,2018.

2.BennyJoseph,'Environmental Science and Engineering',TataMcGraw-Hill,NewDelhi,2016.

3.Gilbert M.Masters,'Introduction to Environmental Engineering and Science',2nd edition,Pearson Education, 2004.

4.Allen,D.T.andShonnard,D.R.,SustainabilityEngineering:Concepts,DesignandCaseStudies, Prentice Hall.

5.Bradley.A.S;Adebayo,A.O.,Maria,P.Engineering applications in sustainable design and development, Cengage learning.

6.Environment Impact Assessment Guidelines,Notification of Government of India,2006.

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1.M.Karpagam,Geetha Jaikumar,"Green Management Theory and Applications",ANE Publishers,First Edition,2010.

2.Matlack,A.S.Introduction to green chemistry,Marcel Dekker:Newyork,2001.

3.Anastas,P.T:Warner,J.C.Green chemistry:Theory and practice,Oxford univ press:oxford,1998.

4.Fankte,peter,et al."Exposure and toxicity characterization of chemical emissions and chemical in products:Global recommendations and implementation in USEtox"The international journal of life cycle assessment,26.5(2021):899-915.

5.Rajagopalan,R,'EnvironmentalStudies-FromCrisistoCure',Oxford University Press,2005.

6.ErachBharucha"Textbook of Environmental Studies for Undergraduate Courses"Orient BlackswanPvt. Ltd. 2013.

CO/PO, PSO Mapping

(3/2/1 indicates the strength of correlation) 3-Strong 2-Medium, 1-Weak
Programme Outcomes (POs) and Programme Specific Outcomes PSOs'

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	1	-	1	1	2	2	1	2	-	3	-	-	-
CO2	3	1	1	-	1	1	3	1	2	2	-	2	-	-	-
CO3	3	1	1	-	1	1	2	1	2	2	-	2	-	-	-
CO4	3	-	1	-	2	2	3	2	2	2	-	3	-	-	-
CO5	3	1	1	-	2	2	3	2	1	2	-	3	-	-	-
AVG	3	1	1	-	1.4	1.4	2.6	1.6	1.6	2	-	2.6	-	-	-

Meenakshi Sundararajan Engineering College

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Department : Mechanical Engineering, R2024, CBCS

U24TA201	தமிழரும் தொழில்நுட்பமும் /TAMILS AND TECHNOLOGY	L	T	P	C
		1	0	0	1

அலகு I நெசவு மற்றும் பானைத் தொழில்நுட்பம்: **UNIT I WEAVING AND CERAMIC TECHNOLOGY**	**3**
சங்க காலத்தில் நெசவுத் தொழில் - பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் - பாண்டங்களில் கீறல் குறியிடுகள் Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.	
அலகு II வடிவமைப்பு மற்றும் கட்டிடக் தொழில்நுட்பம்: **UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY**	**3**
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 பெருங்கோவில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் - நாயக்கர் கால கோவில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாடு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சரோசெனிக் கட்டிடக் கலை Designing and Structural construction House & Designs in household materials during 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.	
அலகு III உற்பத்தித் தொழில் நுட்பம் : **UNIT III MANUFACTURING TECHNOLOGY**	**3**
கப்பல் கட்டும் கலை - உலோகவியல் - இரும்புத் தொழிற்ச்சாலை - இரும்பை உருகுக்குதல், 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 Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold- Coins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.	
அலகு IV வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்: **UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY**	**3**
அணை, ஏரி, குளங்கள், மதகு - சோழர்காலக் குமிழித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம் 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.	

அலகு V அறிவியல் தமிழ் மற்றும் கணித்தமிழ் : **UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING**	**3**
அறிவியல் தமிழின் வளர்ச்சி - கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இனையக் கல்விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம் Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.	
TOTAL PERIODS	**15**

TEXT BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே. கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் 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 C ivilization on the banks of river Vaigai' (Jointly Published by:Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)

10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)

11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Meenakshi Sundararajan Engineering College

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U24CS201	PYTHON PROGRAMMING	L	T	P	C
		3	-	3	4.5

Course Objectives

1	To understand the basics of python programming .
2	To define Python functions and strings.
3	To use Python data structures - lists, tuples, dictionaries to represent complex data.
4	To perform file operations in Python.
5	To learn & use python libraries.

UNIT 1 INTRODUCTION TO PYTHON — **9 + 9**

Python interpreter and interactive mode, debugging; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: circulate the values of n variables, distance between two points.

Practicals:

1.Implement a python program to print an Electricity Bill .(for domestic usage.)

2.Implement a Python program to exchange the values of two variables. (using simple statements and expressions)

UNIT 2 CONTROL FLOW, FUNCTIONS, STRINGS — **9 + 9**

Conditionals: Boolean values and operators, conditional (if), alternative (if-else),chained conditional (if-elif-else);Iteration: state, while,for, break, continue, pass; Fruitful functions, return values, parameters, local and global scope, function composition,Lambda functions, recursion; Strings: string slices, immutability, string functions and methods, string module; Illustrative programs: square root, sum of individual digits of a number.

Practicals:

1.Implement a Python program to print a Number series & Number Patterns.(using Iterative loops).

2.Implement a Python program to find Factorial and largest number in a list(using Functions.).

3.Implement a Python program to perform operations on strings like string reverse,string concatenation & substring .(use switch case).

UNIT 3 - LISTS, TUPLES, DICTIONARIES — **9 + 9**

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs:Students marks statement,Linear Search, Binary Search.

Practicals:

1.Implement a Python program using Lists & Tuples. (operations of list & tuples - Book Catalogue)

2.Implement a Python program using Sets, Dictionaries. (operations of Sets - Product Categories , operations on Dictionaries - Product Categories)

UNIT 4 FILES, EXCEPTIONS AND MODULES — **9 + 9**

Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages, Python Itertools & functools modules, Illustrative programs: Marks range validation.

Practicals:

1.Implement a Python program to perform file operations (copy from one file to another, word count, longest word).

2.Implement a Python program to handle Exceptions.(voter's age validity).

UNIT 5 LIBRARIES,PACKAGES — **9 + 9**

Python libraries - NumPy -Array manipulations, numeric ranges, Slicing, indexing, Searching, Sorting, and splitting, Pandas - Data Analysis, Data-frame, Data selection, group-by, Series, sorting, searching, and statistics, dask (pandas wrapper) ,Matplotlib- Data visualization , Line plot, Style properties, multi line plot, scatter plot

Practicals:

1.Implement a Python program to create a weather data chart using Python Standard Libraries (pandas, numpy. Matplotlib, scipy) .

TOTAL PERIODS — **90**

Meenakshi Sundararajan Engineering College

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Department : Mechanical Engineering, R2024, CBCS

Course Outcomes	
At the end of the course, the student will be able to	
CO1	Develop and execute simple Python programs
CO2	Learn to handle strings and functions in python.
CO3	Represent compound data using Python lists, tuples, dictionaries
CO4	Read and write data from/to files in Python programs.
CO5	Perform basic operations using python Libraries

TEXT BOOKS

1. Allen B. Downey, “Think Python: How to Think like a Computer Scientist”, 2nd Edition, O’Reilly Publishers, 2016.

2.Karl Beecher, “Computational Thinking: A Beginner's Guide to Problem Solving and Programming”, 1st Edition, BCS

REFERENCES

1. Paul Deitel and Harvey Deitel, “Python for Programmers”, Pearson Education, 1st Edition, 2021

2. G Venkatesh and Madhavan Mukund, “Computational Thinking: A Primer for Programmers and Data Scientists”, 1st Edition, Notion

3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling

4.Eric Matthes, “Python Crash Course, A Hands - on Project Based Introduction to Programming”, 2nd Edition, No Starch Press, 2019.

5.Martin C. Brown, “Python: The Complete Reference”, 4th Edition, Mc-Graw Hill, 2018.

CO/PO, PSO Mapping

(3/2/1 indicates the strength of correlation) 3-Strong 2-Medium, 1-Weak

Programme Outcomes (POs) and Programme Specific Outcomes PSOs'

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	-	-	-	-	-	-	-	-	-	-	2	-	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-	2	-	-	-
CO3	2	-	2	2	-	-	-	-	-	-	-	2	-	-	-
CO4	2	3	2	2	-	-	-	-	2	1	1	2	-	-	-
CO5	2	3	2	2	2	1	1	1	2	1	1	2	-	-	-
AVG	2	3	2	2	2	1	1	1	2	1	1	2	-	-	-

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U24CE205	ENGINEERING GRAPHICS FOR MECHANICAL ENGINEERING	L	T	P	C
		3	0	2	4

Course Objectives

CO1	To learn the construction of engineering curves and projection techniques for constructing conic curves, points, and lines.
CO2	To understand the techniques for projecting and visualizing surfaces and solids in various orientations.
CO3	To determine the true shape of sectioned solids and develop their lateral surfaces.
CO4	To develop skills in 3D projection and perspective projection techniques for simple solids.
CO5	To explore advanced 3D modeling techniques in Autodesk Fusion 360 for complex models and manufacturing applications.

UNIT 1 PLANE CURVES, PROJECTION OF POINTS AND LINES	**6 + 9**
Basic Geometrical constructions, Curves used in engineering practices: Conics — Construction of ellipse, parabola and hyperbola by eccentricity method. Orthographic projection- principles-Principal planes-First angle projection-projection of points and straight lines inclined to both the principal planes.	
UNIT 2 PLANE SURFACE AND PROJECTION OF SOLIDS	**6 + 9**
Projection of planes inclined to both the principal planes -. Projection of simple solids like prisms, pyramids, cylinder, and cone. When the axis is inclined to one of the principal planes and parallel to the other by rotating object method.	
UNIT 3 PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF LATERAL SURFACES	**6 + 9**
Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other —obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids — Prisms, pyramids cylinders and cones.	
UNIT 4 ISOMETRIC AND PERSPECTIVE PROJECTION	**6 + 9**
Principles of isometric projection — isometric scale — isometric projections of simple solids - Freehand sketching of multiple views from pictorial views of objects. Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.	
UNIT 5 FUNDAMENTALS OF ADVANCED 3D MODELING TECHNIQUES	**6 + 9**
Fundamentals of advanced modeling techniques in 3D Modeling Software (Autodesk® Fusion 360®) - Basics of creating complex 3D models using multiple tools and techniques - Applications of advanced 3D modeling techniques in various industries - Exporting 3D models for prototyping and manufacturing.	
TOTAL PERIODS	**75**

Course Outcomes

At the end of the course, the student will be able to

CO1	Understand various concepts like dimensioning, conventions and standards related to Engineering Drawing to construct Conic curves, Projection of Points & straight lines.
CO2	Impart knowledge on the projection of plane surfaces and Rolling solids.
CO3	Improve the visualization skills for better understanding of Section of solids and Developments of surfaces
CO4	Develop the imaginative skills of the students required to understand Isometric projection of & Orthographics projections-Freehand sketching
CO5	Explore advanced 3D modeling techniques in Autodesk Fusion 360 for complex models and manufacturing applications.

TEXT BOOKS
Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House,53 Edition, 2019.
Natrajan K.V., “A Text Book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2018.
Parthasarathy, N. S. and Vela Murali, “Engineering Drawing”, Oxford University Press, 2015
Autodesk Fusion 360: A Power Guide for Beginners and Intermediate Users by John Willis, Sandeep Dogra, and Cadartifex, 4e, CADArtifex
REFERENCES
Basant Agarwal and Agarwal C.M., “Engineering Drawing”, McGraw Hill, 2nd Edition, 2019.
Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Publications, Bangalore, 27th Edition, 2017.
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.
Parthasarathy N. S. and Vela Murali, “Engineering Graphics”, Oxford University, Press, New Delhi, 2015.
Shah M.B. and Rana B.C., “Engineering Drawing”, Pearson Education India, 2nd Edition, 2009.
Venugopal K. and Prabhu Raja V., “Engineering Graphics", New Age International (P) Ltd, 2008.
Autodesk Fusion 360 For Beginners: Part Modeling, Assemblies, and Drawings – Tutorial Book

CO-PO, PSO Mapping
(3/2/1 indicates the strength of correlation) 3-Strong 2-Medium, 1-Weak
Program Outcomes (POs) and Program Specific Outcomes PSOs'

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
CO2	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
CO3	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
CO4	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
CO5	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
AVG	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-

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Department : Mechanical Engineering, R2024, CBCS

U24ME101	ENGINEERING PRACTICES LABORATORY	L	T	P	C
		0	0	4	2
Course Objectives					
The main learning objective of this course is to provide hands on training to the students in:					
1	Draw pipe line plan; layout and connect various pipe fittings used in common household plumbing work				
2	To make wood joints commonly used in household wood.				
3	To make various electrical connections in typical household electrical wiring installations.				
4	Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipment; Make a tray out of metal sheet using sheet metal work.				
5	Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.				
PART I CIVIL ENGINEERING PRACTICES					
PLUMBING WORK					
	Theory				
1	Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in households.				
2	Connecting pipes of different materials: Metal, plastic and flexible pipes				
	Experiment				
1	Preparing plumbing line sketches.				
2	Laying pipe connection to the suction side of a pump				
3	Laying pipe connection to the delivery side of a pump.				
	Demo				
1	**In-Campus -** - Water supply lines (RO plant) - Drainage systems - Water Harvesting				
	Self-Study				
1	Household Appliances.- pipes of different materials: Metal, plastic and flexible pipes are utilized in various applications, such as: - Water supply lines - Drainage systems - Gas lines(if any) - Heating and cooling systems - Solar water heating (if any) - Chimney				
WOOD WORK					
	Theory				
1	Tools used in Carpentry & safety measures.				
2	Studying common industrial trusses - https://www.youtube.com/watch?v=-1w4_4Sr2kg				
	Experiment				
1	Sawing,				
2	Planing and				
3	Making joints like T-Joint Mortise joint and Tenon joint and Dovetail joint.				
	Demo				

1	Studying joints in door panels and wooden furniture
2	Study of truss in workshop
	Self-study
1	In house- Types of joints used in window, door, chair, table, specific type of furniture or fixture
ELECTRICAL ENGINEERING PRACTICES 15	
	Theory
1	Electrical Installation tools, equipment & safety measures.
2	Introduction and application of switches, fuses, boards, indicators and lamps - Basic switch board wiring with lamp, fan and three pin socket
	Demo
1	Hands-on session of basic electrical connections for Fuses, Miniature Circuit Breakers and Distribution Box,
2	Electrical wiring system from the Electricity Board (EB) to a classroom on a campus
3	Earth Pit & its maintenance in campus
4	Hands-on session of electrical connections for Motors & Uninterruptible Power Supply.
5	Bringing Renewable Energy to the Classroom: A Solar Smart Grid Demonstration
	Experiment
1	Fluorescent Lamp wiring with introduction to CFL and LED types.
2	Energy meter wiring and related calculations/ calibration
3	Iron Box wiring and assembly
4	Fan Regulator (Resistor type and Electronic type using Diac/Triac/quadrac)
5	emergency lamp wiring/Water heater
	Self-Study
1	House - electrical wiring system from the Electricity Board (EB) to a dining Room
2	Building (Common area)- electrical wiring system from the Electricity Board (EB) to a staircase of the building & water pump
3	Types of fuse / MDB/ MCB/RCD/CU/Switchboard
4	Earth Pit at house
MECHANICAL ENGINEERING PRACTICES	
	Theory
1	Tools and its handling techniques & safety measures.
2	Welding Procedure, Selection & Safety Measures.
3	types of Welding joints Butt Joints, Lap Joints, and Tee Joints
4	Basic of foundry operations- Various types of casting processes Types of patterns used in casting processes Types of moulding sand and materials used for pattern making
5	Making of a cone using sheet metal
	Demo
1	Demonstrating basic foundry operations.- Mold Cavity, Air Vents, Liquid Passages Gates, Runners, Sprues
2	Demonstrating components made out of casting at workshop
3	Demonstration of shaft in gearbox of lathe machine
4	Demonstration of screws RH, LH (Turning, Facing and Thread)
5	Demonstration of Bolted joint

6	Demonstration of sheet metal fabricated components
7	Making of a cone using sheet metal
	Experiment
1	Dis-assembly and assembly of a centrifugal pump.
2	Dis-assembly and assembly of a household mixer /Grinder Mixer
3	Dis-assembly and assembly of an air conditioner.
4	Dis-assembly and assembly of a Ceiling Fan/Table Fan
5	Simple Turning using Lathe machine
6	Drilling & Tapping in Plate (Simple Bolted joint)
7	Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
8	Making of a square tray
1 2 3 4	**Self-Study** List examples of sheet metal fabricated component used in house Application of shaft List examples of welded components commonly used in a house List components made by foundry - casting process
ELECTRONIC ENGINEERING PRACTICES 15	
	Theory
1	Electronic components, equipment & safety measures.
2	Soldering simple electronic circuits and checking continuity.
	Demo
1	Study an elements of smart phone
2	Assembly and dismantle of LED TV
	Experiment
1	Soldering simple electronic circuits and checking continuity.
2	Hands-on session of Soldering Practices in a Printed Circuit Breaker.
3	Assembling and testing electronic components on a small PCB
4	Assembly and dismantle of computer/ laptop
5	Hands-on session of integration of sensors and actuators with a Microcontroller.
6	Hands-on session of Bridge Rectifier, Op-Amp and Trans impedance amplifier.
	Self-Study (mini Project)
1	Sensor-based projects: Create projects using sensors like temperature, humidity, or motion sensors
2	Automatic Fan Controller: Create a system that turns on a fan when the temperature exceeds a certain limit
3	Automatic Night Light: Design a circuit that turns on an LED light when it gets dark.
4	Water Level Indicator
5	Door Alarm: Create a simple alarm system that triggers when a refrigerator door is open for a more than a one minute

Meenakshi Sundararajan Engineering College

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Department : Mechanical Engineering, R2024, CBCS

Upon completion of this course, the students will be able to:															
CO1	To practice and experience the plumbing work														
CO2	To gain practical experience in carpentry by crafting a variety of joints.														
CO3	To acquire knowledge in the methodology and techniques of wiring for electrical connections.														
CO4	To gain knowledge in welding, sheet metal fabrication, and lathe operations.														
CO5	To learn about electronic components, equipment, and their functions—such as resistors, color coding, measuring AC signal parameters, gates, circuits, and more.														
	CO-PO, PSO Mapping (3/2/1 indicates the strength of correlation) 3-Strong 2-Medium, 1-Weak Program Outcomes (POs) and Program Specific Outcomes PSOs'														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
CO2	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
CO3	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
CO4	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
CO5	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
AVG	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1

Meenakshi Sundararajan Engineering College

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Department : Mechanical Engineering, R2024, CBCS

U24TP210	COMMUNICATION SKILLS LAB II	L	T	P	C
		0	0	2	1
Course Objectives					
1	To enhance their ability to understand spoken English in various contexts and take part in effective discussions in a professional context.				
2	To enhance speaking and presentation skills				
3	To identify varied group discussion skills and apply them to take part in effective discussions in a professional context.				
4	To develop students' critical thinking skills				
5	To prepare for real-life communication situations and workplace discussions through the practice of mock interviews.				
UNIT I					**6**
Listening: Listening to voicemail & messages, Audio texts, for writing short answers **Speaking:** Conversation between the interlocutor and each candidate					
UNIT II					**6**
Listening: Listening to podcasts, anecdotes and identifying topics, context etc.. **Speaking:** Presentation on any given topic (Non - Technical)					
UNIT III					**6**
Listening: One extended conversation or monologue - interview, discussion, lectures and educational videos **Speaking:** Group Discussion.					
UNIT IV					**6**
Listening: Listening to presentation and 5 min informal talk **Speaking:** Presentation on any given topic (Technical)					
UNIT V					**6**
Listening: Listening to interview skills **Speaking:** Mock interview					
	TOTAL PERIODS				**30**
At the end of the course, the student will be able to					
CO1	Understand accurately and respond to a variety of spoken content to showcase their ability to capture both main ideas and supporting details.				
CO2	Enhance the students to make effective presentations.				
CO3	Speak effectively in group discussions held in a formal/semi-formal context.				
CO4	Ability to interpret different genres of texts, infer implied meanings and evaluate it for ideas as well as for methods of presentation relevant in different situations				
CO5	Motivate and prepare the students to attend job interviews and be successful in their pursuit.				
List of experiments					
1	Conversation				
2	Presentation on any given topic (Non - Technical)				
3	Group Discussion				
4	Presentation on any given topic (Technical)				
5	Mock interview				

ASSESSMENT PATTERN
End Semester speaking & Writing will be conducted in the classroom
TEXT BOOKS
1. Debra Daise, CharlNorloff, and Paul Carne Reading and Writing (Level 4) Oxford University Press: Oxford, 2011
2. Gramer F. Margot and Colin S. Ward Reading and Writing (Level 3) Oxford University Press: Oxford, 2011
REFERENCES
1. E. Suresh Kumar and et al. Enriching Speaking and Writing Skills. Second Edition. Orient Black swan: Hyderabad, 2012
2. Withrow, Jeans and et al. Inspired to Write. Readings and Tasks to develop writing skills. Cambridge University Press: Cambridge, 2004
3. English and Soft Skills, Dr. S.P. Dhanavel, Orient BlackSwan, 2013
4. Butterfield, Jeff Soft Skills for Everyone. Cengage Learning: New Delhi, 2015
5. Interact English Lab Manual for Undergraduate Students,. OrientBalckSwan: Hyderabad, 2016
6 E. Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2015
7. Raman, Meenakshi and Sangeeta Sharma. Professional Communication. Oxford University Press: Oxford, 2014
8. S. Hariharanetal. Soft Skills. MJP Publishers: Chennai, 2010.

CO/PO, PSO Mapping
(3/2/1 indicates the strength of correlation) 3-Strong 2-Medium, 1-Weak
Program Outcomes (POs) and Program Specific Outcomes PSOs'

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	3	-	2	2	2	-
CO2	-	-	-	-	-	-	-	-	-	3	-	2	2	2	-
CO3	-	-	-	-	-	-	-	-	3	3	-	2	2	2	-
CO4	-	-	-	-	-	-	-	-	-	3	-	2	2	2	-
CO5	-	-	-	-	-	-	-	-	-	3	-	2	2	2	-
AVG	-	-	-	-	-	-	-	-	1.8	3	-	2	2	2	-

Meenakshi Sundararajan Engineering College

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Department : Mechanical Engineering, R2024, CBCS

U24ED211	DESIGN THINKING – DECODING INNOVATION OPPORTUNITY	L	T	P	C
		0	0	1	0.5

Course Objectives

1	Understand and apply the five phases of the Stanford Design Thinking Framework (Empathize, Define, Ideate, Prototype, and Test) to identify user needs and create innovative solutions.
2	Gain knowledge of the five stages of the IDEO Design Thinking Framework (Discover, Interpret, Ideate, Experiment, and Evolve) and explore how to iteratively refine solutions through a human-centered approach.
3	Learn the application of Design Thinking tools such as visualization, journey mapping, value chain analysis, brainstorming, and rapid prototyping to generate and refine ideas that meet customer needs.
4	Apply Design Thinking methodologies to identify opportunities for innovation, scope projects, conduct research, generate ideas, and create business case studies and prototypes for real-world problem-solving.
5	Analyze and clarify innovation opportunities by understanding the problem, stakeholders, and solution context through frameworks like Doblin's Ten Types of Innovation and RACI, focusing on the 'Who', 'What', 'How', and 'Why' aspects of problem-solving.

UNIT – 1: STANFORD DESIGN THINKING FRAMEWORK — **3**

- How To `Empathize'?
- How To `Define'
- How To `Ideate'?
- How To `Prototype'?
- How To `Test'?

UNIT – 2: IDEO DESIGN THINKING FRAMEWORK — **3**

- How To `Discover'?
- How To `Interpret'?
- How To `Ideate'?
- How To `Experiment'?
- How To `Evolve'?

UNIT – 3: DESIGN THINKING & DESIGN DOING — **2**

- `What Is'? - Overview About Visualization, Journey Mapping, Value Chain Analysis & Mind Mapping
- `What If'? - Overview About BrainStorming & Concept Development
- `What Wows'? - Overview About Assumption Testing & Rapid Prototyping
- `What Works'? - Overview About Customer Co-Creation & Learning Launch

UNIT – 4: DESIGN THINKING IN PRACTICE – Identify An Opportunity & Becoming Aware Of Next Steps For Innovation – Overview — **2**

- Before You Begin: Identify An Opportunity – Scope Your Project – Draft Your Design Brief – Make Your Plans
- `What Is' Focus: Do Your Research – Identify Insights – Establish Design Criteria
- What If' Focus: BrainStorm Ideas – Develop Concepts – Create Business Case Studies
- `What Wows' Focus: Surface Key Assumptions – Make Prototypes
- `What Works' Focus: Get Feedback From Stakeholders – Run Learning Launches – Design The On-Ramp

UNIT – 5: CLARIFYING PROBLEM STATEMENT & PRIORITIES BY IDENTIFYING & DECODING THE INNOVATION OPPORTUNITY — **5**

- Overview Of Doblin's Ten Types Of Innovation With Brief-Cases Towards Identifying Innovation Opportunity & Clarifying Problem Statement and Priorities
- Opportunity / Problem Clarity About `Who'? (Who're we solving the problem for?)
- Opportunity / Problem Clarity About `What'? (What is the Problem Or EGO – Expectation, Goal & Objective?)
- Opportunity / Problem Clarity About `HOW'? (How's the Overall Problem Solving Approach Help Highlighting RACI – Who's Responsible, Accountable, Consulted & Informed?)
- Opportunity / Problem Clarity About `WHY'? (Why's this Solution or Product or Service or Process beneficial to the stakeholders?)

TOTAL PERIODS	**15**

Course Outcomes

At the end of the course, the student will be able to

CO1	Apply Design Thinking frameworks, tools, and techniques to real-world problems, identifying opportunities for innovation and creating effective solutions.
CO2	Empathize with users, define problems, ideate solutions, prototype, and test, ensuring that solutions meet customer needs and are feasible, viable, and desirable.
CO3	Analyze problems, stakeholders, and solution contexts using frameworks like Doblin's Ten Types of Innovation and RACI, focusing on the 'Who', 'What', 'How', and 'Why' aspects of problem-solving.
CO4	Generate and refine ideas using Design Thinking tools like visualization, journey mapping, value chain analysis, brainstorming, and rapid prototyping, creating innovative solutions that meet customer needs.
CO5	Develop effective problem-solving skills, including the ability to scope projects, conduct research, generate ideas, and create business case studies and prototypes, preparing them to tackle complex real-world problems..

TEXT BOOKS

1	Tim Brown, "Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation", Harper Publications, 2009
2	Don Norman, "The Design of Everyday Things", Basic Books, 2013
3	Tom Kelley, David Kelley, "Creative Confidence: Unleashing the Creative Potential Within Us All", Currency, 2013

REFERENCES

1	Hasso Plattner, Christoph Meinel, Larry Leifer, "Design Thinking: Understand – Improve – Apply (Understanding Innovation)", Springer, 2011
2	Jakob Schneider, Marc Stickdorn, "This Is Service Design Thinking: Basics, Tools, Cases", John Wiley & Sons, 2011
3	Tom Kelley, The Art of Innovation: Lessons in Creativity from IDEO, America's Leading Design Firm, Currency, 2001

CO/PO, PSO Mapping

(3/2/1 indicates the strength of correlation) 3-Strong 2-Medium, 1-Weak
Program Outcomes (POs) and Program Specific Outcomes PSOs'

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	3	1	3	2	1	3	3	3	3	1	-	1
CO2	2	3	3	3	1	3	2	1	3	3	3	3	1	-	1
CO3	2	3	3	3	1	3	2	1	3	3	3	3	1	-	1
CO4	2	3	3	3	1	3	2	1	3	3	3	3	1	-	1
CO5	2	3	3	3	1	3	2	1	3	3	3	3	1	-	1
AVG	2	3	3	3	1	3	2	1	3	3	3	3	1	-	1

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Department : Mechanical Engineering, R2024, CBCS

U24MA305	STATISTICS AND NUMERICAL METHODS MECHANICAL ENGINEERS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES	
1	This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
2	To acquire the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
3	To introduce the basic concepts of solving algebraic and transcendental equations.
4	To introduce the Interpolation operators and numerical techniques of interpolation in various intervals, numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
5	To acquire the knowledge of various techniques and methods of solving ordinary differential equations.

UNIT 1 TESTING OF HYPOTHESIS	9+3
Sampling distributions - Estimation of parameters - Statistical hypothesis - large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) -Goodness of fit.	
UNIT 2 DESIGN OF EXPERIMENTS	**9+3**
One way and two-way classifications - Completely randomized design – Randomized block design –Latin square design - Two Square factorial design.	
UNIT 3 SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS	**9+3**
Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method - Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by Power method. APPLICATION: Linear Algebra in Image Processing.	

UNIT 4 INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION	9+3
Interpolation operators (Forward, Backward, shifting operators and its properties) –– Newton's forward and backward difference interpolation for equal intervals – Lagrange's and Newton's divided difference interpolations for unequal intervals - Approximation of derivates using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules. APPLICATION: Performance Analysis in Distributed Systems.	
UNIT 5 NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS	**9+3**
Single step methods: Taylor's series method - Euler's method - Modified Euler's method – Fourth order Runge-Kutta method for solving first order equations - Multi step methods: Milne's and Adams- Bash forth predictor corrector methods for solving first order equations. APPLICATION: Network Traffic Prediction.	
TOTAL PERIODS	**60**

COURSE OUTCOMES	
At the end of the course, the student will be able to	
CO1	Apply the concept of testing of hypothesis for small and large samples in real life problems

CO2	Apply the basic concepts of classifications of design of experiments in the field of agriculture.
CO3	Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.
CO4	Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
CO5	Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

TEXT BOOKS

1.Grewal. B.S. and Grewal. J.S., “Numerical Methods in Engineering and Science ", 11th Edition, Khanna Publishers, New Delhi, 2015.

2.Johnson, R.A., Miller, I and Freund J., “Miller and Freund’s Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, Jan 2020.

3.Won Y.Yang,Young K.Choi,Jaekwon Kim,Man Cheol Kim, H.Jin Kim,Taeho lm, ""Engineering Mathematics with MATLAB"" CRC Press Publishers , Ist Edition , 2017

REFERENCES

1. Burden, R.L and Faires, J.D, "Numerical Analysis”, 9th Edition, Cengage Learning, 2016.

2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences”, Cengage Learning, New Delhi, 9th Edition, 1st oct 2020.

3. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis” Pearson Education, 7th Edition, Asia, New Delhi, 2009.

4. Sankara Rao. K., "Numerical Methods for Scientists and Engineers", Prentice Hall of India Pvt. Ltd, 4th Edition, New Delhi, 2018.

5. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., “Probability and Statistics for Engineers and scientists” 9th edition, Pearson Education, Asia, 2010.

CO/PO, PSO Mapping

(3/2/1 indicates the strength of correlation) 3-Strong, 2-Medium, 1-Weak
Programme Outcomes (POs) and Programme Specific Outcomes PSOs'

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	-	1	-	-	-	-	-	1	1	1	-
CO2	3	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO3	3	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO4	3	2	2	1	-	-	-	-	-	-	-	-	1	1	-
CO5	3	2	2	1	-	1	-	-	-	-	-	-	1	1	-

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(An Autonomous Institution, Affiliated to Anna University, Chennai)

Department : Mechanical Engineering, R2024, CBCS

U24ME301	ENGINEERING MECHANICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES – To design and develop a functional mechanical system that demonstrates the principles of statics, rigid body analysis, force analysis, friction, and particle dynamics

1	Determining the resultant forces acting on a particle in 2D and 3D and for applying methods of equilibrium on a particle in 2D and 3D.
2	Evaluating the reaction forces for bodies under equilibrium, for determining the moment of a force, moment of a couple, for resolving force into a force-couple system and for analyzing trusses
3	Assessing the centroids of 2D sections / center of gravity of volumes and for calculating area moments of inertia for the sections and mass moment of inertia of solids.
4	Evaluating the frictional forces acting at the contact surfaces of various engineering systems and for applying the work-energy principles on a particle.
5	Determining kinetic and kinematic parameters of the rigid bodies subjected to concurrent coplanar forces.

UNIT 1 STATICS OF PARTICLES — 9

Fundamental Concepts and Principles - Law of Mechanics - Systems of Units - Method of Problem Solutions - Statics of Particles - Forces in a Plane - Resultant of Forces - Resolution of a Force into Components - Lami's Theorem - Rectangular Components of a Force - Unit Vectors - Equilibrium of a Particle - Newton’s First Law of Motion - Space and Free-Body Diagrams - Principle of Transmissibility

UNIT 2 RIGID BODY ANALYSIS — 9

Equivalent Forces - Vector Product of Two Vectors - Moment of a Force about a Point - Varignon’s Theorem - Rectangular Components of the Moment of a Force - Scalar Product of Two Vectors - Mixed Triple Product of Three Vectors - Moment of a Force about an Axis - Couple - Moment of a Couple - Equivalent Couples - Addition of Couples - Resolution of a Given Force into a Force - Couple system - Further Reduction of a System of Forces - Equilibrium in Two Dimensions - Reactions at Supports and Connections.

UNIT 3 ANALYSIS OF FORCES — 9

Centroids - First moment of area - Second moment of area 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 for prismatic, cylindrical and spherical solids from first principle - Relation to area moments of inertia

UNIT 4 FRICTION AND WORK PRINCIPLES — 9

The Laws of Dry Friction - Coefficients of Friction - Angles of Friction - Equilibrium analysis of simple systems with sliding friction - Wedges - Wheel Friction - Rolling Resistance - Ladder friction - Work of a Force - Kinetic Energy of a Particle - Principle of Work and Energy - Principle of Impulse and Momentum - Impact - Method of Virtual Work - Potential Energy - Potential Energy and Equilibrium.

UNIT 5 DYNAMICS OF PARTICLES — 9

Kinematics and kinetics - displacements, velocity and acceleration - Equations of motion - Rectilinear Motion and Curvilinear Motion of Particles - Kinetics - Uniform Acceleration - Varying Acceleration - projectiles - angle of projection - range - time of flight and maximum height - kinematics of rigid bodies - Newton’s Second Law of Motion -Dynamic Equilibrium - Energy and Momentum Methods.

TOTAL PERIODS	**45**

COURSE OUTCOMES	
At the end of the course, the student will be able to	
CO1	To determine the resultant forces acting on a particle in 2D and 3D and to apply methods of equilibrium on a particle in 2D and 3D
CO2	Evaluate the reaction forces for bodies under equilibrium, to determine moment of a force, moment of a couple, to resolve force into a force-couple system and to analyze trusses
CO3	Assess the centroids of 2D sections / center of gravity of volumes and to calculate area moments of inertia for the sections and mass moment of inertia of solids.
CO4	Evaluate the frictional forces acting at the contact surfaces of various engineering systems and apply the work-energy principles on a particle. evaluate the kinetic and kinematic parameters of a particle.
CO5	Determine kinetic and kinematic parameters of the rigid bodies subjected to concurrent coplanar forces.
TEXT BOOKS	
1	Beer, F.P and Johnston Jr. E.R, Cornwell and Sanghi., “Vector Mechanics for Engineers (In SI Units): Statics and Dynamics”, 12th Edition, McGraw-Hill Publishing company, New Delhi (2018).
2	Rajasekaran S and Sankarasubramanian G., “Engineering Mechanics Statics and Dynamics”, 3rd Edition, Vikas Publishing House Pvt. Ltd., 2005
3	Engineering Mechanics, R.S. Khurmi, S.Chand Publishing
4	A Textbook of Engineering Mechanics, R.K. Bansal, Laxmi Publications
5	Engineering Mechanics, D.S. Bedi, Khanna Book Publishing Co. (P) Ltd.
REFERENCES	
1	Meriam J.L. and Kraige L.G., “Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2”, 7th Edition, Wiley India, 2018.
2	Bhavikatti S S, Engineering Mechanics, New Age International Publishers, 2016
3	Vela Murali, “Engineering Mechanics”, Oxford University Press 2010
4	Irving H. Shames, Krishna Mohana Rao G, Engineering Mechanics – Statics and Dynamics, 4th Edition, Pearson Education Asia Pvt. Ltd., 2005.
5	Timoshenko S, Young D H, Rao J V and Sukumar Pati, Engineering Mechanics, 5thEdition, McGraw Hill Higher Education, 2013.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO 2**	**PSO 3**
CO1	3	3	2	3	1	-	-	-	1	-	-	-	2	-	-
CO2	3	3	2	3	1	-	-	-	1	-	-	-	2	-	-
CO3	3	3	2	3	1	-	-	-	1	-	-	-	2	-	-
CO4	3	3	2	3	1	-	-	-	1	-	-	-	2	-	-
CO5	3	3	2	3	1	-	-	-	1	-	-	-	2	-	-
AV G	3	3	2	3	1	-	-	-	1	-	-	-	2	-	-

Meenakshi Sundararajan Engineering College

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Department : Mechanical Engineering, R2024, CBCS

U24ME302	ENGINEERING THERMODYNAMICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES - To provide fundamental understanding of energy in its various forms, principles governing energy transformations, and the laws of thermodynamics, enabling analysis of engineering systems.

1	To enable students to **apply** the basic principles of thermodynamics to engineering systems.
2	To equip students to **analyze** thermodynamic processes using the Second Laws.
3	To train students to **evaluate** performance using concepts of exergy and efficiency.
4	To develop the ability to **analyze** thermodynamic properties of substances.
5	To provide exposure to **evaluate** advanced thermodynamic relations for practical applications.

UNIT 1 FIRST LAW OF THERMODYNAMICS — **9**

Thermodynamic systems, Properties and processes Thermodynamic Equilibrium - Displacement work - P-V diagram. Thermal equilibrium - Zeroth law – Concept of temperature and Temperature Scales. First law – application to closed and open systems – steady and unsteady flow processes.

UNIT 2 SECOND LAW AND CONCEPT OF ENTROPY — **9**

Heat Engine – Refrigerator - Heat pump. Statements of second law and their equivalence & corollaries. Carnot cycle - Reversed Carnot cycle - Performance - Clausius inequality. Concept of entropy - T-s diagram - Tds Equations - Entropy change for a pure substance, Principle of increase in entropy.

UNIT 3 EXERGY ANALYSIS — **9**

High and low grade energy, Exergy and Anergy, Availability and Irreversibility for open and closed system processes - I and II law Efficiency, Applications of II Law.

UNIT 4 PROPERTIES OF PURE SUBSTANCES, Ideal AND REAL GASES — **9**

Steam - formation and its thermodynamic properties - p-v, p-T, T-v, T-s, h-s diagrams. PVT surface. Determination of dryness fraction of wet and very wet steam. Calculation of work done and heat transfer in non-flow and flow processes using Steam Table and Mollier Chart.

Properties of Ideal gas, real gas - comparison. Equations of state for ideal gas. Real Gas, Vander Waal's relation - Reduced properties - Compressibility factor - Principle of Corresponding states - Generalized Compressibility Chart.

UNIT 5 GAS MIXTURES AND THERMODYNAMIC RELATIONS — **9**

Gas mixtures, Maxwell relations - Tds Equations - heat capacities relations - Energy equation, Joule-Thomson experiment - Clausius- Clapeyron equation.

TOTAL PERIODS — **45**

COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Apply fundamental thermodynamic principles to engineering systems.
CO2	Analyze systems using the First and Second Laws of Thermodynamics to assess energy interactions.
CO3	Evaluate the exergy and energy efficiency of thermodynamic systems.
CO4	Analyze the properties of pure substances and gases using property tables and diagrams.
CO5	Evaluate advanced thermodynamic relations and their applications in real-world systems.

TEXT BOOKS

1	Y. Cengel and Boles, Thermodynamics - An Engineering Approach, Tata McGraw Hill Publishing Company Pvt. Ltd, New Delhi, 2019.

2	P.K. Nag, Engineering Thermodynamics, Tata McGraw Hill Publishing Company Pvt. Ltd, New Delhi, 2018.
3	J.P.Holman, Thermodynamics, Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi,2016.
4	R.K. Rajput, Engineering Thermodynamics, Laxmi Publications Pvt.Ltd., New Delhi, 2017.
5	Gordon J. Van Wylen, Richard E. Sonntag, Fundamentals of Classical Thermodynamics, John Wiley & Sons, 1978.
REFERENCES	
1	Chattopadhyay, P, “Engineering Thermodynamics”, 2nd Edition Oxford University Press, 2016.
2	Gordon Rogers, Yon Mayhew, “Engineering Thermodynamics: Work and Heat Transfer, 4th Edition, Pearson, 2002.
3	Claus Borgnakke and Richard E. Sonntag, “Fundamentals of Thermodynamics”, 7th Edition, Wiley Eastern, 2009.
4	Venkatesh. A, “Basic Engineering Thermodynamics”, Universities Press (India) Limited, 2007.
5	De Didier Fontaine, “Principles of classical Thermodynamics: Applied to Material Science”, World Scientific Publications, 2022

CO/PO, PSO Mapping

(3/2/1 indicates the strength of correlation) 3-Strong 2-Medium, 1-Weak
Programme Outcomes (POs) and Programme Specific Outcomes PSOs'

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	1	-		1	-	-	-	2	1	2	1	2
CO2	2	3	2	1	-		1	-	-	-	2	1	3	1	2
CO3	2	3	2	1	1		1	-	-	-	2	1	3	2	2
CO4	2	3	2	1	-	1		-	-	-	2	1	2	2	2
CO5	2	3	2	1	-	1		-	-	-	2	1	2	1	2
AVG	2	3	2	1	1	1	1	-	-	-	2	1	2.4	1.4	2

Meenakshi Sundararajan Engineering College

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Department : Mechanical Engineering, R2024, CBCS

U24ME303	MANUFACTURING PROCESSES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES – To produce metal and polymer components using basic casting, joining, deformation, and forming processes.

1	To illustrate the working principles of various metal casting processes.
2	To learn and apply the working principles of various metal joining processes
3	To analyse the working principles of bulk deformation of metals.
4	To **understand and apply** the working principles of sheet metal forming processes.
5	To study and practice the working principles of plastics moulding.

UNIT1 METAL CASTING PROCESSES	**9**

Sand Casting - Sand Mould - Type of patterns - Pattern Materials - Pattern allowances - Moulding sand types, Properties and testing - Metal mould casting basics, Moulding machines, Types and applications Melting furnaces - Blast and Cupola Furnaces - Principle of special casting processes - Shell, investment Ceramic mould - Pressure die casting - Centrifugal Casting Continuous casting - Vacuum mould casting, Evaporative pattern casting - Hybrid and vacuum, CO2 process - Stir casting - Defects in Sand casting - full moulding - micro casting - casting techniques for single crystal components.

UNIT2 METAL JOINING PROCESSES	**9**

Introduction, welding types and equipment, operating principle, merits and applications: electrode types and its nomenclatures, Fusion welding processes - Gas Tungsten arc welding (TIG) - Gas metal arc welding (MIG) - Submerged arc welding - Electro slag welding - Operating principle and applications: Resistance welding - Plasma arc welding - Thermit welding - Electron beam welding - Laser welding - Friction welding and Friction Stir Welding, Spot welding, seam welding, projection welding. - Brazing and soldering - Weld defects: types, causes and rectifications process

UNIT3 BULK DEFORMATION PROCESSES	**9**

Hot, cold and warm forming - working principle of forging equipment - forging process, types and defects, Open, impression and closed die forging extrusion: types-hot and cold extrusion, machineries for extrusion process, defects in extrusion, drawing-tube drawing, operating procedure of drawing machineries, rod drawing and wire drawing, drawing defects: rolling: types - Flat strip rolling, contour roll forming, shape rolling operations, rolling defects

UNIT4 SHEET METAL PROCESSES	**9**

Sheet metal characteristics - Typical shearing, bending and drawing operations - Stretch forming operations - Formability of sheet metal - Test methods - special forming processes - Working principle and applications - Hydro forming, Hemming and seaming - Rubber pad forming - Metal spinning - Introduction of Explosive forming, magnetic pulse forming, peen forming, Super plastic forming, Micro forming, Incremental forming. cup forming, embossing, coining, type of dies-simple, compound, progressive, punch and die clearance

UNIT5 POLYMER MANUFACTURING PROCESSES	**9**

Polymers: Classifications of polymers. Thermoplastic Properties and applications (Polyethylene, Poly propylene, Polystyrene, Poly vinyl chloride, Acrylic, Nylon and Teflon). Thermoset Properties and applications (Polyester, Epoxy, Phenolic, Urea and Phenol formaldehydes). Manufacturing process: working - Injection moulding, Compression moulding, Blow Moulding, Extrusion- practical applications - Principle, operations and applications. Rotational moulding - Film blowing - Thermoforming - Bonding of Thermoplastics- duff moulding.

TOTAL PERIODS	**45**

COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Apply the working principles of metal casting processes in manufacturing applications
CO2	Apply suitable metal joining processes for various industrial requirements

CO3	Analyze the mechanics and parameters involved in bulk deformation processes like forging and rolling.
CO4	Apply the various sheet metal forming process.
CO5	Demonstrate and evaluate plastic moulding techniques such as injection, blow, and compression moulding.

TEXT BOOKS

1	Kalpakjian. S, “Manufacturing Engineering and Technology”, Pearson Education India,4th Edition, 2013
2	P.N.Rao Manufacturing Technology Volume 1 Mc Grawhill Education 5th edition,2018.

REFERENCES

1	Roy. A. Lindberg, Processes and materials of manufacture, PHI / Pearson education, 2006.
2	S. Gowri P. Hariharan, A.Suresh Babu, Manufacturing Technology I, Pearson Education, 2008.
3	Paul Degarma E, Black J.T and Ronald A. Kosher, Eight Edition, Materials and Processes, in Manufacturing, Eight Edition, Prentice – Hall of India, 1997.
4	Hajra Chouldhary S.K and Hajra Choudhury. AK., Elements of workshop Technology, volume I and II, Media promoters and Publishers Private Limited, Mumbai, 1997
5	Sharma, P.C., A Text book of production Technology, S.Chand and Co. Ltd., 2004

CO/PO, PSO Mapping

(3/2/1 indicates the strength of correlation) 3-Strong 2-Medium, 1-Weak
Programme Outcomes (POs) and Programme Specific Outcomes PSOs'

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	1	1	2	1	2	-	1
CO2	3	2	-	-	-	-	-	-	1	1	2	1	2	-	1
CO3	3	3	-	2	-	-	-	-	1	1	2	1	2	-	1
CO4	3	2	-	-	-	-	-	-	1	1	2	1	2	-	1
CO5	3	2	2	2	-	-	-	-	1	1	2	1	2	-	1
AVG	3	2.2	0.4	0.8	-	-	-	-	1	1	2	1	2	-	1

Meenakshi Sundararajan Engineering College

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Department : Mechanical Engineering, R2024, CBCS

U24ME304	ENGINEERING MATERIALS AND METALLURGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES – To develop, prepare, and produce metal and polymer samples using material processing techniques to investigate the effects of alloy composition, heat treatment, and composite formation on microstructure and mechanical properties.

1	To enable students to **construct and interpret** the iron–iron carbide phase diagram and identify the phases in steel and cast iron.
2	To design appropriate heat treatment processes for ferrous alloys based on mechanical property requirements.
3	To **select** suitable ferrous and non-ferrous alloys for various engineering applications
4	To **illustrate** the properties and uses of polymers, ceramics, and composite materials.
5	To **describe** mechanical testing procedures and failure mechanisms of engineering materials.

UNIT1 - CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS	**9**

Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectic, eutectoid, peritectic, and peritectoid reactions, application of lever rule for phase calculation; Iron – Iron carbide equilibrium diagram. Classification of steel and cast Iron microstructure, properties and application.

UNIT 2 - HEAT TREATMENT	**9**

Phase transformation- Pearlite, bainite and martensite formation mechanism; Diffusion-Fick's first and second Law-Homogenous and heterogeneous nucleation- critical radius of Nucleation-Full annealing, stress relief, spheroidising –normalizing, hardening and tempering of steel. TTT diagram – continuous cooling Transformation (CCT) diagram – Austempering, Martempering – Hardenability, Jominy end quench test –recrystallisation. Case hardening, carburizing, Nitriding, cyaniding, carbonitriding – Flame and Induction hardening – Vacuum and Plasma hardening – Thermo-mechanical treatments

UNIT 3 - FERROUS AND NON-FERROUS METALS	**9**

Effect of alloying additions on steel (Mn, Si, Cr, Mo, V Ti & W) – stainless and tool steels – HSLA - Maraging steels-TRIP steel, PH steels – Grey, white, malleable, spheroidal – alloy cast irons, Copper and its alloys – Brass, Bronze and Cupronickel – Aluminium and its alloys; Al-Cu – precipitation strengthening treatment – Titanium alloys, Mg-alloys, Ni-based super alloys – shape memory alloys- Properties and Applications

UNIT 4 - NON-METALLIC MATERIALS	**9**

Polymers – types of polymers, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PAI, PPO, PPS, PEEK, PTFE, Thermoset polymers – Urea and Phenol formaldehydes –Nylon, Engineering Ceramics – Properties and applications of Al2O3, SiC, Si3N4, PSZ and SIALON – intermetallics- Composites- Matrix and reinforcement Materialsapplications of Composites - Nano composites

UNIT 5 - MECHANICAL PROPERTIES AND TESTING	**9**

Mechanisms of plastic deformation, slip and twinning – Types of fracture – fracture mechanics- Griffith's theory- Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell), Micro and nano-hardness tests, Impact test Izod and charpy, fatigue and creep failure mechanisms.

TOTAL PERIODS	**45**

Meenakshi Sundararajan Engineering College

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Department : Mechanical Engineering, R2024, CBCS

COURSE OUTCOMES	
At the end of the course, the student will be able to	
CO1	Construct the iron–iron carbide phase diagram and estimate the microstructure phases in steels and cast irons.
CO2	Design a suitable heat treatment process for ferrous alloys to meet specific mechanical properties.
CO3	Suggest appropriate ferrous and non-ferrous alloys for specific engineering applications.
CO4	Evaluate the selection of polymers, ceramics, and composite materials based on their properties and performance for specific engineering applications.
CO5	Analyze standard material testing procedures and evaluate failure mechanisms in engineering materials.
TEXT BOOKS	
1	Kenneth G.Budinski and Michael K.Budinski “Engineering Materials” Prentice-Hall of India Private Limited, 9th Indian Reprint 2009
2	Williams D Callister, “Material Science and Engineering” Wiley India Pvt Ltd, Revised Indian edition 2020.
REFERENCES	
1	Raghavan.V “Materials Science and Engineering”, Prentice Hall of India Pvt., Ltd., 1999.
2	Sydney H.Avner “Introduction to Physical Metallurgy” McGraw Hill Book Company, 1994
3	G.S. Upadhyay and Anish Upadhyay, “Materials Science and Engineering”, Viva Books Pvt.Ltd, New Delhi, 2020.

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Programme Outcomes (POs) and Programme Specific Outcomes PSOs'

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	3	2	2	-	1	1	-	-	-	1	1	2	-	2
CO2	3	3	2	2	-	1	1	-	-	-	1	1	2	-	2
CO3	3	3	2	2	-	1	1	-	-	-	1	1	2	-	2
CO4	3	3	2	2	-	1	1	-	-	-	1	1	2	-	2
CO5	3	3	2	2	-	1	1	-	-	-	1	1	2	-	2
AVG	3	3	2	2	-	1	1	-	-	-	1	1	2	-	2

Meenakshi Sundararajan Engineering College

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Department : Mechanical Engineering, R2024, CBCS

U24ME305	FLUID MECHANICS AND MACHINERY	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES – To develop and construct functional fluid mechanics systems by applying core principles of fluid properties, flow behavior, dimensional analysis, and turbomachinery

1	To introduce the students to properties of fluids and behavior under static conditions.
2	To impart basic knowledge of the dynamics of fluids and boundary layer concepts.
3	To apply conservation laws to real-world fluid systems such as flow measurement, pipe flow (laminar and turbulent), and forces on pipe bends.
4	To exposure to the significance of boundary layer theory and its thicknesses.
5	To expose the students to basic principles of working of hydraulic machineries and to design Pelton wheel, Francis and Kaplan turbine, centrifugal and reciprocating pumps.

UNIT 1 FLUID PROPERTIES AND FLOW CHARACTERISTICS — 10+12

Definitions of fluid - Properties of fluids –Fluid pressure and its measurements – Forces on plane and curved surfaces - Buoyancy and floatation - Flow characteristics - Eulerian and Lagrangian Principle of fluid flow– concept of control volume and system – Continuity equation, energy equation and momentum equation - Applications.

Practicals:

1. Determination of coefficient of discharge of a venturi meter
2. Determination of coefficient of discharge of an orifice meter
3. Determination of metacentric height
4. Determination of forces due to impact of jet on a fixed plate

UNIT 2 FLOW THROUGH PIPES AND BOUNDARY LAYER — 9 +3

Reynold's Experiment- Laminar flow through circular conduits- Hagen Poiseuille equation -Darcy Weisbach equation – friction factor- Moody diagram- minor losses- Hydraulic gradient and total energy gradient – Pipes in series and parallel - Boundary layer concepts – types of boundary layer thickness.

Practicals:

5. Determination of friction factor for flow through pipes

UNIT 3 DIMENSIONAL ANALYSIS AND MODEL STUDIES — 7

Fundamental dimensions - Dimensional homogeneity - Rayleigh's method and Buckingham Pi theorem - Dimensionless parameters - Similitude and model studies - Distorted and undistorted models.

UNIT 4 TURBINES — 10 + 9

Impact of jets - Velocity triangles - Theory of rotodynamic machines - Classification of turbines – Pelton wheel, Francis turbine and Kaplan turbine- Working principles - Work done by water on the runner - Efficiencies – Draft tube - Specific speed - Performance curves for turbines.

Practicals:

6. Characteristics of Pelton wheel turbine
7. Characteristics of Francis turbine
8. Characteristics of Kaplan turbine

UNIT 5 PUMPS — 9 + 6

Classification of pumps- Centrifugal pumps – Working principle - Heads and efficiencies– Work done by the impeller - NPSH – Minimum speed to start the pump - Pumps connected in series and parallel - Performance curves - Reciprocating pump working principle – Indicator diagram and its variations – Air vessels - Work saved by air vessels.

Practicals:

9. Characteristics of centrifugal pumps
10. Characteristics of reciprocating pump

TOTAL PERIODS	**45 L + 30 P = 75**

COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Apply the basic fluid properties and analyze the behavior of fluids under static conditions.
CO2	Estimate head losses in pipes under laminar and turbulent conditions.
CO3	Formulate dimensionless groups for fluid systems using dimensional analysis and evaluate prototype performance from model studies based on similarity principles.
CO4	Design Pelton, Francis, and Kaplan turbines, explain their working principles with draft tube theory, and evaluate the performance characteristics of Pelton wheels.
CO5	Differentiate centrifugal and reciprocating pumps, explain their working using characteristic curves, design pump systems, and evaluate performance characteristics.

TEXT BOOKS

1	Modi P.N. and Seth, S.M. Hydraulics and Fluid Mechanics, Standard Book House, New Delhi, 23rd edition (2022).
2	Jain A. K. Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi, 2014.
3	Kumar K. L., Engineering Fluid Mechanics, Eurasia Publishing House(p) Ltd. New Delhi, 2016.

REFERENCES

1	Fox W.R. and McDonald A.T., Introduction to Fluid Mechanics John-Wiley and Sons, Singapore, 2011.
2	Pani B S, Fluid Mechanics: A Concise Introduction, Prentice Hall of India Private Ltd, 2016.
3	Cengel Y A and Cimbala J M, Fluid Mechanics, McGraw Hill Education Pvt. Ltd., 2014.
4	S K Som; Gautam Biswas and S Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill Education Pvt. Ltd., 2012.
5	Streeter, V. L. and Wylie E. B., Fluid Mechanics, McGraw Hill Publishing Co., 2010.

CO/PO, PSO Mapping

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Programme Outcomes (POs) and Programme Specific Outcomes PSOs'

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	1	-	-	-	-	1	1	2	2	1	1	-
CO2	3	3	-	-	-	-	-	-	1	1	2	2	1	1	-
CO3	3	2	-		-	-	-	-	1	1	2	2	1	1	-
CO4	3	2	-	2	-	-	-	-	1	1	2	3	1	1	-
CO5	3	2	3	-	-	-	-	-	1	1	2	3	1	1	-
AVG	3	2.2	0.6	0.6	-	-	-	-	1	1	2	2	1	1	-

Meenakshi Sundararajan Engineering College

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Department : Mechanical Engineering, R2024, CBCS

U24ME306	COMPUTER AIDED MACHINE DRAWING	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES – To Design and develop comprehensive 2D assembly and component drawings by applying BIS engineering drawing standards, geometric dimensioning and tolerancing, and fit selection for mechanical systems

1	Applying standard drawing practices using fits and tolerances.
2	Modelling orthogonal views of machine components.
3	Modelling orthogonal views of assembled components.
4	Preparing standard drawing layout for modelled parts or assemblies with BoM.
5	Gaining practical experience in handling 2D drafting software systems.

List of Experiments	**45**

PART – I DRAWING STANDARDS & FITS AND TOLERANCES – 12

	Code of practice for Engineering Drawing - BIS specifications – Thread forms, Welding symbols, riveted joints, keys, fasteners - Reference to hand book for the selection of standard components like bolts, nuts, screws, keys etc. Limits, Fits, Tolerancing of individual dimensions - IS919 - Specification of Fits, Preparation of production drawings and reading of part and assembly drawings, basic principles of Geometric Dimensioning & Tolerancing.

PART– II 2D DRAFTING – 33

Drawing, Editing, Dimensioning, Layering, Hatching, Block, Array, Detailing, Detailed Drawing.

1	Bearings – Bush Bearing
2	Valves – Safety and Non-return Valves.
3	Couplings – Flange, Oldham's couplings.
4	Joints – Universal, Knuckle, Gib & Cotter
5	Engine parts – Piston, Connecting Rod, Crosshead (vertical and horizontal), Stuffing box
6	Machine Components – Screw Jack, Lathe Tail Stock, Lathe Chuck, Plummer Block

Total: 20% of classes for theory classes and 80% of classes for practice Note: 25% of assembly drawings must be done manually and remaining 75% of assembly drawings must be done by using any CAD software. The above tasks can be performed manually and using standard commercial 2D CAD software.

COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Practice drawing standards using fits and tolerances.
CO2	Model orthogonal views of machine components
CO3	Model orthogonal views of assembled components.
CO4	Prepare standard drawing layout for modelled parts or assemblies with BoM.
CO5	Create standard drawing for modelled parts or assemblies using modelling software.

TEXT BOOKS

1	Gopalakrishna K.R., "Machine Drawing", 17th Edition, Subhas Stores Books Corner, Bangalore,2003.
2	N. D. Bhatt and V.M. Panchal, "Machine Drawing", 51st Edition, Charator Publishers,2022.

REFERENCES	
1	K. L Narayana, P.Kannaiah, K.Venkata Reddy, Machine Drawing , 15 Edition , New Age International Publication
2	Goutam Pohit, Goutam Ghosh, “Machine Drawing with AutoCAD”, 1st Edition, Pearson, 2004
3	Junnarkar, N.D., “Machine Drawing”, 1st Edition, Pearson Education, 2004
4	N. Siddeshwar, P. Kanniah, V.V.S. Sastri,” Machine Drawing”, Tata McGrawHill,2006
5	S. Trymbaka Murthy, “A Text Book of Computer Aided Machine Drawing”, CBS Publishers, New Delhi, 2007

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Programme Outcomes (POs) and Programme Specific Outcomes PSOs'

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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CO2	3	3	3	-	3	-	-	1	1	2	1	3	1	2	-
CO3	3	3	3	-	3	-	-	1	1	2	1	3	1	2	-
CO4	3	3	3	-	3	-	-	1	1	2	1	3	1	2	-
CO5	3	3	3	-	3	-	-	1	1	2	1	3	1	2	-
AVG	3	3	3	-	3	-	-	1	1	2	1	3	1	2	-

Meenakshi Sundararajan Engineering College

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Department : Mechanical Engineering, R2024, CBCS

U24RM312	INTRODUCTION TO PROBLEM SOLVING	L	T	P	C
		0	0	1	0.5

COURSE OBJECTIVES

1	Develop an understanding of the types and characteristics of problems in research and real-life scenarios
2	Enable students to explore creative and critical thinking strategies for solving complex problems
3	Introduce engineering-oriented and methodical problem-solving techniques using logical and algorithmic thinking.
4	Equip students to analyze, model, and evaluate real-world problems in diverse domains.
5	Foster the ability to apply scientific inquiry and strategic design to derive optimized solutions

UNIT1 Problem Solving	**2**
Problem – types and characteristics, Problem vs research question, Curiosity and observation in research, Introduction to critical and analytical thinking, Literature Survey, Redefined Problem Statement	
UNIT2 The Art and Craft of Creative Problem Solving	**3**
Understanding the nature of problems, Techniques for defining and analysing problems, Strategies for investigating problems, Tactics for solving problems, Creative thinking methods for generating solutions, Evaluating and implementing solutions effectively, The toolbox, Algebra, Combinatronics, Number Theory, Geometry, Calculus.	
UNIT3 Problem Solving for New Engineers	**2**
Formulation, Myths of Discovery, Experimenting with Storytelling, Variation, Strategic Design, Randomness.	
UNIT4 Methodical Approach in Problem Solving	**2**
Scientific methods and its applications in research, Algorithmic thinking, Step-wise problem decomposition, Heuristics and Optimization strategies, Comparative analysis of problem solving techniques	
UNIT5 Real-life Examples in Problem Solving techniques	**6**
Problem solving examples in Healthcare, Education, Urban and Infrastructure, Business and Workplace related problems, Technology and Software, Agriculture and Environment, Engineering and Design, Society and Community problems	
	TOTAL: 15

COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Demonstrate critical, analytical, and observational skills to redefine a research problem
CO2	Apply creative thinking and problem analysis techniques to generate and evaluate solutions.
CO3	Use mathematical tools like algebra, number theory, and geometry to solve structured problems
CO4	Adopt algorithmic, heuristic, and optimization strategies in scientific problem solving.
CO5	Analyze and apply appropriate problem-solving approaches to real-life sector-specific problems.

TEXT BOOKS

1.	G. Polya, How to Solve It: A New Aspect of Mathematical Method, 2nd ed. Princeton, NJ, USA: Princeton University Press, 2014.
2.	M. Buie, Problem Solving for New Engineers: What Every Engineering Manager Wants You to Know. Boca Raton, FL, USA: CRC Press, 2018.
3.	A. Barker, How to Solve Almost Any Problem: The Creative Approach to Any Problem Solving. New York, NY, USA: Wiley, 2001.

4.	P. Zeitz, The Art and Craft of Problem Solving, 3rd ed. Hoboken, NJ, USA: Wiley, 2016.

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Programme Outcomes (POs) and Programme Specific Outcomes PSOs'

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	1	-	-	-	-	1	1	1	-	-	1	-
CO2	3	2	3	-	-	-	-	-	1	1	1	-	-	1	-
CO3	3	2	2	-	-	-	-	-	1	1	1	-	-	1	-
CO4	2	0	-	-	-	-	-	-	1	1	1	-	-	1	-
CO5	2	3	-	2	-	-	-	-	1	1	1	-	-	1	-
AVG	2.6	1.8	1	0.6	-	-	-	-	1	1	1	-	-	1	-

Meenakshi Sundararajan Engineering College

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Department : Mechanical Engineering, R2024, CBCS

U24ME401	MANUFACTURING TECHNOLOGY	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES: To perform, analyze and develop the various components by providing the knowledge of various machining process such as Turning, Milling, Gear hobbing, drilling, grinding and CNC machine Part Programming.

1	To understand the fundamental principles in material removal processes and importance of metal cutting parameters.
2	To apply the principles of lathes / special purpose machines for various applications.
3	To understand the need for milling & hole making processes and various gear cutting methods
4	To understand the surface finish and material removal in abrasive machining operations including grinding and super finishing.
5	To analyze and simulate CNC programs and analyze how machining parameters affect tool life and surface finish.

UNIT 1 THEORY OF METAL CUTTING — 9+6

Need for metal cutting--Classification of metal cutting processes -Mechanics of orthogonal and oblique cutting-forces in machining -Shear stress and shear strain in metal cutting -Types of chip -Nomenclature of single point cutting tool -Material factors -work piece materials and cutting tool materials -Tribological aspects in metal cutting -friction at the tool -chip interface- cutting fluids -thermal aspects cutting temperatures their measurement and heat transfer models effect of process parameters - tool wear and mechanisms tool life - surface integrity , surface roughness -machining induced microstructural changes, Machinability

Practicals:

1. Analysis of chip morphology in machining
2. Measurement of machining temperature using thermocouple & pyrometer
3. Study the effect of workpiece material property on machinability

UNIT 2 TURNING MACHINES — 9+9

Centre lathe - constructional features- specification -Specification of cutting tool inserts and tool holders as per ISO standard - operations taper turning methods- thread cutting methods
-special attachments - machining time and power estimation - Capstan and turret lathes - tool layout - automatic lathes: semi-automatic - single spindle -Swiss type - automatic screw type -
multi spindle

Practicals:

1. Turning and Facing on circular parts using lathe machine
2. Taper Turning and Eccentric Turning on circular parts using lathe machine.
3. Knurling, external and internal thread cutting on circular parts using lathe machine.
4. Cutting force calculation using dynamometer in lathe machine

UNIT 3 ROTATING CUTTING TOOLS, GEAR CUTTING AND BROACHING	9+12
Drilling - geometry of helical drills -special modifications to improve drill performance -Allied operations - reaming, boring ,tapping- Milling Classification- Horizontal vs Vertical and Conventional vs Climb milling-types of milling cutters - Surface finish in milling - machining time calculations - Gear cutting - gear hobbing and gear shaping - gear finishing methods- broaching machines- broach construction push, pull, surface broaching **Practicals:** 1. Drilling and Reaming using vertical drilling machine 2. Milling contours on plates using vertical milling machine 3. Cutting spur and helical gear using milling machine 4. Generating gears using gear hobbing machine 5.Generating gears using gear shaping machine 6.Cutting force calculation using dynamometer in milling machine	
UNIT 4 ABRASIVE PROCESSES	**9+3**
Grinding- Mechanics of grinding and specific energy in grinding --grinding wheel - specifications and selection- types of grinding process - cylindrical grinding - surface grinding- centerless grinding- internal grinding - Surface integrity in grinding Traditional micro/ nano finishing methods - Honing, Lapping Superfinishing - Typical applications - Magnetorheological finishing machines - Maintenance of grinding wheels - Hybrid mass finishing of AM parts. **Practicals:** 1. Grinding components using cylindrical and centerless grinding machines. 2. Grinding components using a surface grinding machine.	
UNIT 5 COMPUTER NUMERICAL CONTROL MACHINE TOOLS	**9**
Computer Numerical Control (CNC) machine tools -Need, types -constructional details- special features - Drives -ball screws -ATC - sensors - machining centre -part programming fundamentals - Coordinates axis and motion - Absolute vs Incremental- interpolators , Polar coordinates - Program planning - G-codes and M-codes -manual part programming and AI assisted part programming -Introduction to Additive Manufacturing.	
TOTAL Periods	**75**

1	Geofrey Boothroyd, Winston A. Knight “Fundamentals of Machining and Machine Tools”, Taylor & Francis, CRC press, 2006.
2	P.N. Rao. “Manufacturing Technology: Metal Cutting and Machine Tools, McGraw Hill Education (India) Private Limited, 2019.
3	HMT – “Production Technology”, Tata McGraw Hill, 1998
4	Richerd R Kibbe, John E .Neely, Roland O. Merges and Warren J. White “Machine Tool Practices”, Prentice Hall of India, 1998.
5	Roy. A. Lindberg, Processes and materials of manufacture, PHI / Pearson education, 2006
6	B.L.Juneja, G.S.Sekhon, Nitin Seth, Fundamentals of Metal cutting and Machine tools, Second Edition, New Age International (P) Ltd., 2005.
7	https://nptel.ac.in/courses/112105233/

CO/PO, PSO Mapping
(3/2/1 indicates the strength of correlation) 3-Strong 2-Medium, 1-Weak
Programme Outcomes (POs) and Programme Specific Outcomes PSOs'

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	1	1	2	-	3	-	2
CO2	3	2	-	-	-	-	-	-	1	1	2	-	3	-	2
CO3	3	2	-	-	-	-	-	-	1	1	2	-	3	-	2
CO4	3	2	-	2	-	-	-	-	1	1	2	-	3	-	2
CO5	3	2	2	2	-	-	-	-	1	1	2	-	3	-	2
AVG	3	2	0.4	0.8	-	-	-	-	1	1	2	-	3	-	2

Meenakshi Sundararajan Engineering College

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Department : Mechanical Engineering, R2024, CBCS

U24ME402	Metrology and Measurements	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES: To provide the knowledge regarding various measurement techniques essential in manufacturing, including dimensional measurements, form analysis, surface finish evaluation, tolerance analysis, geometric dimensioning, laser metrology, and the use of coordinate measuring machines.

1	To understand the knowledge of the metrology and importance of measurements
2	To apply the knowledge of linear and angular dimensions assembly and transmission elements.
3	To understand the fundamentals of tolerance analysis in manufacturing
4	To apply the fundamentals of GD & T and surface metrology
5	To analyze the knowledge of the advanced measurements for quality control in manufacturing industries.

UNIT I BASICS OF METROLOGY — 9+6

Measurement – Need, Process - Role in quality control; -Factors affecting measurement- SWIPE Errors in Measurements - Types errors - Control - Measurement uncertainty – Types ,Estimation,- Problems on Estimation of Uncertainty- Statistical analysis of measurement data - Measurement system analysis -Calibration of measuring instruments -Estimation of Gage R&R using Range and average method - Principle of air gauging- ISO standards.

Practicals:

1.Calibration of Vernier Caliper
2.Calibration of Micrometer
3.Calibration of Mechanical Comparator

UNIT – II MEASUREMENT OF LINEAR, ANGULAR DIMENSIONS, ASSEMBLY AND TRANSMISSION ELEMENTS — 9+6

Linear Measuring Instruments – Vernier caliper - Micrometer, Vernier height gauge- Depth Micrometer, Bore gauge - Telescoping gauge - Gauge blocks – Use and precautions Comparators – Working and advantages - Opto-mechanical measurements using measuring microscope - Profile projector -Angular measuring instruments – Bevel protractor, Clinometer -Angle gauges, Precision level, Sine bar -Autocollimator, Angle dekkor - Alignment telescope. -Measurement of Screw threads - Single element measurements - Pitch Diameter, Lead, Pitch.- Measurement of Gears – purpose - Analytical measurement – Runout, Pitch variation, Tooth profile,- Tooth thickness, Lead – Functional checking – Rolling gear test.

Practicals:

1.Measurement of Components using Vernier Height Gauge & 2D height gauge
2.Measurement of Components using Vernier Depth Gauge
3.Measurement of Angle using Vernier Bevel Protractor
4.Measurement of Taper Angle Measurement using Sine Bar and Slip Gauge

UNIT – III TOLERANCE ANALYSIS — 9+6

Tolerance - interchangeability - Selective assembly -Tolerance representation, -Terminology, Limits and Fits, - Problems (using tables IS919); Design of Limit gauges, Problems.- Tolerance analysis in manufacturing - Process capability - tolerance stackup -tolerance charting.

Practicals:

1.Measurement of Gear Parameters using Gear Tooth Vernier
2.Measurement of Thread Parameters by using Floating Carriage Micrometer
3.Measurement of Thread Parameter using Profile Projector

UNIT – IV METROLOGY OF SURFACES — 9+6

Fundamentals of GD & T- Conventional vs Geometric tolerance - Datums -Inspection of geometric deviations like straightness, flatness, roundness deviations- Simple problems - Measurement of Surface finish - Functionality of surfaces - Parameters, Comparative, - Stylus based and Optical- Measurement techniques - Filters - Introduction to 3D surface metrology- Parameters.

Practicals:

1.Measurement of Thread Parameters Using Tool Maker’s Microscope
2.Measurement of Surface Roughness Using Surface Roughness Tester

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(An Autonomous Institution, Affiliated to Anna University, Chennai)

Department : Mechanical Engineering, R2024, CBCS

UNIT – V ADVANCES IN METROLOGY	**9+6**
Lasers in metrology - Advantages of lasers - Laser scan micrometers - Laser interferometers Applications – Straightness, Alignment; Ball bar tests - Computer Aided Metrology - Basic concept of CMM – Types of CMM - Constructional features – Probes – Accessories – Software – Applications – Multi sensor CMMs. Machine Vision - Basic concepts of Machine Vision System – Elements ,Applications - On-line and in-process monitoring in production- Computed tomography White light Scanners Metrology for e-mobility - Role of Metrology in I4.0 / Smart Manufacturing - Requirements for Metrology for I4.0. **Practicals:** 1.Measurement of Straightness and Flatness Using Two Axis AutoCollimator 2.Measurement of Torque using Gauge Load Cell 3.Measurement of Force using Strain Gauge Load Cell 4.Measurement of Geometric dimensions using CMM	
TOTAL	**75**

COURSE OUTCOMES	
At the end of the course, the student will be able to	
CO1	Discuss the concepts of measurements to apply in various metrological instruments
CO2	Apply the principle and applications of linear and angular measuring instruments, assembly and transmission elements.
CO3	Apply the tolerance symbols and tolerance analysis for industrial applications.
CO4	Apply the principles and methods of form and surface metrology
CO5	Apply the advances in measurements for quality control in manufacturing Industries.
TEXT BOOKS	
1	Dotson Connie, “Dimensional Metrology”, Cengage Learning, First edition, 2012.
2	Mark Curtis, Francis T. Farago, “Handbook of Dimensional Measurement”, Industrial Press, Fifth edition, 2013.
3	Jain R.K. —Engineering Metrologyll, Khanna Publishers, 25th Reprint 2020.
4	Raghavendra N.V. and Krishnamurthy. L., Engineering Metrology and Measurements, Oxford University Press, 2022.
REFERENCES	
1	AmmarGrous, J “Applied Metrology for Manufacturing Engineering”, Wiley-ISTE, 2011.
2	Galyer, J.F.W. Charles Reginald Shotbolt, “Metrology for Engineers”, Cengage Learning EMEA; 5th revised edition, 1990.
3	National Physical LaboratoryGuideNo. 40, No. 41, No. 42, No. 43, No. 80, No. 118, No. 130, No. 131. http://www.npl.co.uk
4	Venkateshan, S. P., “Mechanical Measurements”, Second edition, John Wiley &Sons, 2015.

CO/PO, PSO Mapping

(3/2/1 indicates the strength of correlation) 3-Strong 2-Medium, 1-Weak

Programme Outcomes (POs) and Programme Specific Outcomes PSOs'

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	2	2	-	-	-	1	2	-	1	3	2	1
CO2	3	2	2	2	2	-	-	-	1	2	-	1	3	2	1
CO3	3	2	2	2	2	-	-	-	1	2	-	1	3	2	1
CO4	3	2	2	2	2	-	-	-	1	2	-	1	3	2	1
CO5	3	2	2	2	2	-	-	-	1	2	-	1	3	2	1
AVG	3	2	2	2	2	-	-	-	1	2	-	1	3	2	1

Meenakshi Sundararajan Engineering College

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Department : Mechanical Engineering, R2024, CBCS

U24ME403	STRENGTH OF MATERIALS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES: To **analyze, design, and evaluate structural components** by applying the fundamental principles of solid mechanics, preparing them to develop product-based projects involving stress analysis and mechanical design.

1	Analyze the fundamental concepts of stress, strain, and elastic constants of solids subjected to external loading.
2	Evaluate the effects of transverse and bending loads on structural components and predict their behavior under such loads.
3	Examine the deformation characteristics of shafts and springs under torsional loading and determine the resulting stresses and strains.
4	Apply various methods to calculate and analyze the deflection of beams under different loading conditions.
5	Assess the stress distribution and behavior of shell structures such as thin cylinders and spheres under internal and external pressure.

UNIT – I STRESS, STRAIN AND DEFORMATION OF SOLIDS — 9+9

Rigid bodies and deformable solids Tension, Compression and Shear Stresses Deformation of simple and compound bars Elastic constants and Relationships Thermal stresses Strain energy and unit strain energy Strain energy in uniaxial loads - Volumetric strains - Stresses on inclined planes , principal stresses and principal planes Mohr"s circle of stress.

Practicals:

1.Double shear test on Mild steel and Aluminium rods (UTM)
2.Tension test on mild steel rod

UNIT II TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM — 9+3

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 Carriage springs Shear stress distribution- Shear Centre.

Practicals:

3.Compression test on wood, and bricks.

UNIT– III TORSION — 9 + 6

Theory of Pure Torsion ,Stresses and deformation in circular and hollows shafts Transmission of power through hollow & solid shafts Stepped shafts Shaft fixed at the both ends Closed and Open Coiled helical springs Stresses in helical springs Deflection of helical springs

Practicals:

4.Torsion test on mild steel rod.
5.Compression test on helical springs
6.Elongation of Closed Coil Spring
7.Deflection test on Carriage Spring (UTM)

UNIT – IV DEFLECTION OF BEAMS	**9+6**
Elastic curve Governing differential equation Double Integration method Macaulay"s method - Area moment method Conjugate beam method for computation of slope and deflection of determinant beams. Strain energy method computation of slopes and deflections in beams Maxwell's reciprocal theorem. **Practicals:** 8.Deflection test on Cantilever Beam 9..Deflection test on Simply Supported Beam	
UNIT V THIN &THICK SHELLS, THEORIES OF FAILURE	**9+6**
Stresses and deformations in thin cylindrical shells and spherical shells subjected to internal pressure Stresses in thick cylinders circumferential and longitudinal stresses and deformation in thin and thick cylinders spherical shells subjected to internal pressure Deformation in spherical shells Lame"s theorem Stresses, Strain, Maximum Shear stress, Changes in dimensions and volume. **Practicals:** 10. Impact Test - Charpy / Izod 11. Brinell and Rockwell Hardness Test	
	TOTAL: 75

COURSE OUTCOMES	
At the end of the course, the student will be able to	
CO1	Analyse stresses and strains under extremal loading and principal stresses
CO2	Illustrate the relation among shear force and bending moment of beams for beams subjected to different loading conditions.
CO3	Apply and solve torsion equations for shafts and springs.
CO4	Evaluate the slope and deflection of various beams
CO5	Determine stresses acting on thin cylinders and spheres

TEXT BOOKS	
1	Bansal, R.K., "Strength of Materials", 6th edition, Laxmi Publications (P) Ltd., 2022
2	Jindal U.C., "Strength of Materials", Pearson Pvt. Ltd., New Delhi, 2012
3	Rajput, R.K., Strength of Materials, S Chand And Company Ltd., New Delhi, 2018
4	Rattan S.S., "Strength of Materials", Tata McGraw Hill Education Pvt .Ltd., New Delhi, 2017.

REFERENCES	
1	Egor. P.Popov "Engineering Mechanics of Solids" Pearson Publication, 2015.
2	Ramamurtham S and R Narayanan., "Strength of Materials", Dhanpat Rai publishing company,2020.
3	Hibbeler, R.C., "Mechanics of Materials", Pearson Education, 2022.
4	Ferdinand P. Beer, Russell Johnson, Jr. and John J. Dewole Mechanics of Materials, 7 th Edition, Tata McGraw Hill publishing 'co. Ltd., New Delhi, 2014.
5	Hibbeler, R.C., Mechanics of Materials, Pearson Education, 10th Edition, 2022.
6	Subramanian R., Strength of Materials, Oxford University Press, Oxford Higher Education Series, 200

Meenakshi Sundararajan Engineering College

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Department : Mechanical Engineering, R2024, CBCS

CO/PO, PSO Mapping (3/2/1 indicates the strength of correlation) 3-Strong 2-Medium, 1-Weak Programme Outcomes (POs) and Programme Specific Outcomes PSOs'															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	-	-	-	-	-	-	2	1	2	-	-	2	-
CO2	3	3	2	-	-	-	-	-	2	1	2	-	-	2	-
CO3	3	3	2	-	-	-	-	-	2	1	2	-	-	2	-
CO4	3	2	2	-	-	-	-	-	2	1	2	-	-	2	-
CO5	3	3	2	-	-	-	-	-	2	1	2	-	-	2	-
AVG	3	2.8	1.6	-	-	-	-	-	2	1	2	-	-	2	-

Meenakshi Sundararajan Engineering College

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Department : Mechanical Engineering, R2024, CBCS

U24ME404	THERMAL ENGINEERING	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES : To understand and apply the principles of thermodynamics by analyzing thermodynamic and vapor cycles, evaluating the performance of steam nozzles, turbines, and IC engines, and studying their components, operations, and governing mechanisms.

1	To apply thermodynamic laws to analyze air standard and vapor power cycles
2	To examine steam nozzle performance and understand the working of steam generators.
3	To evaluate steam turbine performance and governing methods using velocity diagrams.
4	To analyze IC engine operation using timing diagrams and combustion characteristics.
5	To assess IC engine performance through testing and study of auxiliary systems.

UNIT I THERMODYNAMIC AND VAPOUR POWER CYCLES — 9 + 6

Air Standard Cycles, Carnot Cycle, Otto Cycle, Diesel Cycle, Dual Cycle, Brayton Cycle, Cycle Analysis, Performance and Comparison, Basic Rankine Cycle, modified, reheat and regenerative cycles

Practicals:

1.Performance test on four stroke diesel engine

2.Performance test on four stroke petrol engine

UNIT II STEAM GENERATOR AND STEAM NOZZLE — 9 + 3

Steam Generators: definition, classifications, accessories and mountings, working principle, comparison, Steam Nozzle: Types and Shapes of nozzles, Flow of steam through nozzles, Critical pressure ratio, Variation of mass flow rate with pressure ratio, Effect of friction, Metastable flow

Practicals:

3.Study of steam boiler

4.Performance test on steam boiler

UNIT III STEAM AND GAS TURBINES — 9 + 3

Types, Impulse and reaction principles, Velocity diagrams, Work done and efficiency, optimal operating condition, Multi-staging turbine, compounding Turbine, governing of turbine, Gas turbine cycle analysis – open and closed cycle, Performance and its improvement techniques, Regenerative type gas turbine, Intercooled type gas turbine, Reheated type gas turbine and their combination

Practicals::

5.Study of steam Turbines

6.Performance test on steam turbines

UNIT IV INTERNAL COMBUSTION ENGINES – FEATURES AND COMBUSTION — 9 + 9

IC engine – Classification, working, components and their functions, Ideal and actual : Valve and port timing diagrams, p-v diagrams - two stroke & four stroke SI & CI engines – comparison, Geometric, operating, and performance comparison of SI and CI engines, Desirable properties and qualities of fuels, Air-fuel ratio calculation – lean and rich mixtures, Combustion in SI & CI Engines – Knocking – phenomena and control

Practicals::

7.Determining the port position by port timing diagram for two stroke Spark ignition Engine

8.Determining the valve position by Valve timing diagram for four stroke CI engine

9.Determining the viscosity of lubricating oil

10.Determining the flash and fire point of oil

UNIT V INTERNAL COMBUSTION ENGINE PERFORMANCE AND AUXILIARY SYSTEMS	**9 + 9**

Performance and Emission Testing, Performance parameters and calculations, Morse and Heat Balance tests, Multipoint Fuel Injection system, Common rail direct injection systems, Ignition systems – Magneto, Battery and Electronic, Lubrication and Cooling systems, Concepts of Supercharging and Turbocharging, Emission Norms

Practicals:

11.Retardation test on four stroke diesel engine
12.Eddy current test
13.Morse test on four stroke petrol engine
14.Heat balance test on four stroke diesel engine

TOTAL	**75 Periods**

COURSE OUTCOMES	
At the end of the course, the student will be able to	
CO1	Apply thermodynamic laws to solve problems on air standard and vapor power cycles.
CO2	Analyze the performance of steam nozzles and explain the operation of steam generators.
CO3	Evaluate steam turbine performance using velocity diagrams and interpret various governing methods
CO4	Analyze IC engine operation with the help of valve timing diagrams and combustion processes.
CO5	Evaluate IC engine performance using testing data and interpret auxiliary system functions.

TEXT BOOKS	
1	Mahesh. M. Rathore, “Thermal Engineering”, 1st Edition, Tata McGraw Hill, 2010.
2	Ganesan.V, " Internal Combustion Engines" 4th Edition, Tata McGraw Hill, 2012.
3	Mathur M.L and Mehta F.S., “Thermal Science and Engineering”, 3rd Edition, Jain Brothers Pvt. Ltd, 2017.
4	Nag P.K, “Basic and Applied Thermodynamics”, 2nd Edition, Tata McGraw Hill, 2010
5	Soman. K, “Thermal Engineering”, 2nd Edition, Prentice Hall of India, 2011.

REFERENCES	
1	Ballaney. P, “Thermal Engineering”, 25th Edition, Khanna Publishers, 2017.
2	Domkundwar, Kothandaraman, & Domkundwar, “A Course in Thermal Engineering”, 6th Edition, Dhanpat Rai & Sons, 2011.
3	Gupta H.N, “Fundamentals of Internal Combustion Engines”, 2nd Edition Prentice Hall of India, 2013.
4	Yunus A Cengel and Michael a Boles, “Thermodynamics - An Engineering Approach”, 8th Edition, Tata McGraw-Hill Education, 2015
5	T.D.Eastop and McConkey, “Applied Thermodynamics for Engineering Technologists” 5th Edition, Pearson Education Ltd, 2009

CO/PO, PSO Mapping
(3/2/1 indicates the strength of correlation) 3-Strong 2-Medium, 1-Weak
Programme Outcomes (POs) and Programme Specific Outcomes PSOs'

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	-	-	-	-	-	-	1	1	2	1	2	1	1
CO2	3	2	-	1	-	-	-	-	1	1	2	1	2	1	1
CO3	3	2	2	2	-	-	-	-	1	1	2	1	2	1	1
CO4	3	2	-	2	-	-	-	-	1	1	2	1	2	1	1
CO5	3	2	2	2	-	-	-	-	1	1	2	1	2	1	1
AVG	3	2	0.8	1.4	-	-	-	-	1	1	2	1	2	1	1

Meenakshi Sundararajan Engineering College

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Department : Mechanical Engineering, R2024, CBCS

U24ME405	HYDRAULICS AND PNEUMATICS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES : To design, simulate and troubleshoot fluid power circuits through intelligent control, real-time monitoring, predictive maintenance, and fault detection. The course also covers the use of Actuators and machine learning algorithms to optimize energy efficiency, safety, and sustainability in modern industrial environments and improve decision-making processes.

1	To Understand the basic principles of fluid power and classify types of hydraulic pumps
2	To Analyze the working and selection of hydraulic actuators and control components
3	To Design and interpret hydraulic circuits for industrial applications
4	To Examine pneumatic and electro-pneumatic systems and their industrial uses
5	To Analyse faults, troubleshoot issues, and apply fluid power systems in real-world scenarios

UNIT1 FLUID POWER PRINCIPLES AND HYDRAULIC PUMPS — 9+6

Introduction to Fluid power - Advantages and Applications - Fluid power systems - Types of fluids - Properties of fluids and selection - Basics of Hydraulics - Pascal's Law - Principles of flow Friction loss - Work, Power and Torque- Problems - Sources of Hydraulic power: Pumping Theory - Pump Classification - Construction, Working, Design, Advantages, Disadvantages - Performance, Selection criteria of pumps - Fixed and Variable displacement pumps

Practicals:

1. Study and simulation of basic structure of Fluid power systems and its components
2. Selection of hydraulic pumps and motors and simulation using Automation software

UNIT2 HYDRAULIC ACTUATORS AND CONTROL COMPONENTS — 9+6

Hydraulic Actuators: Cylinders - Types and construction, Application - Rotary Actuators - Hydraulic motors - Control Components: Direction Control - Flow control and pressure control valves - Types, Construction and Operation - Accessories: Accumulators, Pressure Intensifiers - Reservoirs, Pressure Switches - Filters - types and selection- Applications - Fluid Power ANSI Symbols – Problems

Practicals:

1. Simulation of single and double actuators with different direction control actuating systems
2. Simulation of a speed control circuit for hydraulic table feed on a surface grinder.

UNIT3 HYDRAULIC CIRCUITS AND SYSTEMS — 9+6

Industrial hydraulic circuits - Regenerative, Pump Unloading Double-Pump - Air-over oil, Sequence - Reciprocation, Synchronization - Fail-Safe, Speed Control - Deceleration circuits - Sizing of hydraulic systems - Hydrostatic transmission - Electro hydraulic circuits - Servo and Proportional valves - Applications - Mechanical - hydraulic servo systems

Practicals :

1. Study and Simulation of regenerative, synchronization and metering circuits.
2. Design and simulation of hydraulic counter balance and unloading circuits.

UNIT4 PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS — 9+6

Properties of air –Air preparation and distribution - Filters, Regulator, Lubricator, Muffler - Air control Valves, Quick Exhaust Valves - Pneumatic actuators - Design of Pneumatic circuit –classification - single cylinder and multi cylinder circuits - Cascade method - Introduction to Fluidics - Electro Pneumatic System – Elements - Ladder diagram – timer circuits - Problems - Introduction to fluidics and pneumatic logic circuits - Controlling Fluid power actuators.

Practicals :

1.Design and simulation of pneumatic single and double acting cylinder circuits.
2. Design and develop an electro pneumatic circuit by cascade method for the punching press.

UNIT 5 TROUBLE SHOOTING AND APPLICATIONS	**9+6**

Installation, Selection - Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems - Conditioning of hydraulic fluids Design of hydraulic circuits for Drilling, Planning - Shaping, Surface grinding - Press and Forklift applications- mobile hydraulics - Design of Pneumatic circuits for metal working, handling - clamping counter, timer circuits - Pick and Place applications - Low-cost Automation - Hydraulic and Pneumatic power packs - IOT in Hydraulics and pneumatics

Practicals:

1. Design and study of hydraulic circuits of Drilling, Planning, Shaping, Surface grinding machines and Presses using Automation software
2. Design and simulation of cascade method of sequential circuits using Automation studio software.

TOTAL PERIODS	**75**

COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Understand the working principles of fluid power systems and analyze the selection criteria for hydraulic pumps.
CO2	Analyse hydraulic actuators and control components, and construct circuits for speed and direction control.
CO3	Design and interpret hydraulic circuits for industrial applications
CO4	Examine pneumatic and electro-pneumatic systems and their industrial uses
CO5	Analyse faults, troubleshoot issues, and apply fluid power systems in real-world scenarios

TEXT BOOKS

1	Anthony Esposito, “Fluid Power with Applications”, Prentice Hall, 2009.
2	Majumdar, S.R., “Oil Hydraulics Systems – Principles and Maintenance”,TataMcGraw Hill, 2001.

REFERENCES

1	Anthony Esposito, Fluid Power with Applications, Pearson Education, New Delhi, 2011.
2	Dudelyt, A. Pease and John T. Pippenger, Basic Fluid Power, Prentice Hall, 1987
3	Mikell P Groover, Automation Production Systems and Computer Integrated Manufacturing, Pearson Education, New Delhi, 2015.
4	Shanmugasundaram. K, Hydraulic and Pneumatic controls, Chand & Co, 2006.

CO/PO, PSO Mapping
(3/2/1 indicates the strength of correlation) 3-Strong 2-Medium, 1-Weak
Programme Outcomes (POs) and Programme Specific Outcomes PSOs'

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	-	-	-	-	-	-	-	1	2	1	1
CO2	2	1	1	1	-	-	-	-	-	-	-	1	2	1	1
CO3	2	1	1	1	-	-	-	-	-	-	-	1	2	1	1
CO4	2	1	1	1	-	-	-	-	-	-	-	1	2	1	1
CO5	2	1	1	1	-	-	-	-	-	-	-	1	2	1	1
AVG	2	1	1	1	-	-	-	-	-	-	-	1	2	1	1

Meenakshi Sundararajan Engineering College

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Department : Mechanical Engineering, R2024, CBCS

U24ED411	IDEAANDSIMULATION LAB	L	T	P	C
		0	0	1	0.5

Course Objectives

1	To understand the purpose and process of ideation and how to transition effectively from empathy and definition phases.
2	To apply structure dideageneration techniques such as Brain writing and Brainstorming to foster creative solutions.
3	Toanalyzeandfacilitateideaselectionbyevaluatingdesirability,feasibility,andviabilityofsolutions.
4	ToevaluateandrefinesolutionsusingtheSCAMPERframeworkandotherideationtechniquesto address real-world needs.
5	Tocreateactionablesolutionmodelsbydefiningconcepts,mappingprocesses,andoutlining requirements for market-ready offerings.

UNIT IIDEATEMODE — **1**

- TransitioningfromEmpathizeandDefine Modes
- Whatisthe IDEATEMode?
- WhyIdeate?
- HowtoIdeate?
- Howtotransition and move from“Ideate”to “Prototype”Modes

UNITIIIDEAGENERATION — **2**

- Howtogenerateideas?
- HowtoBrainwrite?(6-3-5and3-3-5techniques)
- HowtoprepareforBrainstorming?
- Prepareachecklistfor Brainstorming
- PrepareBrainstormingrules

UNITIIIBRAINSTORMINGFACILITATION — **4**

- Preparewarmupquestionstofacilitateeffectivebrainstorming
- Preparefocus areas and topics forbrainstorming
- Discussdesirability,feasibilityandviabilityperspectivespluspoint-of-views
- Documentdesirability,feasibilityandviabilityratingsandrankings
- Selectpromisingideas thathaspotentialto becomesolutions

UNITIVSKETCHTOTHINK BEYOND — **4**

- Introductionto“SCAMPER”Frameworktoimprovesolutionstopromisingproductsand services
- Refineideastobecomepotentialsolutionswithstakeholderacceptable results
- Doarealitycheckbyassessingvalue,needs,challenges,andbarriers
- Improveand formnewconcepts leading to products and services
- Writea one-sentence conceptdescription (Why?Whyis this solution thebestin class?)

UNITVTRANSLATESOLUTIONSTOPRODUCTSANDSERVICES — **4**

- Describeyour ideawithconcept name
- Drawa sketch ormindmap reflecting atleastBusiness,People,Process,Technologyand Stakeholders / Customers
- Describehowthe productwillwork and produce the intended Output,Outcomes andResults
- Evaluateresourcesandinfrastructurerequirementstobuildtheproductsand services
- DetailaplantoarriveatMarket-ReadyProduct/ Service

TOTALPERIODS — **15**

CourseOutcomes	
Attheendofthecourse,studentswillbeableto	
1	DescribetheIDEATEmode,explain itsrole indesignthinking,andillustratethetransitionfrom ideate to prototype.
2	Demonstrate theuseofBrainwriting (6-3-5,3-3-5)and constructeffective brainstorming rules and checklists.
3	Analyze ideasbasedondesirability,feasibility,andviability,andselecthigh-potentialideasfor further development.
4	EvaluateideasusingSCAMPER,refinethem byassessingvalueandbarriers,andformulate concise concept descriptions.
5	Designaproduct/serviceconceptwithclearstakeholdermapping,developadetailedactionplan, and justify its readiness for market.
TEXT BOOKS	
1	AnIntroductiontoDesignThinkingPROCESSGUIDE,HassoPlattner,d.School
2	Tim Brown,“ChangebyDesign:HowDesignThinkingTransformsOrganizationsandInspires Innovation”, Harper Publications, 2009
3	Don Norman,“TheDesign ofEverydayThings”,Basic Books,2013
4	Tom Kelley,DavidKelley,“CreativeConfidence:UnleashingtheCreativePotentialWithinUsAll”, Currency, 2013
REFERENCE BOOKS	
1	Hasso Plattner, Christoph Meinel, Larry Leifer, “Design Thinking: Understand – Improve – Apply (Understanding Innovation)”, Springer, 2011
2	JakobSchneider,MarcStickdorn,“ThisIs ServiceDesignThinking:Basics,Tools,Cases”,John Wiley & Sons, 2011
3	Tom Kelley, TheArtof Innovation:LessonsinCreativityfrom IDEO,America'sLeadingDesignFirm, Currency, 2001

CO/PO,PSO Mapping

(3/2/1 indicates the strength of correlation) 3-Strong 2-Medium, 1-Weak
ProgrammeOutcomes(POs)andProgrammeSpecificOutcomes(PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	3	1	3	2	1	3	3	3	3	-	-	1
CO2	2	3	3	3	1	3	2	1	3	3	3	3	-	-	1
CO3	2	3	3	3	1	3	2	1	3	3	3	3	-	-	1
CO4	2	3	3	3	1	3	2	1	3	3	3	3	-	-	1
CO5	2	3	3	3	1	3	2	1	3	3	3	3	-	-	1
AVG	2	3	3	3	1	3	2	1	3	3	3	3	-	-	1

Meenakshi Sundararajan Engineering College

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Department : Mechanical Engineering, R2024, CBCS

U24RM414	HYPOTHESIS	L	T	P	C
		0	0	1	0.5

1	To understand the fundamental principles and types of hypothesis and their role in scientific research
2	To enable students to formulate clear and testable hypothesis from research problems using variable analysis
3	To equip students with knowledge of research methodology and statistical tools for hypothesis testing
4	To apply hypothesis in real-world, interdisciplinary research while addressing ethical considerations
5	To explore advanced hypothesis techniques in modern fields such as AI, business analytics, and design thinking

UNIT1 Foundations of Hypothesis in Research	**3**
Definition and Role of Hypothesis in Research, Characteristics of good hypothesis – testable, specific, falsifiable – Difference between assumptions, theories and hypotheses, Types – Null, alternative, directional, non-directional, Hypothesis vs Research questions.	
UNIT2 Hypothesis Formulation and Design	**3**
Steps in developing a hypothesis from a problem statement, Operationalization of variables, Independent, dependent, and controlled variables, Conceptual vs. empirical hypothesis, Case studies on hypothesis framing in various disciplines.	
UNIT3 Research Methodology and Hypothesis Testing	**3**
The scientific method and its relationship to hypotheses, Experimental vs. non-experimental designs, Statistical tools for hypothesis testing (t-test, chi-square, ANOVA, etc.), Type I and Type II errors, p-values, confidence intervals, Sampling techniques and hypothesis testing limitations.	
UNIT4Applications of Hypothesis in Real-World Research	**3**
Hypothesis-driven research in natural sciences, social sciences, and engineering, Hypothesis in qualitative vs. quantitative research, Hypothesis in interdisciplinary and applied research, Ethics in hypothesis formulation and testing, Case studies and analysis of published research papers.	
UNIT5 Advanced Topics and Contemporary Approaches	**3**
Hypotheses in data science, AI, and machine learning (e.g., model hypothesis space), Hypothesis in action research and participatory methods, Iterative hypothesis development in design thinking, A/B testing and hypothesis validation in business research, Writing research proposals with strong hypothesis foundations.	
	TOTAL: 15

At the end of the course, the student will be able to

CO1	Explain the characteristics, types, and significance of hypothesis in research
CO2	Develop and operationalize hypothesis using variables and domain specific frameworks
CO3	Apply statistical methods and research methodology to test and validate hypothesis
CO4	Analyze the application and ethics of hypothesis usage in various domains using case studies
CO5	Evaluate and construct advanced, iterative hypotheses in modern research contexts.

TEXT BOOKS

1	C. R. Kothari and G. Garg, Research Methodology: Methods and Techniques, 4th ed. New Delhi, India: New Age International Publishers, 2019.

2	P. D. Leedy and J. E. Ormrod, Practical Research: Planning and Design, 12th ed. Boston, MA, USA: Pearson, 2019.
3	W. Goddard and S. Melville, Research Methodology: An Introduction, 4th ed. Chichester, UK: Wiley-Blackwell, 2004.
REFERENCES	
1	J. W. Creswell and J. D. Creswell, Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, 5th ed. Thousand Oaks, CA, USA: SAGE Publications, 2017.
2	M. J. Schervish, Theory of Statistics, 2nd ed. New York, NY, USA: Springer, 1995. (for statistical hypothesis theory)

CO/PO, PSO Mapping

(3/2/1 indicates the strength of correlation) 3-Strong 2-Medium, 1-Weak
Programme Outcomes (POs) and Programme Specific Outcomes PSOs'

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	2	-	1	-	-	-
CO2	3	3	2	-	-	-	-	-	-	2	-	2	-	-	-
CO3	3	3	3	3	2	-	-	-	-	2	-	2	-	-	-
CO4	3	3	2	3	2	2	1	3	2	2	1	3	-	-	-
CO5	3	3	3	3	3	2	2	2	2	3	2	3	-	-	-
AVG	3	2.8	2.5	3	2.3	2	1.5	2.5	2	2.2	1.5	2.2	-	-	-

Meenakshi Sundararajan Engineering College

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Department : Mechanical Engineering, R2024, CBCS

U24ME501	DESIGN OF MACHINE ELEMENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES - To master engineering design and stress analysis of machine components like shafts, couplings, joints, springs, flywheels, and connecting rods under various loads. Additionally, the focus is on selecting and designing sliding and rolling contact bearings for optimal performance.

1	To excel in the engineering design process and advanced stress analysis of machine components subjected to different loading conditions.
2	To gain knowledge of shaft and coupling design principles for various applications.
3	To develop an understanding of the design of temporary and permanent joints, including flanged, bushed pin type couplings.
4	To study the design procedures of springs, flywheels, and connecting rod.
5	To outline the selection and design steps for sliding and rolling contact bearings

UNIT I- FUNDAMENTAL CONCEPTS IN DESIGN **9**

Introduction to the design process - factors influencing machine design, selection of materials based on mechanical properties - Preferred numbers- Direct, Bending, and torsional loading, Modes of failure - Factor of safety – Combined loads – Principal stresses curved beams – crane hook and 'C' frame- theories of failure – Design based on strength and stiffness – stress concentration – Fluctuating stresses – Endurance limit – Design for finite and infinite life under variable loading - Exposure to standards

UNIT II DESIGN OF SHAFTS AND COUPLINGS **9**

Shafts and Axles - Design of solid and hollow shafts based on strength, rigidity, and critical speed – Keys and splines – Rigid and flexible couplings.

UNIT III DESIGN OF JOINTS AND POWER SCREWS **9**

Threaded fasteners - Bolted joints – Simple and eccentrically loaded bolted joints- Welded joints – Butt, Fillet and parallel transverse fillet welds – welded joints subjected to bending and torsional loads. Terminology of Power Screw- Torque Requirement- Self-Locking Screw- Efficiency of Screws-Collar Friction Torque

UNIT IV DESIGN OF SPRINGS AND PIPE JOINTS **9**

Types of springs, design of helical and concentric springs–Surge in springs, Design of laminated springs Introduction to pipe joints and fittings- soldered fittings-screwed connections - pipe connections- oval type flanged pipe joint.

UNIT – V DESIGN OF BEARINGS **9**

Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Sommerfeld Number, Raimondi & Boyd graphs - Selection of Rolling Contact bearings-Seals and Gaskets.

TOTAL Periods **45**

COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Analyze machine components under static and dynamic loading conditions using advanced stress analysis techniques.
CO2	Apply the design principles to develop shafts and couplings for mechanical systems.
CO3	Apply the design methodology for both temporary and permanent joints including flanged and bushed-pin couplings.

CO4	Analyze the design of mechanical elements such as springs, flywheels, and connecting rods based on loading requirements.
CO5	Evaluate the selection and design parameters of sliding and rolling contact bearings for various applications.
TEXT BOOKS	
1	Bhandari V, Design of Machine Elements, 4th Edition, McGraw-Hill Book Co, 2020.
2	Joseph Shigley, Richard G. Budynas and J. Keith Nisbett, —Mechanical Engineering Design‖, 10th Edition, Tata McGraw-Hill, 2015.
3	R.S. Khurmi, J.S. Gupta, A Textbook in Machine Design, S Chand Publishing, 2022
REFERENCES	
1	PSG Design Databook
2	Design of Machine Elements | SI Edition | Eighth Edition | By Pearson by M. F. Spotts, Terry E. Shoup, et al., 2019
3	Ansel C Ugural, “Mechanical Design – An Integral Approach”, 1st Edition, Tata McGraw-Hill Book Co, 2004.
4	Merhyle Franklin Spotts, Terry E. Shoup, and Lee Emrey Hornberger, “Design of Machine Elements” 8th Edition, Printice Hall, 2004
5	Robert C. Juvinall and Kurt M. Marshek, “Fundamentals of Machine component Design”,6th Edition, Wiley, 2017.
6	Sundararajamoorthy T. V. and Shanmugam. N, “Machine Design”, Anuradha Publications, Chennai, 2003.

CO/PO, PSO Mapping
(3/2/1 indicates the strength of correlation) 3-Strong 2-Medium, 1-Weak
Programme Outcomes (POs) and Programme Specific Outcomes PSOs'

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	-	-	-	-	-	1	1	2	-	3	2	2
CO2	3	3	-	2	-	-	-	-	1	1	2	-	3	2	2
CO3	3	3	-	2	-	-	-	-	1	1	2	-	3	2	2
CO4	3	3	-	2	-	-	-	-	1	1	2	-	3	2	2
CO5	3	3	2	2	-	-	-	-	1	1	2	-	3	2	2
AVG	3	2.8	1	1.6	-	-	-	-	1	1	2	-	3	2	2

Meenakshi Sundararajan Engineering College

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Department : Mechanical Engineering, R2024, CBCS

U24ME502	THEORY OF MACHINES	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES : To design, analyze, and experimentally study a simple mechanical system incorporating kinematics, gear trains, mass balancing, force analysis, and friction.

1	To understand the principles in the formation of mechanisms and their kinematics.
2	To apply the basic concepts of toothed gearing and kinematics of gear trains.
3	To analyze the importance of balancing and vibration.
4	To analyze the forces and torque acting on simple mechanical systems.
5	To evaluate the effect of friction in different machine elements.

UNIT I- KINEMATIC ANALYSIS IN SIMPLE MECHANISMS AND CAMS — **9+3**

Mechanisms -Terminology and definitions -kinematics inversions and analysis of 4 bar and slider crank chain- velocity and acceleration polygons- Cams- classifications- displacement diagrams- layout of plate cam profiles.

Practicals:

1.Cams – Cam profile drawing and Motion curves .

UNIT II TOOTHED GEARING AND GEAR TRAINS — **9+3**

Gear terminology- law of toothed gearing - involute gearing - Gear tooth action- Interference and undercutting - gear trains - parallel axis gear trains - epicyclic gear trains.

Practicals:

1. Study of gear parameters: Experimental study of velocity ratios of simple, compound, epicyclic and differential gear trains.

UNIT III BALANCING OF ROTATING MASSES AND VIBRATION — **9+24**

Static and Dynamic balancing - Balancing of revolving masses - Balancing machines -Free vibrations - natural Frequency - Damped Vibration -Critical speed of simple shafts - Forced vibration - Harmonic forcing - Vibration isolation.

Practicals:

1.Single degree of freedom Spring Mass System – Determination of natural Frequency and verification of Laws of springs.

2.Determination of torsional natural frequency of single undamped rotor system.

3.Whirling of shafts – Determination of critical speeds of shafts with concentrated loads.

4.Determination of Mass moment of inertia of Fly wheel and Axle system.

5.Determination of Mass Moment of Inertia of axisymmetric bodies using Turn table apparatus.

6.Motorized gyroscope – Study of gyroscopic effect and couple.

7.Governor - Determination of range sensitivity and effort for Watts and Porter governor.

8.Governor - Determination of range sensitivity and effort for Proell governor.

UNIT IV STATIC AND DYNAMIC FORCE ANALYSIS — **9**

Applied and Constrained Forces - Free body diagrams - Static equilibrium conditions - Static Force analysis in simple mechanisms - Dynamic Force Analysis in simple machine members - Inertia Forces and Inertia Torque - D'Alembert's principle.

UNIT – V FRICTION ASPECTS IN MACHINE COMPONENTS — **9**

Surface contacts - Sliding and Rolling friction - Friction drives - Friction in screw threads - Friction clutches - Belt drives - Friction aspects in brakes.

TOTAL Periods — **75**

Meenakshi Sundararajan Engineering College

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Department : Mechanical Engineering, R2024, CBCS

COURSE OUTCOMES	
At the end of the course, the student will be able to	
CO1	**Create** the linkages and the cam mechanisms for specified output motions.
CO2	**Analyze** the gear parameters of toothed gearing and speeds of gear trains in various applications
CO3	**Analyze** the balancing masses on rotating machineries and the natural frequencies of free and forced vibratory systems.
CO4	**Analyze** the forces on members of mechanisms during static and dynamic equilibrium conditions and to determine gyroscopic couple and various parameters of governors
CO5	**Evaluate** the frictional torque in screw threads, clutches, brakes and belt drives and to determine mass moment of inertia of flywheel and axle system and axisymmetric bodies.

TEXT BOOKS	
1	Uicker, J.J., Pennock G.R and Shigley, J.E., “Theory of Machines and Mechanisms”, Oxford University Press, 2017.
2	Ramamurthi. V, “Mechanics of Machines”, Narosa Publishing House, 3rd edition 2019

REFERENCES	
1	Cleghorn. W. L., Nikolai Dechev, “Mechanisms of Machines”, Oxford University Press, 2015.
2	Rao.J.S. and Dukkipati.R.V. “Mechanism and Machine Theory”, New Age International Pvt. Ltd., 2006
3	Rattan, S.S, “Theory of Machines”, McGraw-Hill Education Pvt. Ltd., 2014
4	Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw-Hill, 2017.

CO/PO, PSO Mapping

(3/2/1 indicates the strength of correlation) 3-Strong 2-Medium, 1-Weak

Programme Outcomes (POs) and Programme Specific Outcomes PSOs'

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	3	-	2	-	-	-	1	1	1	1	3	1	-
CO2	3	3	-	2	2	-	-	-	1	1	1	1	3	1	-
CO3	3	3	-	3	2	-	-	-	1	1	1	1	3	1	-
CO4	3	3	-	2	2	1	-	-	1	1	1	1	3	1	-
CO5	3	3	-	2	2	-	-	-	1	1	1	1	3	1	-
AVG	3	2.8	0.6	1.8	2	0.2	-	-	1	1	1	1	3	1	-

Meenakshi Sundararajan Engineering College

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Department : Mechanical Engineering, R2024, CBCS

U24ME503	HEAT AND MASS TRANSFER	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES: To apply the principles of heat and mass transfer to analyze, design, and develop product-based projects through practical learning and application-driven problem solving.

1	To enable students to understand and apply various methods to analyze conduction heat transfer mechanisms through practical exposure and problem-solving.
2	To expose the mechanisms of free and forced convection using experimental and analytical approaches.
3	To demonstrate the phase change heat transfer and determine the performance of heat exchanging devices
4	To develop and apply shape factor algebra for black body and grey body radiation using geometrical configurations
5	To develop the fundamental concepts of diffusion and convective mass transfer with application-oriented understanding

UNIT-1 CONDUCTION — 9 + 9

General Differential equation- Cartesian, Cylindrical and Spherical Coordinates with and without heat generation Boundary Conditions. Thermal Contact -Resistance State Heat Conduction. Plane and Composite Systems- Critical radius of insulation -Extended Surfaces. Unsteady Heat Conduction Lumped Analysis - Semi Infinite and Infinite Solids -Use of Heisler's charts. Methods of enhanced thermal conduction.

Practicals:

1. . Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.
2. Thermal conductivity measurement of Guarded plate apparatus
3. Determination of thermal conductivity of a composite wall, insulating powder, oils, and water.

UNIT-2 CONVECTION — 9 + 6

Classification of fluid flows, Momentum equations- Energy &, Velocity & Thermal Boundary layers -Forced Convection Entry region, heat transfer and pressure drop for fluid flow in tubes. Drag and heat transfer in External flow. Flat plate, cylinders, spheres and tube banks. Free convection – Vertical, Horizontal, Inclined plates, Cylinders and Spheres.

Practicals:

4. Determination of heat transfer coefficient of air under natural convection
5. Determination of heat transfer coefficient of air under forced convection.
6. Heat transfer from pin-fin under natural convection
7. Heat transfer from pin-fin under forced convection.

UNIT-3 HEAT TRANSFER APPLICATIONS — 9 + 9

Boiling and Condensation Physical mechanisms, Regimes and heat transfer Fin Design Uniform and non-uniform cross sectional area, fin performance, overall surface efficiency. Heat Exchangers - Overall heat transfer coefficient, LMTD, ε-NTU method, TEMA classification - calculations.

Practicals:

8. Determination of heat flux under pool boiling and flow boiling in various regimes.
9. Determination of heat transfer coefficient in film-wise and drop-wise condensation.
10. Determination of Overall, heat transfer coefficient of cold/hot fluid and effectiveness of a double pipe heat exchanger

UNIT-4 RADIATION	**9 + 6**
Fundamental concepts- Radiation intensity, Black body radiation, View factor Surface emission. ,Kirchhoff's law , Radiation heat transfer between two surfaces. Radiation shields, Thermal radiation network. **Practicals:** 11. Determination of Stefan – Boltzmann constant. 12. Determination of emissivity of a Test surface.	
UNIT-5 SIMULTANEOUS HEAT & MASS TRANSFER	**9**
Machine Learning in Heat Transfer Introduction, Linear regression and Neural networks. Fick's law of diffusion Boundary conditions, Rate equations, Convective Mass Transfer, Analogy between Friction, Heat and Mass transfer coefficients.	
	TOTAL: 75

COURSE OUTCOMES	
At the end of the course, the student will be able to	
CO1	Apply various analytical and experimental methods to calculate conduction heat transfer in different geometries through practical problem-solving.
CO2	Analyze free and forced convection heat transfer phenomena and interpret results from experiments.
CO3	Demonstrate and evaluate the performance of heat exchange devices involving phase change (boiling/condensation)
CO4	Apply shape factor algebra to evaluate radiative heat exchange between surfaces for black and grey bodies
CO5	Apply basic principles of diffusion and convective mass transfer in engineering applications.

TEXT BOOKS	
1	Sachdeva, R.C., "Fundamentals of Engineering Heat and Mass Transfer", New Age International Publishers, 2017.
2	Yunus A.Cengel and Afshin Ghajar, "Heat and Mass Transfer: Fundamentals and Applications", 6th Edition, Mc Graw Hill Education, 2020.

REFERENCES	
1	Nag P.K., "Heat and Mass Transfer", 3rd Edition, Mc Graw Hill Education, 2011
2	Mahesh M. Rathore, "Engineering Heat and Mass Transfer", LaxmiPublication , 4th Edition, 2023.
3	Necati Ozisik, "Heat Transfer – a Basic Approach", McGraw Hill, 1994
4	Holman, J.P., "Heat Transfer", 10th Edition, McGraw Hill Education, 2017
5	Rajput, R.K., "A Text Book of Heat and Mass Transfer", 7th Edition, S.Chand& Company Ltd, 2018.
6	Prof. Gaurav Dixit A Text Book of Convective Heat Transfer Indian Institute Of Technology Roorkee, NPTEL

Meenakshi Sundararajan Engineering College

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Department : Mechanical Engineering, R2024, CBCS

CO/PO, PSO Mapping (3/2/1 indicates the strength of correlation) 3-Strong 2-Medium, 1-Weak Programme Outcomes (POs) and Programme Specific Outcomes PSOs'															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	-	1	-	-	-	-	2	1	2	-	1	2	-
CO2	3	3	-	2	-	-	-	-	2	1	2	-	1	2	-
CO3	3	3	-	2	-	-	-	-	2	1	2	-	1	2	-
CO4	3	3	-	2	-	-	-	-	2	1	2	-	1	2	-
CO5	3	2	-	2	-	-	-	-	-	-	-	-	-	2	-
AVG	3	2.6	-	1.8	-	-	-	-	1.8	0.8	1.8	-	0.8	2	-

Meenakshi Sundararajan Engineering College

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Department : Mechanical Engineering, R2024, CBCS

U24ME504	CAD /CAM LAB	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES : To create and simulate complete mechanical systems through 3D modeling, assembly, and CNC programming, integrating design and manufacturing principles for real-world applications.

1	To apply the gain practical experience in handling 2D drafting and 3D modelling software systems
2	To analyze the designing 3 Dimensional geometric model of parts, sub-assemblies, assemblies and exporting it to drawing
3	To evaluate the programming G & M Code programming and simulate the CNC program and Generating part programming data through CAM software
LIST OF EXPERIMENTS	
PART – I CAD Introduction	
1	Sketch: Solid modeling: Extrude, Revolve, Sweep, Variational sweep and Loft. Surface modeling: Extrude, Sweep, Trim, Mesh of curves and Free form. Feature manipulation: Copy, Edit, Pattern, Suppress, History operations. Assembly: Constraints, Exploded Views, Interference check Drafting: Layouts, Standard & Sectional Views, Detailing & Plotting
PART– II Creation of 3D assembly model of following machine elements using 3D Modelling software	
1	Flange Coupling
2	Plummer Block
3	Screw Jack
4	Universal Joint
5	Stuffing box
6	Crosshead
7	Connecting rod
8	Piston
PART– III MANUAL PART PROGRAMMING	
1	CNC Machining Centre i) Linear Cutting. ii) Circular cutting. iii) Cutter Radius Compensation. iv) Canned Cycle Operations.
2	CNC Turning Centre i) Straight, Taper and Radial Turning. ii) Thread Cutting. iii) Rough and Finish Turning Cycle. iv) Drilling and Tapping Cycle.
3	COMPUTER AIDED PART PROGRAMMING i) Generate CL Data and Post process data using CAM packages for Machining and Turning Centre. ii) Application of CAPP in Machining and Turning
TOTAL Periods	**60**

COURSE OUTCOMES	
At the end of the course, the student will be able to	
CO1	**Apply** the design experience in handling 2D drafting and 3D modelling software systems
CO2	**Analyze** the design 3 Dimensional geometric model of parts, sub-assemblies, assemblies and export it to drawing
CO3	**Evaluate** the manual part programming and simulate the CNC program and Generate part programming using G and M code through CAM software.
TEXT BOOKS	
1	Radhakrishnan.P, Subramanyan.S and Raju V., CAD/CAM/CIM, 2nd Edition, New Age International (P) Ltd, New Delhi, 2018. [ISBN: 8122439802].
REFERENCES	
1	Ibrahim Zeid, Mastering CAD CAM, Tata McGraw-Hill PublishingCo.2007. [ISBN:9780070634343].
2	Chris McMahon and Jimmie Browne, CAD/CAM Principles, Practice and Manufacturing management, Second Edition, Pearson Education, 2000. [ISBN: 9814053112].
3	Donald Hearn and M. Pauline Baker, Computer Graphics, Prentice Hall, Inc,1996. [ISBN: 9780135309247].

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Programme Outcomes (POs) and Programme Specific Outcomes PSOs'

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	3	-	-	-	2	-	-	1	3	3	1
CO2	2	2	2	2	3	-	-	-	2	-	-	1	3	3	1
CO3	2	2	2	2	3	-	-	-	2	-	-	1	3	3	1
AVG	2	2	2	2	3	-	-	-	2	-	-	1	3	3	1

Meenakshi Sundararajan Engineering College

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Department : Mechanical Engineering, R2024, CBCS

U24ED511	PROTOTYPE AND MARKET VALUATION	L	T	P	C
		0	0	1	0.5

Course Objectives

1	To understand the purpose, process, and transition from ideation to prototyping in the design thinking framework.
2	To develop the ability to plan and perform testing processes for validating prototypes and iterating for improvement.
3	To analyze and create various forms of rapid and resource-efficient experimentation methods including risk and failure analysis
4	To evaluate and incorporate feedback through structured methods for refining the prototype based on stakeholder insights.
5	To create a strategic roadmap for evolving prototypes into validated market-ready solutions through metrics and stakeholder planning.

UNIT I PROTOTYPE — **1**

- Transitioning from Ideate Mode
- What is the Prototype mode?
- Why Prototype?
- How to Prototype?
- How to seamlessly transition from Prototype to Test?

UNIT II TEST — **2**

- What is the Test Mode?
- How to Test?
- How to iterate for continuous improvements?
- Deciding how to move forward (Persevere or Pivot)
- How to make the process to repetitively lead to product / service improvements

UNIT III EXPERIMENTATION — **4**

- Make prototypes (Fast & Cheap / Simulate & Stimulate)
- Create and Try, Experience Prototypes by shrinking big things down
- Rapid Concept Development
- Assumptions, Constraints, Limitations, Potential point of failures and Risk Analysis
- Test prototypes by Customer Co-Creation

UNIT IV FEEDBACK — **4**

- Identify potential sources of feedback
- Obtain feedback from select participants (Client / Customer / Consumer / Stakeholder)
- Build a questionnaire guide by starting specific to moving broad
- Probe deep, facilitate feedback prompts, capture input and integrate overall feedback
- Identify costs, resources, infrastructure, features and functionalities to iterate based on what is available vs. needed at the institution to decide buying needs

UNIT V EVOLUTION — **4**

- Track learnings and establish Learning Launches
- Define success with Impact Guidance
- Identify methods of tracking (Measures / Metrics – Lag or Lead)
- Document progress and asset needs iteratively by effective stakeholder engagement to plan next steps
- Define RASCI / RACI Chart to prepare and pitch product or service concept for Market Valuation by Storytelling

TOTAL PERIODS — **15**

Meenakshi Sundararajan Engineering College

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Department : Mechanical Engineering, R2024, CBCS

Course Outcomes	
At the end of the course students will be able to	
1	Explain the importance of prototyping and describe how to create and transition from ideate to prototype and then to test mode.
2	Apply appropriate testing techniques to evaluate prototypes and determine whether to persevere or pivot based on test results.
3	Analyze assumptions, constraints, and risks in experimental prototypes and develop effective rapid concept models.
4	Evaluate feedback using probing tools like questionnaires and integrate the insights to modify their solution.
5	Design a market-pitch-ready concept using tools like RASCI/RACI, impact tracking, and storytelling.
TEXTBOOKS	
1	An Introduction to Design Thinking PROCESS GUIDE, Hasso Plattner, d. School
2	Tim Brown, “Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation”, Harper Publications, 2009
3	Don Norman, “The Design of Everyday Things”, Basic Books, 2013
4	Tom Kelley, David Kelley, “Creative Confidence: Unleashing the Creative Potential Within Us All”, Currency, 2013
REFERENCE BOOKS	
1	Hasso Plattner, Christoph Meinel, Larry Leifer, “Design Thinking: Understand – Improve – Apply (Understanding Innovation)”, Springer, 2011
2	Jakob Schneider, Marc Stickdorn, “This Is Service Design Thinking: Basics, Tools, Cases”, John Wiley & Sons, 2011
3	Tom Kelley, The Art of Innovation: Lessons in Creativity from IDEO, America's Leading Design Firm, Currency, 2001

CO/PO, PSO Mapping

(3/2/1 indicates the strength of correlation) 3-Strong 2-Medium, 1-Weak

Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	3	1	3	2	1	3	3	3	3	-	-	-
CO2	2	3	3	3	1	3	2	1	3	3	3	3	-	-	-
CO3	2	3	3	3	1	3	2	1	3	3	3	3	-	-	-
CO4	2	3	3	3	1	3	2	1	3	3	3	3	-	-	-
CO5	2	3	3	3	1	3	2	1	3	3	3	3	-	-	-
AVG	2	3	3	3	1	3	2	1	3	3	3	3	-	-	-

Meenakshi Sundararajan Engineering College

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Department : Mechanical Engineering, R2024, CBCS

U24RM514	DOMAIN SPECIFIC EXPERIMENTS/METHODOLOGY/ALGORITHMS	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES

1	Analyze different research paradigms and experimental design types to select appropriate methodologies for domain-specific research.
2	Apply experimental methodologies and instrumentation techniques in laboratory and simulation contexts for engineering research.
3	Analyze and implement domain-specific algorithms and optimization techniques using computational tools.
4	Analyze qualitative research methodologies and tools for social science data collection and analysis.
5	Evaluate interdisciplinary research approaches and emerging technologies to enhance research quality and reproducibility.

UNIT1 Introduction to Research Methodologies and Experimental Design	**6**
Overview of research paradigms (qualitative, quantitative, mixed methods), Types of experimental designs (true, quasi, and non-experimental), Domain-specific needs: controlled vs. field experiments, Key concepts: validity, reliability, reproducibility, Ethical considerations in experimentation	
UNIT2 Experimental Methodologies in Science and Engineering	**6**
Laboratory vs. simulation-based experiments, Design of Experiments (DoE) in engineering, Measurement systems and calibration, Data acquisition and instrumentation techniques, Case studies: electrical circuits, mechanical systems, fluid dynamics, etc.	
UNIT3 Algorithms in Computational and Data-Driven Domains	**6**
Algorithmic problem-solving in domain-specific contexts (e.g., shortest path in transportation, clustering in biology), Numerical methods and optimization algorithms, AI/ML algorithms and model evaluation strategies, Domain-specific programming and simulation tools (e.g.,MATLAB, Python, R, NS-3, Ansys, etc.), Case studies: image processing, robotics, bioinformatics, cybersecurity, etc.	
UNIT4 Methodologies in Social Sciences and Humanities	**6**
Survey research, interviews, and ethnographic methods, Sampling techniques and field data collection, Case study and content analysis, Tools: SPSS, NVivo, ATLAS.ti, Case studies: behavioral research, education studies, cultural research	
UNIT5 Interdisciplinary Approaches and Emerging Trends	**6**
Cross-domain methodologies: combining qualitative and quantitative, IoT-based experiments (e.g., smart agriculture, smart health), Simulation-based research and digital twins, Research using big data and cloud platforms, Ethics, reproducibility, and open science trends	
	TOTAL: 30

At the end of the course, the student will be able to

CO1	Differentiate research paradigms and experimental designs, evaluating their applicability and ethical considerations in various fields.
CO2	Design and conduct experiments using DoE principles, data acquisition systems, and measurement calibration in engineering applications.
CO3	Solve algorithmic problems using numerical methods and AI/ML models, applying appropriate programming and simulation tools.
CO4	Design and conduct surveys, interviews, and case studies using qualitative tools like SPSS, NVivo, and ATLAS.ti.

CO5	Integrate cross-domain methods, employ IoT and big data tools, and uphold ethical standards in modern research contexts.
TEXT BOOKS	
1	R. Kumar, Research Methodology: A Step-by-Step Guide for Beginners, 4th ed. London, UK: SAGE Publications, 2019.
2	D. C. Montgomery, Design and Analysis of Experiments, 9th ed. Hoboken, NJ, USA: Wiley, 2017.
3	S. J. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, 4th ed. Upper Saddle River, NJ, USA: Pearson, 2020.
REFERENCES	
1	B. Stroustrup, Programming: Principles and Practice Using C++, 2nd ed. Boston, MA, USA: Addison-Wesley Professional, 2014. (for algorithm implementations)
3	S. S. Rao, Engineering Optimization: Theory and Practice, 5th ed. Hoboken, NJ, USA: Wiley, 2020.

CO/PO, PSO Mapping

(3/2/1 indicates the strength of correlation) 3-Strong 2-Medium, 1-Weak
Programme Outcomes (POs) and Programme Specific Outcomes PSOs'

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	1	1	2	2	2	1	2	-	-	-
CO2	3	2	3	2	3	1	1	2	2	3	2	3	-	-	-
CO3	3	3	3	2	3	1	1	2	3	3	2	3	-	-	-
CO4	2	2	2	3	2	1	1	3	2	3	3	3	-	-	-
CO5	3	3	3	3	3	2	2	3	3	3	3	3	-	-	-
AVG	2.8	2.6	2.6	2.6	2.6	1.2	1.2	2.4	2.4	2.8	2.2	2.8	-	-	-

Meenakshi Sundararajan Engineering College

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Department : Mechanical Engineering, R2024, CBCS

U24ME601	DESIGN OF TRANSMISSION SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES : To design, develop, and demonstrate mechanical transmission systems and components by integrating theoretical knowledge and fabrication skills to create functional models for real-world applications.

1	To analyze and compare different types of mechanical power transmission elements like belts, chains, and ropes for various loading and speed conditions.
2	To evaluate the performance of gear systems (spur, helical, bevel, worm) under varying dynamic and load conditions using standard design methodologies such as AGMA.
3	To design and synthesize advanced mechanical systems such as multi-speed gearboxes, clutches, brakes, and cams considering strength, fatigue, wear, and operational constraints.
4	To integrate knowledge of gear and flexible element design into complete transmission systems for industrial and automotive applications.
5	To critically assess failure modes in power transmission elements and propose design improvements or alternative configurations.

UNIT-1 DESIGN OF FLEXIBLE ELEMENTS	**9**

Design of Flat belts and pulleys, - Selection of V belts and sheaves - Selection of wire ropes and pulleys, Design of Transmission Chains and Sprocket, Motor power capacity for various applications .

.

UNIT-2 SPUR GEARS AND PARALLEL AXIS HELICAL GEARS	**9**

Spur and Helical gears Introduction. Gear materials, Speed ratios and number of teeth Design of straight tooth spur & helical gears. Force analysis, Tooth stresses and Dynamic effects, Failure in gears. Fatigue strength, Factor of safety, strength, and wear considerations .Design of gears using AGMA procedure involving Lewis and Buckingham equations.

UNIT-3 BEVEL AND WORM GEARS	**9**

Bevel Gear- Introduction, Straight bevel gear Types, Geometry, Angle relations, Gear materials, Tooth terminology, tooth forces and stresses, Force analysis Equivalent number of teeth, Estimation of dimensions of straight bevel gears. Worm Gear: Gear materials Tooth terminology, Forces on worm and worm wheel, Thermal capacity, forces and stresses, efficiency, estimation of dimensions of worm gear pair. Modes of failures.

UNIT-4 GEAR BOXES	**9**

Geometric progression Standard step ratio - Construction of Kinematic diagram for driver and driven, Ray diagram, kinematics layout - Design of sliding mesh gear box, Design of multi speed gear box for machine tool applications Calculation of number of teeth. Constant mesh gear box Speed reducer unit. Variable speed gearbox Fluid Couplings Torque Converters for automotive applications.

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UNIT 5 CAMS, CLUTCHES AND BRAKES	**9**
Cam Design Types- pressure angle and undercutting base circle determination forces and surface stresses, Design of plate clutches axial clutches-cone clutches- internal expanding rim clutches Electromagnetic clutches Band and Block brakes external shoe brakes Internal expanding shoe brake.	
	TOTAL: 45

Course Outcomes	
At the end of the course, the student will be able to	
CO1	Analyze the suitability of belts, ropes, and chains for specific power transmission applications based on operating conditions and design constraints.
CO2	Evaluate gear tooth stresses, dynamic effects, and gear failure mechanisms using AGMA standards, and recommend improvements for enhanced durability.
CO3	Design spur, helical, bevel, and worm gear systems incorporating strength, wear, and thermal considerations.
CO4	Analyze the kinematic and dynamic behavior of gearboxes and develop optimized gear train layouts for specific performance targets.
CO5	Design and synthesize advanced braking and clutch systems for automotive and industrial applications, considering material strength and actuation forces.

TEXT BOOKS	
1	Bhandari V, “Design of Machine Elements”, 4th Edition, Tata McGraw-Hill Book Co, 2016.
2	Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett “Mechanical Engineering Design”, 8th Edition, Tata McGraw-Hill, 2008.
3	S.Md.Jalaludeen, Machine Design, Anuradha Publications,Chennai, 2003

REFERENCES	
1	Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, “Design of Machine Elements” 8th Edition, Printice Hall, 2003.
2	Orthwein W, “Machine Component Design”, Jaico Publishing Co, 2003.
3	Prabhu. T.J., “Design of Transmission Elements”, Mani Offset, Chennai, 2000.
4	Robert C. Juvinall and Kurt M. Marshek, “Fundamentals of Machine Design”, 4th Edition, Wiley,2005
5	Sundararajamoorthy T. V, Shanmugam .N, “Machine Design”, Anuradha Publications,Chennai, 2003.

CO/PO, PSO Mapping

(3/2/1 indicates the strength of correlation) 3-Strong 2-Medium, 1-Weak

Programme Outcomes (POs) and Programme Specific Outcomes PSOs'

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	2	-	-	-	-	1	1	2	2	3	1	2
CO2	3	3	3	2	-	-	-	-	1	1	2	2	3	1	2
CO3	3	3	3	2	-	-	-	-	1	1	2	2	3	1	2
CO4	3	3	3	2	-	-	-	-	1	1	2	2	3	1	2
CO5	3	3	3	2	-	-	-	-	1	1	2	2	3	1	2
AVG	3	3	3	2	-	-	-	-	1	1	2	2	3	1	2

Meenakshi Sundararajan Engineering College

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Department : Mechanical Engineering, R2024, CBCS

U24MG602	PROJECT MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives: To explore a range of AI tools aimed at providing a comprehensive understanding of project management principles and practices.

1	To analyze the structure and dynamics of project management systems, including project lifecycles, goals, and constraints.
2	To evaluate the effectiveness of project planning techniques such as critical path analysis and PERT in managing time and risk.
3	To critically assess project budgeting and procurement strategies, incorporating cost estimation challenges, quality, and risk management principles.
4	To interpret and analyze earned value metrics for measuring project performance in terms of cost and schedule efficiency.
5	To create and apply forecasting models for financial planning and project evaluation based on time value of money and investment appraisal techniques.

UNIT- I INTRODUCTION TO PROJECT MANAGEMENT	**9**
"Introduction to PM What is "PM"? Systems Approach to PM Project structures Project and product life cycles Project Portfolio Process Project justification - The specification Constraints, limits, assumptions, and technical requirements & Terms - Mission, goals and Strategy.	
UNIT-2 PROJECT PLANNING	**9**
Project planning Project planning as a value adding activity - Process of project planning - Managing the planning process Communicating project plans Analysing the network - Critical Path Analysis - Activity on nodes diagramming, Dealing with the uncertainty Program Evaluation and Review Technique	
UNIT-3 PROJECT BUDGETING	**9**
Project Cost Estimation & Budgeting -Effects of Cost and Demand in Project Budgeting, Problems in Cost Estimation - Project Quality Management - Project Risk Management - Project Procurement Management & Contracting Project Monitoring & Control Agile & Lean PM – Project auditing - Accounting Basics.	
UNIT-4 EARNED VALUE MANAGEMENT	**9**
Introduction to financial management - Understanding Financial Statements- Accounting Basics Planned value and earned value Actual cost - Cost and Schedule Cost and schedule analysis .	
UNIT-5 PROJECT COST, FORECASTING & EVALUATION	**9**
Project Level Cost Control Introduction Project Level Cost Control – Problems Forecasting Financial Needs Forecasting Financial Needs Problems, Time Value of Money and Evaluating investments Time Value of Money and Evaluating investments Problems.	
TOTAL Periods	**45**

COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	**Analyze** project structures, life cycles, and justifications to align project missions with organizational strategy.
CO2	**Evaluate** complex project planning scenarios using techniques like network analysis, critical path, and PERT under uncertainty.

CO3	**Analyze and assess** the impacts of cost, demand, and risk in project budgeting and procurement management.
CO4	Evaluate project performance through earned value analysis by interpreting financial metrics such as planned value, actual cost, and earned value.
CO5	**Create** project cost forecasts and investment evaluations using financial tools like NPV and time value of money for long-term project success.

TEXT BOOKS

1	V E Rama Moorthy and P Gopalakrishnan, “Text Book of Project Management”, Laxmi Publications Pvt Ltd, First Edition, 2021.
2	John M. Nicholas and Herman Steyn, “Project management for Engineering, Business and Technology”, 6th Ed., Routledge Pub., NY, USA, 2021.
3	Daniel W. Halpin and Bolivar A. Senior, “Financial Management & Accounting Fundamentals for Construction”, John Wiley & Sons Inc., 2009.

REFERENCES

1	Joseph Heagney, “Fundamentals of Project Management:” Fifth Edition, AMAcom Publications, American Management Association, E book, 2021
2	Punmia B. C. and Khandelwal K.K., “Project Planning and Control with PERT/CPM”, Laxmi publications, New Delhi, 1989.
3	"A Guide to the Project Management Body of Knowledge (PMBOK Guide)” - Fifth Edition, An American National Standard, ANSI/PMI 990001-2008.
4	Jerome D. Wiest and Ferdinand K. Levy, “A Management Guide to PERT/CPM”, Prentice Hall of India Publishers Ltd., New Delhi, 1994.
5	Srinath L.S., “PERT & CPM- Principles and Applications”, Affiliated East West Press Pvt., Ltd., New Delhi, 2008
6	NPTEL videos at https://nptel.ac.in/courses/112102107/ by Prof. Arun Kanda, Dept of Mechanical Engineering, IIT, Delhi.
7	NPTEL videos at https://nptel.ac.in/courses/105106149/ by Dr. Koshy Varghese, Dept of Civil Engineering, IIT, Madras.

CO/PO, PSO Mapping
(3/2/1 indicates the strength of correlation) 3-Strong 2-Medium, 1-Weak
Programme Outcomes (POs) and Programme Specific Outcomes PSOs'

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	-	-	1	-	-	2	1	3	2	2
CO2	3	3	3	3	2	-	-	1	-	-	1	2	3	3	2
CO3	3	3	2	3	1	-	-	1	-	-	2	2	3	3	2
CO4	2	3	2	3	3	-	-	1	-	-	1	2	3	3	2
CO5	2	3	3	3	3	-	-	1	-	-	2	1	2	3	2
AVG	2.6	2.8	2.4	2.4	2.2	-	-	1	-	-	1.6	1.6	2.8	2.8	2

Meenakshi Sundararajan Engineering College

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Department : Mechanical Engineering, R2024, CBCS

U24ME602	Finite Element Analysis	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES :(Develop 1D FEM skills (spar/beam elements, thermal/vibration analysis) and expand to 2D elasticity (plane stress/strain/axisymmetric), including isoparametric formulations and numerical integration)

1	Improve your skills in developing stiffness matrices and load vectors for one-dimensional spar elements.
2	Prepare to develop the stiffness matrices and load vectors for one-dimensional beam elements.
3	Analyze heat transfer and vibration problems using one-dimensional finite element formulations.
4	Conduct a two-dimensional finite element analysis on elasticity issues that encompass plane stress, plane strain, and axisymmetric conditions.
5	Acquaint students with iso-parametric formulations and methods of numerical integration

UNIT 1 INTRODUCTION — **9**

Historical Background – Mathematical Modeling of field problems in Engineering – Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems– Weighted Residual Methods – Variational Formulation of Boundary Value Problems – Ritz Technique – Basic concepts of the Finite Element Method.

UNIT 2 ONE-DIMENSIONAL PROBLEMS — **9 + 12**

One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectorsAssembly of Matrices - Solution of problems from solid mechanics including thermal stresses heat transfer. Natural frequencies of longitudinal vibration and mode shapes. Fourth Order Beam Equation – Transverse deflections and Transverse Natural frequencies of beams

Practicals:

1.Force and Stress analysis using link elements in Trusses, cables and bars
2.Stress and deflection analysis in beams with different support conditions.
3.Modal analysis of Beams
4.Harmonic, transient, and spectrum analysis of simple systems

UNIT 3 TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS — **9 + 6**

Second Order 2D Equations involving Scalar Variable Functions – Variational formulation – Finite Element formulation – Triangular elements and Quadrilateral elements- Shape functions and element matrices and vectors. Application to Field Problems - Thermal problems – Torsion of Non-circular shafts

Practicals:

5.Stress and deflection analysis in beams with different support conditions
6.Thermal stress and heat transfer analysis of fins, plates, and cylinders

UNIT 4 TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS — **9 + 6**

Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Constitutive matrices and Strain displacement matrices – Stiffness matrix – Stress calculations - Plate and shell elements

Practicals:

7.Stress analysis of axi–symmetric components
8.Stress analysis of flat plates and simple shells

UNIT 5 ISOPARAMETRIC FORMULATION AND ADVANCED TOPIC — **9 + 6**

Natural co-ordinate systems – Isoparametric elements – Shape functions for isoparametric elements– One and two dimensions – Serendipity elements – Numerical integration - Meshing techniques - Introduction to Analysis Software-Introduction to Non Linearity

Practicals:

9.To model and analyze a 2D rectangular plate with a circular hole using iso parametric elements

10. To model and analyze a 2D spherical shell using iso parametric elements

TOTAL	**75 Periods**

COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Enhance your abilities to create stiffness matrices and load vectors specifically for one-dimensional spar elements.
CO2	Create the stiffness matrices and load vectors for one-dimensional beam elements, in addition to conducting vibration analysis.
CO3	Formulate and solve second-order 2D field problems using FEM, applying variational principles, triangular and quadrilateral elements, and higher-order elements to thermal analysis and torsion of non-circular shafts.
CO4	Analyze equations of elasticity for plane stress, plane strain, and axisymmetric problems in structural applications.
CO5	Develop shape functions for rectangular, quadrilateral, and isoparametric elements using natural coordinate systems.

TEXT BOOKS

1	Tirupathi R. Chandrupatla and Ashok D Belegunudu, Introduction to Finite Elements in Engineering, 5th Edition, 2021, Cambridge University Press
2	Daryl L Logan, “A First Course in Finite Element Method”, 2016, Cengage Learning.
3	Rao, S.S., “The Finite Element Method in Engineering”, 6th Edition, ButterworthHeinemann,2018.

REFERENCES

1	1. Bhavikatti S S , "Finite Element Analysis", 1 st Edition, New Age International, 2015
2	2. J N Reddy, Introduction to Finite Element Method, 2020, McGraw Hill Education.
3	David Hutton, Introduction to Finite Element Analysis, 2017, McGraw Hill Education

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(3/2/1 indicates the strength of correlation) 3-Strong 2-Medium, 1-Weak
Programme Outcomes (POs) and Programme Specific Outcomes PSOs'

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	2	2	-	-	-	1	1	2	1	3	2	2
CO2	3	3	-	2	2	-	-	-	1	1	1	2	3	2	2
CO3	3	3	2	3	2	-	-	-	1	1	2	2	3	2	2
CO4	3	3	-	2	2	-	-	-	1	1	1	2	3	2	2
CO5	3	2	2	-	2	-	-	-	1	1	2	1	3	2	2
AVG	3	2.6	0.8	1.8	2	-	-	-	1	1	1.6	1.6	3	2	2

Meenakshi Sundararajan Engineering College

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Department : Mechanical Engineering, R2024, CBCS

U24RM612	TECHNICAL WRITING AND RESEARCH ETHICS	L	T	P	C
		0	0	1	0.5

COURSE OBJECTIVES

1	Apply the principles of clarity, conciseness, coherence, and correctness in technical writing tasks.
2	Analyze the structure and components of various research and technical documents using the IMRaD format.
3	Apply principles of formal, objective, and precise language in crafting professional technical documents.
4	Evaluate the effectiveness of visual elements (tables, charts, graphs) in technical documentation and revise them for clarity and precision.
5	Analyze ethical issues related to research publication, data integrity, authorship, and collaborative writing.

UNIT 1 Fundamental of Technical Writing	**3**
Nature and scope of technical writing vs. academic writing, Characteristics of effective technical writing: clarity, conciseness, coherence, correctness, Audience analysis and purpose identification, Writing process: planning, drafting, revising, editing, Common technical documents: manuals, reports, proposals, research papers	
UNIT 2 Writing Research and Technical Documents	**3**
Structure and format of research papers (IMRaD structure), Writing abstracts, introductions, literature reviews, methodologies, results, and conclusions, Writing technical reports, project documentation, lab reports, Research proposals and funding applications, Case studies of well-written technical documents	
UNIT 3 Language and Style in Technical Writing	**3**
Use of formal, objective, and precise language, Active vs. passive voice; tone and style, Grammar, punctuation, and sentence construction, Avoiding jargon, redundancy, and ambiguity, Consistency in units, terminology, and symbols	
UNIT 4 Data Presentation and Visual Communication	**3**
Integrating tables, charts, graphs, and diagrams effectively, Captioning, labelling, and referencing visuals, Tools for creating visuals (Excel, Python, R, LaTeX), Guidelines for formatting figures and tables (APA, IEEE, etc.), Visual abstracts and infographics in technical communication	
UNIT 5 Ethics, Review, and Publishing	**3**
Plagiarism, citation styles (APA, MLA, IEEE), and referencing tools (Zotero, Mendeley), Ethics in authorship, collaborative writing, and data reporting, Ethical issues in Research planning and design, Ethics in data collection, analysis and interpretation, Publication ethics and professional conduct, Contemporary and Emerging ethical challenges.	
	TOTAL: 15

At the end of the course, the student will be able to

CO1	Draft effective technical documents that demonstrate clarity, coherence, and appropriateness for a specified audience and purpose.
CO2	Deconstruct well-written technical documents and identify effective strategies in structuring abstracts, literature reviews, and methodologies.
CO3	Produce grammatically accurate and stylistically appropriate texts while minimizing ambiguity and redundancy.
CO4	Design and integrate well-labeled, correctly formatted visuals to support technical arguments in reports and presentations.
CO5	Critically assess research practices for ethical compliance, and apply appropriate citation and referencing standards using tools like Zotero or Mendeley.

TEXT BOOKS	
1	M. Alley, The Craft of Scientific Writing, 3rd ed. New York, NY, USA: Springer, 1996.
2	A. Eisenberg, Guide to Technical Writing, New York, NY, USA: Macmillan, 1978.
3	W. Strunk Jr. and E. B. White, The Elements of Style, 4th ed. Boston, MA, USA: Pearson, 2022.
4	D. B. Resnik, The Ethics of Science: An Introduction, 2nd ed. New York, NY, USA: Routledge, 2018.
5	A. E. Shamoo and D. B. Resnik, Responsible Conduct of Research, 4th ed. New York, NY, USA: Oxford Univ. Press, 2022.
REFERENCES	
1	J.-L. Lebrun, Scientific Writing: A Reader and Writer's Guide, Singapore: World Scientific, 2007.
2	S. Bailey, Academic Writing: A Handbook for International Students, 5th ed. New York, NY, USA: Routledge, 2018.

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Programme Outcomes (POs) and Programme Specific Outcomes PSOs'

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	1	1	1	1	1	2	3	1	2	-	-	-
CO2	2	3	2	3	2	1	1	2	2	3	2	3	-	-	-
CO3	2	2	2	1	1	1	1	2	2	3	2	3	-	-	-
CO4	2	2	3	2	3	1	1	1	2	3	3	3	-	-	-
CO5	2	2	1	2	2	2	2	3	2	3	2	3	-	-	-
AVG	2.0	2.0	2.0	1.8	1.8	1.2	1.2	1.8	2.0	3.0	2.0	2.8	-	-	-

Meenakshi Sundararajan Engineering College

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Department : Mechanical Engineering, R2024, CBCS

U24ME701	ARTIFICIAL INTELLIGENCE AND ROBOTICS FOR MECHANICAL SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES: To design and demonstrate intelligent robotic and AI systems to solve simplified mechanical engineering problems

1	Demonstrate an understanding of fundamental AI concepts and ethical concerns.
2	Apply AI techniques such as search and learning for simple problem-solving tasks.
3	Analyze mechanical and control aspects of robotic systems.
4	Implement planning, navigation, and vision algorithms in robotic applications.
5	Evaluate the role of AI and robotics in enhancing mechanical engineering systems.

UNIT 1 INTRODUCTION TO ARTIFICIAL INTELLIGENCE — **9**

What is AI? Definition, Goals, Real-life Examples - History and Evolution of AI (1950s to Industry 4.0) - Human vs Machine Intelligence: Capabilities & Limitations - Components of AI Systems: Perception, Reasoning, Learning - Key Issues in AI: Adaptability, Autonomy, Safety, Sustainability - Intelligent Agents: What they are, Types, Simple Examples - AI in Industry 4.0: Smart Factories & Digital Transformation

UNIT 2 PROBLEM SOLVING AND MACHINE LEARNING FUNDAMENTALS — **9**

Problem Formulation and State-Space Search - Uninformed Search: BFS, DFS – visual and mechanical examples - Informed Search: Heuristics, A* Algorithm - Basics of Machine Learning: Supervised vs Unsupervised - Regression & Classification (concept only) - Evaluation Metrics: Accuracy, Overfitting, Cross-validation

UNIT 3 FUNDAMENTALS OF ROBOTICS — **9**

What is a Robot? Types (Wheeled, Legged, Industrial) - Core Components: Sensors, Actuators, Controllers - Degrees of Freedom, Links, Joints - Forward and Inverse Kinematics (Concept only) - Introduction to Robot Motion: Trajectory Planning - Static Stability & Compliance in Robot Design - Introduction to Robot Control: Open vs Closed Loop.

UNIT 4 ROBOTICS INTELLIGENCE AND CONTROL SYSTEMS — **9**

Robot Perception: Vision, Proximity, Range Sensors - Introduction to SLAM (Simultaneous Localization and Mapping) - Path Planning and Navigation (e.g., A* in robot path planning) - Feedback Control and PID in Robots (visual approach) - Machine Learning in Robot Control and Behavior - Autonomous Robots: Examples from Rescue, Military, Space - Safety and Ethics in Robotics.

UNIT 5 AI APPLICATIONS IN MANUFACTURING AND ADVANCED SYSTEMS — **9**

AI in Quality Inspection, Fault Diagnosis & Condition Monitoring - Robotics in Automation & Smart Manufacturing (CNC, AM) - Predictive Maintenance and Inventory Management - AI in Design Optimization: Generative Design, Topology Optimization - Robotics in Self-Driving Cars, Smart Battery Systems, HMI - Case Studies: Rescue Robots, De-mining Robots, Self-parking Cars - Future Trends: AI in Sustainability, Human-Robot Collaboration.

TOTAL Periods — **45**

COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Demonstrate an understanding of fundamental AI concepts and ethical concerns.
CO2	Apply AI techniques such as search and learning for simple problem-solving tasks.
CO3	Analyze mechanical and control aspects of robotic systems.
CO4	Implement planning, navigation, and vision algorithms in robotic application.
CO5	Evaluate the role of AI and robotics in enhancing mechanical engineering systems.

TEXT BOOKS

1	S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, 4th ed., Pearson, 2021.
2	M. J. Mataric, The Robotics Primer, MIT Press, 2017.

3	K. S. Fu, R. C. Gonzalez, and C. S. G. Lee, Robotics: Control, Sensing, Vision and Intelligence, McGraw-Hill, 2007.
REFERENCES	
1	N. J. Nilsson, The Quest for Artificial Intelligence, Cambridge University Press, 2010.
2	R. Siegwart, I. R. Nourbakhsh, and D. Scaramuzza, Introduction to Autonomous Mobile Robots, 2nd ed., MIT Press, 2011.
3	S. Thrun, W. Burgard, and D. Fox, Probabilistic Robotics, MIT Press, 2005.
4	T. Mitchell, Machine Learning, McGraw-Hill, 2007.
5	B. Siciliano and O. Khatib, Springer Handbook of Robotics, Springer, 2016.

CO/PO, PSO Mapping
(3/2/1 indicates the strength of correlation) 3-Strong 2-Medium, 1-Weak
Programme Outcomes (POs) and Programme Specific Outcomes PSOs'

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	2	1	1	2	3	1	2	1
CO2	3	3	2	2	3	-	-	-	1	1	2	3	1	2	1
CO3	3	3	2	2	2	-	-	-	2	1	2	3	1	2	1
CO4	3	3	3	3	3	-	-	-	2	1	3	3	1	2	1
CO5	3	3	3	-	3	2	2	-	2	1	3	3	1	2	1
AVG	2.8	2.4	2	1.4	2.2	0.4	0.4	0.4	1.6	1	2.4	3	1	2	1

Meenakshi Sundararajan Engineering College

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Department : Mechanical Engineering, R2024, CBCS

U24ME702	MECHATRONICS AND IoT	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES: To design, develop, and integrate mechatronic and IoT-enabled systems using sensors, actuators, controllers, embedded platforms, and PLCs, applying signal conditioning and automation principles to solve interdisciplinary engineering problems with real-time monitoring and control capabilities

1	Understand and analyze various sensors and actuators used in mechatronic systems.
2	Develop competency in signal conditioning and PLC programming.
3	Gain foundational knowledge of IoT and embedded systems.
4	Explore and implement Arduino and Raspberry Pi for automation.
5	Design and develop an apt mechatronics/IoT based system for the given real- time application.

UNIT I - INTRODUCTION TO MECHATRONICS — **9+6**

Introduction to Mechatronics - Measurement Systems and Control Systems - Mechatronic Design Process - Sensors and Transducers: Performance Terminologies and Characteristics - Displacement, Position and Proximity - Velocity and Motion Force - Temperature - Fluid Pressure - Liquid Flow - Liquid Level - Light Sensors - Electrical Actuation Systems - Direct Current Motors - Alternating Current Motors - Stepper Motors - Servo Motors

Practicals:

1. Speed and Direction Control of AC and DC Motor using IGBT Controller
2. Calibration of Pressure and Temperature Transducer and Determination of Sensor Characteristics.

UNIT II - SIGNAL CONDITIONING CIRCUITS AND PROGRAMMABLE LOGIC CONTROLLERS — **9+6**

Signal Conditioning - Operational Amplifier (OPAmps) - Protection - Filtering - Wheatstone Bridge - Pulse Modulation - Problems with Signals - Power Transfer - Multiplexer - Data Acquisition Systems - Electrical Actuation Systems - Electrical Systems - Mechanical Switches - Solid-State Switches - Programmable Logic Controller - Basic PLC Architecture - Input / Output Processing - Ladder Programming - Latching and Internal Relays, Sequencing - Sequencing, Timers and Counters, Shift Registers, Master and Jump Controls - Data Handling, Analogue Input / Output

Practicals:

1. Data Acquisition System, Measurement of Physical Quantities
2. PLC Automation with Timers and Counters

UNIT III - THE INTERNET OF THINGS (IOT) — **9+6**

A New Design Paradigm: The Internet of Things - Introduction to the IoT Framework - IoT Potential - Streamlining Operations, Repurposing Data and Data Monetization - The Effective Implementation of IoT: The Detailed Procedure - Challenges of Implementing Effective IoT Systems - Embedded Systems: An Introduction - Single-Chip Microcontroller Systems - Single-Board Microcontroller Systems - Single-Board Computer Systems - Embedded Systems: Peripherals, Software Considerations

Practicals:

1. Speed and Direction control of DC Motor, Stepper and Servo motors using Arduino and Raspberry Pi
2. Remote data acquisition by using IoT.

Unit IV Foundational Concepts and Controllers — **9+6**

Foundational Topics - Programming Languages: C++ and Python - Linux Operating System - Arduino Boards - Arduino Peripherals - Arduino Integrated Development Environment - Raspberry Pi Boards - Raspberry Pi Peripherals - Raspberry Pi Operating System

Practicals:

1. Interfacing and Controlling I/O devices by Arduino and Raspberry Pi with LEDs, Push buttons
2. Interfacing and Controlling I/O devices by Arduino and Raspberry Pi with Light intensity sensor, Ultrasonic distance sensor, Temperature sensor, Humidity sensor.

Unit V MECHATRONICS AND IoT CASE STUDIES — **9+6**

Mechatronics systems: Aerial drone actuation and Control - Autonomous Robot with Vision System - Automotive Mechatronics: Electronic Ignition System - ABS - EBD - Adaptive Cruise Control - IoT case studies: Remote Monitoring Systems - Remotely Operated Autonomous Systems - Centralized Water Management System - IoT Enabled Robotic Camera Dolly - Portable, Wireless, Interactive IoT Sensors for Agriculture - IoT Vehicle Management System with Network Selection

Practicals:

1. Vision based image acquisition and processing technique for inspection and classification
2. IoT based Home Automation

TOTAL PERIODS	**75**

COURSE OUTCOMES

At the end of the course, the student will be able to

CO1	Identify and select suitable sensors and actuators for mechatronic systems.
CO2	Design and implement signal conditioning circuits and develop PLC-based control systems.
CO3	Understand and apply fundamental concepts of IoT and embedded systems.
CO4	Develop and control I/O devices using Arduino and Raspberry Pi.
CO5	Design and develop an apt mechatronics/IoT based system for the given real- time application.

TEXT BOOKS

1	Bolton W., “Mechatronics”, Pearson Education, 2019.
2	Bradley D.A., Burd N.C., Dawson D., Loader A.J., “Mechatronics: Electronics in Products and Processes”, Routledge, 2017.
3	Sami S.H and Kisheen Rao G “The Internet of Mechanical Things: The IoT Framework for Mechanical Engineers”, CRC Press, 2022.
4	Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things; Apress, 2016

REFERENCES

1	John Billingsley, “Essentials of Mechatronics”, Wiley, 2006
2	David H., Gonzalo S., Patrick G.,Rob B. and Jerome H.,“IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, Pearson Education, 2018.
3	Nitin G and Sharad S, “Internet of Things: Robotic and Drone Technology”, CRC Press, 2022
4	Newton C. Braga, “Mechatronics for The Evil Genius”, McGrawHill, 2005.
5	Bell C., “Beginning Sensor Networks with Arduino and Raspberry Pi”, Apress, 2013

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Programme Outcomes (POs) and Programme Specific Outcomes PSOs'

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	-	-	-	-	-	-	-	1	2	1
CO2	3	3	3	1	2	-	-	-	1	-	-	2	1	2	1
CO3	3	1	3	1	2	-	2	-	-	-	-	-	1	2	1
CO4	3	3	3	3	3	-	-	-	3	-	-	3	1	2	1
CO5	3	3	3	3	3	3	2	-	3	-	-	3	1	2	1
AVG	3.0	2.6	2.6	1.8	2.2	0.6	0.8	-	1.4	-	-	1.6	1.0	2.0	1.0

Meenakshi Sundararajan Engineering College

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Department : Mechanical Engineering, R2024, CBCS

U24RM712	DATA COLLECTION, ANALYSIS AND INTERPRETATION	L	T	P	C
		0	0	1	0.5

COURSE OBJECTIVES

1	Analyze different types of data, sources, and sampling methods in research contexts to ensure appropriate data collection.
2	Apply appropriate digital and manual tools for designing and administering data collection instruments across disciplines.
3	Analyze and preprocess raw data using statistical and visualization techniques to prepare it for analysis.
4	Evaluate statistical methods and domain-specific analysis techniques for their suitability in different research scenarios.
5	Evaluate the significance of data analysis results and effectively communicate findings through structured research outputs.

UNIT 1 Introduction to Research Data and Collection Techniques	**3**
Types of data: qualitative vs. quantitative; primary vs. secondary, Sources of data: surveys, experiments, sensors, interviews, observations, literature, Tools and techniques for data collection: questionnaires, focus groups, digital sensors, APIs, Sampling methods: probability and non-probability sampling, Data quality: validity, reliability, accuracy, and bias	
UNIT 2 Tools and Methods for Data Collection	**3**
Designing data collection instruments: scales, forms, and logs, Using online tools: Google Forms, SurveyMonkey, KoboToolbox, IoT and sensor-based data acquisition in engineering and science, Ethical considerations in data collection: consent, privacy, anonymization, Case studies from various domains	
UNIT 3 Data Preparation and Analysis Techniques	**3**
Data cleaning and preprocessing: handling missing, duplicate, and outlier data, Organizing data: tabulation, coding, categorization, Descriptive statistics: mean, median, mode, standard deviation, variance, Data visualization: charts, graphs, dashboards using Excel, Python, R, Introduction to data analysis tools: SPSS, Excel, Python (Pandas), R	
UNIT 4 Statistical and Analytical Methods	**3**
Inferential statistics: hypothesis testing, confidence intervals, Correlation and regression analysis, ANOVA, chi-square, and non-parametric tests, Multivariate analysis (introductory), Domain-specific analysis techniques (e.g., sentiment analysis in social sciences, FFT in engineering)	
UNIT 5 Data Interpretation and Research Reporting	**3**
Interpreting statistical results in context, Drawing meaningful conclusions and identifying patterns, Reporting and visualizing findings (charts, tables, narrative explanation), Using data to support or refute hypothesis, Writing data-driven research papers, reports, and presentations	
	TOTAL: 15

At the end of the course, the student will be able to

CO1	Distinguish and evaluate data types, sources, and sampling methods to design valid and reliable research strategies.
CO2	Design effective data collection tools using platforms like Google Forms, SurveyMonkey, and IoT-based systems, while addressing ethical considerations.
CO3	Clean, organize, and summarize datasets using descriptive statistics and visualize results using tools like Excel, Python, or R.
CO4	Select and apply appropriate statistical and analytical techniques such as regression, ANOVA, and chi-square to interpret research data.
CO5	Interpret analytical outcomes and prepare data-driven research reports and presentations that effectively communicate insights.

TEXT BOOKS	
1	A. Field, Discovering Statistics Using SPSS / R / Python, 5th ed. London, UK: SAGE Publications, 2018.
2	J. F. Hair, W. C. Black, B. J. Babin, and R. E. Anderson, Multivariate Data Analysis, 8th ed. Andover, UK: Cengage Learning EMEA, 2018.
3	C. R. Kothari and G. Garg, Research Methodology: Methods and Techniques, 4th ed. New Delhi, India: New Age International Publishers, 2019.
REFERENCES	
1	G. James, D. Witten, T. Hastie, and R. Tibshirani, An Introduction to Statistical Learning: with Applications in R, 1st ed. New York, NY, USA: Springer, 2013.
2	E. R. Tufte, The Visual Display of Quantitative Information, 2nd ed. Cheshire, CT, USA: Graphics Press, 2001.

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CO1	2	2	2	2	1	1	1	2	1	2	1	2	-	-	-
CO2	2	2	3	2	3	1	1	3	2	3	2	3	-	-	-
CO3	2	3	2	2	3	1	1	2	2	3	2	3	-	-	-
CO4	3	3	3	3	3	1	1	2	2	3	3	3	-	-	-
CO5	2	2	3	2	2	1	1	3	2	3	3	3	-	-	-
AVG	2.2	2.4	2.6	2.2	2.4	1.0	1.0	2.4	1.8	2.8	2.2	2.8	-	-	-

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