K.R. MANGALAM UNIVERSITY

THE COMPLETE WORLD OF EDUCATION

SCHOOL OF ENGINEERING

AND

TECHNOLOGY

Bachelor of Technology (Mechanical Engineering)

B.Tech (ME)

Programme Code: 02

2021-25

Approved in the 26th Meeting of Academic Council Held on 11 August 2021

Academic Council
Member Secretary
K.R. Mangalam University

Registrar
K.R. Mangalam University
Sohna Road, Gurugram, (Haryana)

K.R. MANGALAM UNIVERSITY

THE COMPLETE WORLD OF EDUCATION

SCHOOL OF ENGINEERING

AND

TECHNOLOGY

Bachelor of Technology (Mechanical Engineering)

B.Tech (ME)

Programme Code: 02

2021-25

Approved in the 26th Meeting of Academic Council Held on 11 August 2021

PREFACE

The Academic council in consultation with Deans, Faculty Members, Industry Experts and University Alumni constituted school-wise committees to draft the model curriculum of UG engineering courses. During the meetings held for developing curriculum for undergraduate engineering courses, a concern was shared that the overall credits are too high.

The respective Head of Committees, Faculty members along with Industry Experts and Alumni discussed the existing system prevalent in various universities, industry requirements and market trends, employability, problem solving approach, need for life-long learning, and after due deliberations, the scheme and syllabus of the B. Tech (ME) has been formalized.

Salient features of model curriculum are enumerated below:

1. Curriculum has been designed in such a way that it encourages innovation and research as total numbers of credits have been reduced and many new courses have been incorporated in consultation with industry experts.
2. The curriculum has been designed where the students can understand the industry requirements and have hands-on experience. The students will develop a problem-solving approach and will meet the challenges of future.
3. Emerging areas in Mechanical Engineering has been included in sixth and seventh semester.
4. Emphasis on hands-on training has been promoted by including two industrial training of 4 weeks and 6 weeks respectively, and project in seventh semester, and six-month Industrial Internship in eighth semester.
5. The School will ensure the revision of the curriculum to help students to achieve better employability, start-ups, and other avenues for higher studies.

About K.R Mangalam University

The K.R. Mangalam Group has made a name for itself in the field of education. The K.R. Mangalam story goes back to the chain of schools that offered an alternative option of world-class education, pitching itself against the established elite schools, which had enjoyed a position of monopoly till then. Having blazed a new trail in school education, the focus of the group was aimed at higher education.

K.R. Mangalam University is the fastest-growing higher education institute in Gurugram, India. K. R. Mangalam University was established under the Haryana Private University Act 2006, received the approval of Haryana Legislature vide Amendment Act # 36 of 2013 and consent of the Hon'ble Governor of Haryana on 11th April 2013, which was published in the Gazette notification vide Leg. No.10/2013, dated 3rd May 2013.

Since its inception in 2013, the University has been striving to fulfil its prime objective of transforming young lives through ground-breaking pedagogy, global collaborations, and world-class infrastructure. Resources at K.R Mangalam University have been continuously upgraded to optimize opportunities for the students. Our students are groomed in a truly interdisciplinary environment where they grow up with integrative skills through interaction with students from engineering, social sciences, management and other study streams.

K.R Mangalam University is unique because of its:

i. Enduring legacy of providing education to high achievers who demonstrate leadership in diverse fields.

ii. Protective and nurturing environment for teaching, research, creativity, scholarship, social and economic justice.

Objectives

i. To impart undergraduate, post graduate and doctoral education in identified areas of higher education.

ii. To undertake research programmes with industrial interface.

iii. To integrate its growth with the global needs and expectations of the major stake holders through teaching, research, exchange & collaborative programmes with foreign, Indian Universities/Institutions and MNCs.

iv. To act as a nodal center for transfer of technology to the industry.

v. To provide job oriented professional education to the Indian student community with particular focus on Haryana.

About School of Engineering & Technology (SOET)

School of Engineering and Technology (SOET), K.R. Mangalam University is dedicated to fostering innovation, excellence, and advancement in engineering and technology. Empowering the new generation of change-makers by imparting exceptional understanding and intellect to facilitate the creation of highly sophisticated futuristic solutions. Our well-qualified academicians, accomplished researchers and industry insiders are focused on imparting their extensive knowledge and expertise to students through various lectures, workshops, industrial visits, projects, and competitions throughout the year ensuring that students receive a comprehensive education that blends theory with practical application.

These programs offered at SOET have the distinct objective of equipping the students with knowledge, skills and attitudes in engineering and technology, to make them capable of successfully meeting the present requirements and future challenges in the engineering profession. SOET brings together outstanding academics, industry professionals, and experienced researchers to deliver a unique hands-on and multi-disciplinary learning experience.

The curriculum of programs has been designed to cater to the ever changing needs and demands of the industry. The curriculum is regularly updated. The school has best infrastructure including domain-specific labs. SOET aims to provide exposure to the principles and practices of Design / Developments and Projects in the area of engineering. SOET is offering Ph.D. programs also.

School Vision

To create, disseminate, and apply knowledge in science and technology to meet the higher education needs of India and the global society, To serve as an institutional model of excellence in scientific and technical education characterized by integration of teaching, research and innovation.

School Mission

M1: To create an environment where teaching and learning are prioritized, with all support activities being held accountable for their success.

M2: To strengthen the institution's position as the school of choice for students across the State & Nation.

M3: To promote creative, immersive, and lifelong learning skills while addressing societal concerns.

M4: To promote co- and extra-curricular activities for overall personality development of the students.

M5: To promote and undertake all-inclusive research and development activities.

M6: To instill in learners an entrepreneurial mindset and principles.

M7: Enhance industrial, institutional, national, and international partnerships for symbiotic relationships.

M8: To help students acquire and develop knowledge, skills and leadership qualities of the 21st Century and beyond.

Programmes offered by the School

School offers undergraduate B. Tech Program, B.Sc. (Hons) Program, postgraduate M. Tech Program, and Doctoral Program. All these programs are designed to impart scientific knowledge to the students and provide theoretical and practical training in their respective fields.

B. Tech in Mechanical Engineering

Eligibility Criteria: The student should have passed the 10+2 examination conducted by the Central Board of Secondary Education or equivalent examination from a recognized Board in Science with mathematics as one of the subjects and with an overall aggregate of 50% or more. The School has taken a thoughtful step by introducing the concept of Learning Outcome Based Curriculum Framework (LOCF) and Choice Based Credits System (CBCS) system.

Course Outline: Electric vehicle Engineering design, Thermodynamics, Manufacturing Technology, Additive Manufacturing, Refrigeration and Air-conditioning, Theory of Machines, Design of Machines Elements, CAD Mold Wizard Fundamental Process, Fluid Machinery, Robotics and Automation, CAD sheet Metal/Surface Modelling, CAD Advanced Fundamental Process, Power Plant Engineering.

Career Options: Aerospace Industry, Nuclear power plant, Automotive industry, All government psu's, Indian Defense service.

Program Educational Objectives (PEO)

PEO 1: To develop graduates who have strong foundation of knowledge and skills in the field of computer science and engineering.

PEO 2: To develop graduates who are employable in industries/public sector/research organizations or work as an entrepreneur.

PEO 3: To foster graduates who can provide solutions to challenging problems in their profession by applying computer engineering theory and practices.

PEO 4: To encourage graduates who can provide leadership and are effective in multidisciplinary environment.

PEO 5: To develop ability to demonstrate team work with the ability of leadership, analytical

reasoning for solving time critical problems and strong human values for responsible professional.

PEO 6: To impart knowledge and skills to analyze, design, test and implement diverse range of technology.

Program Outcomes (PO)

PO 1 Engineering Knowledge: Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PO 2 Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3 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.

PO 4 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.

PO 5 Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 6 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 employability.

PO 7 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.

PO 8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9 Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10 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.

PO 11 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 through entrepreneurship skills and in multidisciplinary environments.

PO 12 Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change through skill development.

Program Specific Outcomes (PSO)

PSO1 Applications of Concepts: Ability to apply fundamentals of mathematics, science, and engineering knowledge to understand, analyze and develop the knowledge of Production, Manufacturing and Industrial Engineering for analysis, optimization, and development of mechanical system.

PSO2 Innovation and Industry Friendly: Ability to Apply the concepts of Design and Thermal Engineering to model, analyze and develop the mechanical components and systems by employing the appropriate techniques and modern engineering hardware and software tools for the design.

PSO3 Ethics and Communication Skills: Implementation of professional engineering solutions for the betterment of society keeping the environmental context in mind, be aware of professional ethics and be able to communicate effectively.

Programme Duration: 4 Years: The maximum period for the completion of the B.Tech. (ME) Programme offered by the University shall be four years.

Class Timings: The classes will be held from Monday to Friday from 9.10 am to 4.00pm.

Scheme of Studies and Syllabi

The scheme of studies and syllabi of B. Tech (ME) is given in the following pages. These are arranged as (a) common courses (b) degree-specific courses, in numeric order of the last three digits of the course code.
The first line contains; Course Code and Credits (C) of the course for each course.

This is followed by the course objectives, course outcome, a syllabus (Unit I to IV), Textbook, and reference books.

Four Years B. Tech Mechanical Engineering (ME) Program at a Glance

Semester	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Total**
Courses	8	7	9	9	11	10	9	1	**64**
Credits	22	19.5	20	19	25	22	24	12	**163.5**

Scheme of Studies as per Learning Outcome Based Curriculum Framework (LOCF) and Choice Based Credit System (CBCS)

SEMESTER-I

S. No.		**Subject Code**	**Title**	**L**	**T**	**P**	**C**
1	SE	ETMA105A	Applied Mathematics-I	3	1	-	4
2	SE	ETPH109A	Engineering Physics	3	1	-	4
4	SE	UCES125A	Environmental Studies	3	-	-	3
5	SE	ETEC101A	Basics of Electrical & Electronics Engineering	3	1	-	4
6	CC	ETME101A	Basics of Mechanical Engineering	3	1	-	4
7	SE	ETPH151A	Engineering Physics Lab	-	-	2	1
8	SE	ETEC151A	Basics of Electrical & Electronics Engineering Lab	-	-	2	1
9	CC	ETME151A	Basics of Mechanical Engineering Lab	-	-	2	1
				15	**4**	**6**	**22**

SEMESTER-II

S. No.		**Subject Code**	**Title**	**L**	**T**	**P**	**C**
1	SE	ETMA104A	Applied Mathematics-II	3	1	-	4
2	SE	ETCS104A	Introduction to Computer Science and Programming in Python	3	1	-	4
4	SE	ETCH119A	Engineering Chemistry	3	1	-	4

5	SE	UCCS 155A	Communication Skills	4	-	-	4
6	SE	ETCS150A	Introduction to Computer Science and Programming in Python Lab	-	-	2	1
7	SE	ETCH159A	Engineering Chemistry Lab	-	-	2	1
8	CC	ETME 157A	Workshop Practices	-	-	3	1.5
				13	**3**	**7**	**19.5**

SEMESTER-III							
1	SE	BSMA215A	Probability and Statistics	3	1	-	4
2	CC	ETME 205A	Thermodynamics	3	1	-	4
3	CC	ETME 215A	Strength of Materials	3		-	3
4	CC	ETME 217A	Fluid Mechanics	3	-	-	3
5	SE	UCDM 301A	Disaster Management	3	-	-	3
7	CC	ETME 253A	Strength of Materials Lab	-	-	2	1
8	CC	ETME 255A	Fluid Mechanics Lab	-	-	2	1
9	CC	ETME159A	CAD Fundamental Processes Part-A	-	-	2	1
				18	**2**	**8**	**20**

Semester - IV							
1	CC	ETME 230A	Fluid Machines	3	-	-	3
2	CC	ETME 214A	Turbomachines	3	-	-	3
3	CC	ETME 220A	Engineering Mechanics	3	-	-	3
4	SE	ETMC 226A	Fundamentals of Management	3	-	-	3
5	CC	ETME 226A	Theory of Machines	3	1	-	4
6		VAC 131	Employability and Analytical Skills (Value Added Course)	2	-	-	0
7	CC	ETME 252A	Fluid Machines Lab	-	-	2	1
8	CC	ETME 258A	Theory of Machines Lab	-	-	2	1
9	CC	ETME 156A	CAD Fundamental Process Part-B	-	-	2	1
TOTAL				**17**	**3**	**8**	**19**

Semester - V							
1	CC	ETME 309A	Manufacturing Technology	3	-	-	3
2	CC	ETME 319A	Internal Combustion Engine	3		-	3
3	CC	ETME 213A	CAD Advanced Processes	3	-	-	3
4	CC	ETME 228A	CAD Sheet Metal/Surface Modelling	3	-	-	3
5	CC	ETME 324A	Non-Conventional Energy Resources	3	-	-	3
6	CC	ETMC 421A	Entrepreneurship Development	3	-	-	3
7	CC	ETME 315A	Design of Machine Elements	3	1	-	4
8	CC	ETME 381A	Practical Training-I	-	-	2	1
9	CC	ETME 357A	Manufacturing Technology Lab	-	-	2	1
10	CC	ETME 363A	Internal Combustion Engine Lab	-	-	2	1
11	SE	VAC 132	Employability and Analytical Skills (Value Added Course)	2	-	-	0
TOTAL				**21**	**1**	**6**	**25**

Semester - VI							
1	CC	ETME 302A	Heat Transfer	3	1	-	4
2	CC	ETME 322A	Robotics & Automation	3	-	-	3
3	CC	ETME 326A	Automobile Engineering	3	-	-	3
4	CC	ETME 317A	CAD Mold Wizard Fundamental Process	3	-	-	3
5	CC	ETME 328A	Electric Vehicle Engineering Design	3	-	-	3
6	CC	ETME 352A	Heat Transfer Lab	-	-	2	1
7	CC	ETME 354A	Robotics & Automation Lab	-	-	2	1
8	CC	ETME 356A	Automobile Engineering Lab	-	-	2	1
9	SE	VAC 133	Employbility and Analytical Skills (Value Added Course)	2	-	-	0
10	SE		Professional Elective Course (PEC/DE)				3
TOTAL				**17**	**1**	**8**	**22**

Semester - VII							
1	CC	ETME 425A	Refrigeration And Air-Conditioning	3	-	-	3
2	CC	ETME 427A	Power Plant Engineering	3	-	-	3
3	CC	ETME 417A	Solar Energy	3	-	-	3
4	SE		Open Electice Courses (OEC)	3			3
5	CC		Professional Elective Course (PEC/DE)	3	-	-	3
6	CC	ETME 451A	Refrigeration And Air-Conditioning Lab	-	-	2	1
7	CC	ETME 481A	Practical Training-II	-	-	-	1
8	CC	ETME 453A	Measurement & Metrology Lab	-	-	2	1
9	CC	ETME 455A	Project	-	-	-	6
TOTAL				**15**	**-**	**4**	**24**

Semester – VIII						
1	ETME 452A	Internship	-	-	-	12
Total			**0**	**0**	**0**	**12**
Total Credits [C]			**163.5**			

OE	OPEN ELECTIVE
CC	CORE COURSE
SE	SKILL ENHANCEMENT
DE	DEPARTMENTAL ELECTIVE

SEMESTER I

ETMA105A	APPLIED MATHEMATICS-I	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

1. Provide the brief idea to students of Complex numbers and its applications
2. To understand and learn about the differential calculus and find the curve tracing.
3. Deliver a brief knowledge of Matrices and its properties.
4. Apply the concept of eigenvalue and eigenvector to find higher power of the matrix.
5. Recognize and find the general solution of ordinary differential equation

Course Outcomes

On completion of this course, the students will be able to

CO1. Understand and able to apply the basic concept of complex variable.

CO2. Recognize and able to apply the concepts of continuity and differentiability for complex functions and solve the analytic function and its properties.

CO3. Applied the differential calculus method for curve tracing and radios of curvatures.

CO4. Use the characteristic polynomial to compute the eigenvalues and eigenvectors of a square matrix and use them to Diagonalizable matrices when this is possible.

CO5. Explain the qualitative long-term behaviour of the solutions to an ODE or system of ODE's.

CO6. Demonstrate knowledge and understanding ordinary differential equations and how they relate to different modelling situations.

Catalog Description

Applied mathematics-I is the mathematical study of basic concepts, principles, and application, relate or unify various disciplines. The core of the program the following principles and their mathematical formulations: complex number and variables, ordinary differential equations, differential calculus, and matrices. The concepts of applied mathematics-I are extremely useful in physics, economics and social sciences, natural sciences, and engineering. Due to its broad range of applications, linear algebra is one of the most widely taught subjects in college-level mathematics. Important objectives of the linear algebra are to develop and strengthen the students' problem-solving skills and to teach them to read, write, speak, and think in the language of mathematics. Students learn how to apply the tools of calculus to a variety of problem situations.

Course Content

Unit I: 10 lecture hours

Complex Numbers and Infinite Series: De Moivre's theorem, Roots of complex numbers, Euler's theorem, Logarithmic Functions, Circular and Hyperbolic Functions, Convergence and Divergence of Infinite series, Necessary condition for convergence, Positive term infinite series test, Alternating series, Lebnitz test, Absolute and Conditional Convergence.

Unit II: 10 lecture hours

Application of Differential Calculus: Successive differentiation, Leibnitz theorem (without proof), Taylor's and Maclaurin's theorem and expansion of functions, Asymptotes (Cartesian and polar), Curve Tracing, Curvature, Radius of Curvature.

Unit III: 10 lecture hours

Matrices and its application: Elementary transformation, Inverse of matrix by elementary operations, Rank, Linear and orthogonal transformations, Hermitian and skew - Hermitian forms, Solutions of simultaneous linear equations, Eigen values, Eigen vectors and its properties, Caley - Hamilton theorem (without proof), Diagonalisation of a matrix.

Unit IV: 10 lecture hours

Ordinary Differential Equations: Exact differential equations of first order and first degree, Linear differential equations of higher order with constant coefficients, Variation of parameters, Solution of simultaneous linear differential equations, Solution of homogeneous differential equations - Cauchy and Legendre forms.

Textbooks

1. Kresyzig, "Advanced Engineering Mathematics", John Wiley and Sons.
2. Jain and Iyengar, "Advanced Engineering Mathematics", Narosa Publication

Reference Books/Materials

1. B.S.Grewal, " Higher Engineering Mathematics", Khanna Publishers.
2. H.K. Dass, "Advanced Engineering Mathematics", S. Chand & Company.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand and able to apply the basic concept of complex variable.	**PO1**
CO2	Recognize and able to apply the concepts of continuity and differentiability for complex functions and solve the analytic function and its properties.	**PO8**
CO3	Applied the differential calculus method for curve tracing and radios of curvatures.	**PO2**
CO4	Use the characteristic polynomial to compute the eigenvalues and eigenvectors of a square matrix and use them to Diagonalizable matrices when this is possible.	**PO4**
CO5	Explain the qualitative long-term behaviour of the solutions to an ODE or system of ODE's.	**PO3**
CO6	Demonstrate knowledge and understanding ordinary differential equations and how they relate to different modeling situations.	**PO1**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
ETMA 105A	Applied Mathematics - I	3	3	3	3				1					3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETPH109A	ENGINEERING PHYSICS	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	Waves & Optics				
Co-requisites					

Course Objectives

1. Learning different types of harmonic oscillators.
2. Understanding phenomenon of non-dispersive and transverse waves in strings.
3. Analysing propagation of light, geometric and wave optics.
4. Understanding of various laser systems.

Course Outcomes

On completion of this course, the students will be able to:

CO1. Understand difference between different types of harmonic oscillators and can find quality factor.

CO2. Solve non-dispersive transverse and longitudinal waves equations.

CO3. Analyze propagation of light, geometric and wave optics.

CO4. Design different laser source systems.

Catalog Description

This course imparts the basic concepts of waves and optics. This course enables learners to solve non-dispersive transverse and longitudinal waves equations. This course helps learners to analyse propagation of light, geometric and wave optics. The course introduces the basic concepts about lasers and helps learners to design different laser source systems.

Course Content

UNIT-I **10 Lecture Hours**

Simple harmonic motion, damped and forced simple harmonic oscillator

Mechanical and electrical simple harmonic oscillators damped harmonic oscillator: heavy, critical, and light damping, energy decay in a damped harmonic oscillator, quality factor.

UNIT-II **08 Lecture Hours**

Non-dispersive transverse and longitudinal waves in one dimension and introduction to dispersion

Transverse wave on a string, The wave equation on a string, Harmonic waves, reflection, and transmission of waves at a boundary. Longitudinal waves and the wave equation for them, acoustics waves and speed of sound, wave groups and group velocity.

UNIT-III **12 Lecture Hours**

The propagation of light and geometric optics

Laws of reflection and refraction, Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection.

Wave optics

Huygens' principle, superposition of waves and interference of light by wave front splitting and amplitude splitting: Young's double slit experiment, Newton's rings. Fraunhofer diffraction from a single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision: Diffraction gratings and their resolving power.

UNIT-IV **08 Lecture Hours**

Lasers

Amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO_2), solid-state lasers (Ruby, Neodymium), dye lasers. Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, laser speckles, applications of lasers in science, engineering, and medicine.

Suggested Reference Books

1. Ian G. Main, Oscillations, and waves in physics
2. H.J. Pain, The physics of vibrations and waves
3. E. Hecht, Optics
4. A. Ghatak, Optics
5. O. Svelto, Principles of Lasers

Modes of Evaluation: Quiz/Assignment/ Presentation/ Extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and Pos		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand difference between different types of harmonic oscillators and can find quality factor.	**PO1**
CO2	Solve non-dispersive transverse and longitudinal waves equations.	**PO4**

CO3	Analyze propagation of light, geometric and wave optics	**PO5**
CO4	Design different laser source systems.	**PO2**

Course Code	Course Title	PO1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ETPH109 A	ENGINEERING PHYSICS	2	2		3	3								3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

UCES125A	**ENVIRONMENTAL STUDIES**	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure	Basics of Environment				
Co-requisites	--				

Course Objectives

1. To aware the students about the environment.
2. To learn the student's concepts and methods from ecological and physical sciences and their application in environmental problem solving.
3. To think across and beyond existing disciplinary boundaries, mindful of the diverse forms of knowledge and experience that arise from human interactions with the world around them.
4. communicate clearly and competently matters of environmental concern and understanding to a variety of audiences in appropriate forms.

Course Outcomes

On completion of this course, the students will be able to

CO1. To comprehend and become responsive regarding environmental issues.

CO2.Acquire the techniques to protect our mother earth, as without a clean, healthy, aesthetically beautiful, safe, and secure environment no specie can survive and sustain.

CO3. Enable the students to discuss their concern at national and international level with respect to formulate protection acts and sustainable developments policies.

CO4.To know that the rapid industrialization, crazy consumerism, and over-exploitation of natural resources have resulted in degradation of earth at all levels.

CO5. Become consciousness about healthy and safe environment.

Catalog Description

This course imparts the basic concepts of environment which enable them to solve basic problems related to their surroundings. This course helps them to get an idea adverse effect of industrialization, population, and degradation of natural resources on the environment. The course introduces the concepts of renewable and non-renewable resources.

Course Content

UNIT I **8 Lectures**

Environment and Natural Resources:

Multidisciplinary nature of environmental sciences; Scope and importance; Need for public awareness.

Land resources; land use change; Land degradation, soil erosion and desertification. Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.

Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state). Energy resources: Renewable and non- renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

UNIT II **12 Lectures**

Ecosystems and Biodiversity:

Ecosystem: Definition and Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems: a) Forest ecosystem

b) Grassland ecosystem c) Desert ecosystem d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biological diversity: genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots ; India as a mega-biodiversity nation; Endangered and endemic species of India; Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity; Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

UNIT III **10 Lectures**

Environmental Pollution and Environmental Policies:

Environmental pollution: types, causes, effects and controls; Air, water, soil and noise pollution nuclear hazards and human health risks; Solid waste management: Control measures of urban and industrial waste; Pollution case studies.
Sustainability and sustainable development; Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture; Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

UNIT IV **06 Lectures**

Human Communities and the Environment and Field work:
Human population growth: Impacts on environment, human health, and welfare; Resettlement and rehabilitation of project affected persons; case studies; Disaster management: floods, earthquake, cyclones and landslides; Environmental movements: Chipko, Silent valley, Bishnoi's of Rajasthan; Environmental ethics: Role of Indian and other religions and cultures in environmental conservation; Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).
Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc.
Visit to a local polluted site-Urban/Rural/Industrial/Agricultural.
Study of common plants, insects, birds, and basic principles of identification.
Study of simple ecosystems-pond, river, Delhi Ridge, etc.

Textbooks

1. Kaushik and Kaushik, Environmental Studies, New Age International Publishers (P) Ltd. New Delhi.

Reference Books/Materials

1. A.K. De, Environmental Chemistry, New Age International Publishers (P) Ltd. New Delhi.
2. S.E. Manahan, Environmental Chemistry, CRC Press.
3. S.S Dara and D.D. Mishra, Environmental Chemistry and Pollution Control, S.Chand& Company Ltd, New Delhi.
4. R. Gadi, S. Rattan, S. Mohapatra, Environmental Studies Kataria Publishers, New Delhi.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	The learners will be able to comprehend and become responsive regarding environmental issues.	PO7
CO2	Students will acquire the techniques to protect our mother earth, as without a clean, healthy, aesthetically beautiful, safe and secure environment no specie can survive and sustain.	PO8
CO3	It enables the students to discuss their concern at national and international level with respect to formulate protection acts and sustainable developments policies.	PO10
CO4	Students come to know that the rapid industrialization, crazy consumerism and over-exploitation of natural resources have resulted in degradation of earth at all levels.	PO6
CO5	Students become consciousness about healthy and safe environment.	PO7

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
UCES125A	Environmental Studies						2	3	3		3				1	2

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETEC 101A	BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING	L	T	P	C
		3	1	0	4
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives:

To understand the circuit behaviour on the DC and AC supply.

1. To analyse the complex circuits using various theorems to resolve it to a simple circuit.
2. To be able to perform analysis of single-phase ac circuits consisting of combinations (series and parallel) elements.
3. To analyse the circuit response with addition of circuit elements i.e inductor and capacitors.
4. To gain basic insight of semiconductors based switching and amplifying circuits, also with brief overview of working of logic gates.

Course Outcomes:

On completion of this course, the students will be able to

CO1 Understand and apply Knowledge of AC and DC Circuits in making real time projects to solve engineering difficulties.
CO2 Determine an understanding of logic gates.
CO3 Demonstrate the ability to identify series, parallel complex circuits. Utilization of the preliminary knowledge gained to obtain real existing power related problems.
CO4 Create an understanding of semiconductor devices application to existing apparatuses

Catalog Description:

The aim of the course is to familiarize students with complex AC and DC circuits. For better recognition and learning point of view to identify the response of circuits with addition of capacitor and inductor elements in AC and DC circuits as real time. This course consists of learning with experimental studies involved of semiconductor switches and utilization as amplifier circuits. Basic topics included are AC and DC circuits, Series and Parallel Connections, CRO introduction and utilization, AC circuits with capacitor and inductor responses, Digital logic gates, Semiconductor introduction as BJT, MOSFET etc. along with their application to solving practical engineering problems.

Course Content

Unit I **12 Hour**

Circuit Analysis: Ohm's Law, KCL, KVL Mesh and Nodal Analysis, Circuit parameters, energy storage aspects, Superposition, Thevenin's, Norton's, Reciprocity, Maximum Power Transfer Theorem, Millman's Theorem, Star-Delta Transformation. Application of theorem to the Analysis of D.C. circuits.

Unit II **08 Hour**

A.C. Circuits: R-L, R-C, R-L-C circuits (series and parallel), Time Constant, Phasor representation, Response of R-L, R-C and R-L-C circuit to sinusoidal input Resonance-series and parallel R-L-C Circuits, Q-factor, Bandwidth.

Cathode Ray Oscilloscope: Basic CRO circuit (Block Diagram), Cathode ray tube (CRT) & its component

Unit III **12 Hour**

Semiconductor Physics: Basic concepts, Intrinsic and extrinsic semiconductors, diffusion, and drift currents.

P-N junction diode: Ideal diode, P-N junction under open-circuit and closed-circuit, Diode Current Equation, Diode Resistance, Transition and Diffusion Capacitance, Effect of Temperature, Carrier Lifetime, Continuity Equation.

Special Diodes: Zener Diode, Photodiode, Light Emitting Diodes, applications of Diodes.

08 Hour

Unit IV

Digital Electronics: Boolean algebra, Truth tables of logic gates (AND, OR, NOT), NAND, NOR as universal gates

Bipolar junction transistor: Introduction to transistors: construction, transistor operations, BJT characteristics, load line, operating point, leakage currents.

Application of BJT: CB, CE configurations, Introduction to FETs and MOSFETs.

TEXTBOOKS:

1. D.P. Kothari & I J Nagrath, Basic Electrical Engineering, Tata McGraw Hill , New Delhi.
2. B L Thareja – A textbook of Electrical Technology
3. Boylestad & Nashelsky, "Electronic Devices & Circuits", Pearson Education, 10th Edition.
4. V. K. Mehta & Rohit Mehta, "Principles of Electronics", S. Chand Publishers, 27th Edition.

REFERENCE BOOKS:

1. Electrical Engineering Fundamentals, V.Del Toro
2. Problems in Electrical Engineering – Parker Smith.S.
3. Sedra A S and Smith K C, "Microelectronic Circuits" 4th Ed., New York, Oxford University Press, New York.
4. Tocci R J and Widmer N S, "Digital Systems – Principles and Applications", 8th Ed., Pearson Education India, New Delhi.

5. A.K. Sawhney, “A course in Electrical & Electronics Measurements & Instrumentation”, Dhanpat Rai & Sons.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand and apply Knowledge of AC and DC Circuits in making real time projects to solve engineering difficulties.	**PO1**
CO2	Determine an understanding of logic gates.	**PO2**
CO3	Demonstrate the ability to identify series, parallel complex circuits. Utilization of the preliminary knowledge gained to obtain real existing power related problems.	**PO2**
CO4	Create an understanding of semiconductor devices application to existing apparatuses	**PO12**

Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETEC101	BASICS OF ELECTR	3	3										3	3		

A	ICAL & ELECTRONICS ENGINEERING															

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETME 101A	**BASICS OF MECHANICAL ENGINEERING**	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	Basics of Thermodynamics, Fluid Machinery and Power transmission				
Co-requisites	--				

Course Objectives: The subject expects students to achieve the following objectives.

1. Understanding Basic Materials and e.
2. Understand laws of thermodynamics and Thermodynamic processes.
3. Understanding working Principles of Thermal Machines and Power Transmitting Devices.
4. Impart knowledge of General Principles of Mechanical system.

Course Outcomes: Upon the completion of this course the students will be able to:

- CO1. Know the basics of thermodynamics and workshop machinery.
- CO2 Understand the basic knowledge of Refrigeration and Hydraulic Machinery.
- CO3. Get the knowledge about power transmission method and device with mechanical properties.
- CO4. Know the various concept about NC, CNC Machines.

Catalog Description: This course gives introductory knowledge about Thermodynamics, refrigeration, cooling, power transmission, and the basics of CNC and Hydraulic machines. It enables the students to understand the working of these systems. It also enhances the students thinking capability to calculate the efficiency and load capacity of the systems. This course is also helping students to answer fundamental questions of Mechanical Engineering at the time of the interview.

Course Content

Unit I: 12 lecture hours

Introduction to Machine Tools: Commonly used Machine Tools in a Workshop, Lathe, Shaper, Planer, Milling, Drilling, Slotter, Introduction to Metal Cutting, Problems.

Basic Concepts of Thermodynamics: Introduction, States, Work, Heat, Temperature, Zeroth, 1st, 2nd and 3rd law of thermodynamics, Concept of internal energy, enthalpy, and entropy. Problems Properties of Steam, Formation of steam at constant pressure, Thermodynamic properties of Steam, Numerical.

Unit II: 08 lecture hours

Refrigeration & Air-conditioning: Introduction to refrigeration and air -conditioning, Rating of refrigeration machines, Coefficient of performance, Simple refrigeration vapor compression cycle, Various Psychrometric Processes, Types of Air Conditioners, Human comforts.

Hydraulic Turbines & Pumps: Introduction, Classification, Construction details and working of Pelton, Francis and Kaplan turbines, Classification of water pumps (Centrifugal and Reciprocating Pump) and their working.

Unit III: 12 lecture hours

Power Transmission Methods and Devices: Introduction to Power transmission, Belt, Rope, Chain and Gear drive, Types and functioning of clutches.

Stresses and Strains: Introduction, Concept & types of Stresses and strains, Poison's ratio, Stress-strain diagrams, Hooks law, Elastic constants & their relationships.

Unit IV: 08 lecture hours

Introduction to Manufacturing Systems: Fundamentals of Numerical Control (NC), Advantage of NC systems, Classifications of NC, Comparison of NC, and CNC.

Textbooks:

1. Elements of Mechanical Engineering – R.K. Rajput Laxmi Pub., Delhi
2. Elements of Mechanical Engineering – D.S. Kumar, S.K. Kataria and Sons
3. Engineering Thermodynamics- P.K.Nag TMH, New Delhi
4. Refrigeration & Air-conditioning – Arora &Domkundwar, Dhanpat rai &co.pvt ltd
5. Workshop Technology Vol.I& II - Hazra & Chaudhary, Asian Book Comp., New Delhi.

6. Process and Materials of Manufacture -- Lindberg, R.A. Prentice Hall of India, New Delhi.
7. Principles of Manufacturing Materials and Processes - Campbell, J.S.- McGraw- Hill

Reference Books/Materials:

1. Strength of Materials – Popov, Pub. PHI, New Delhi.
2. Hydraulic Machines – Jagdish Lal, Pub. Metropolitan, Allahabad.
3. Strength of Materials - G.H. Ryder, Pub. ELBS.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	**Quiz**	**Attendance**	**Mid Term Exam**	**Presentation/ Assignment/ etc.**	**End Term Exam**
Weightage (%)	**10**	**10**	**20**	**10**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Know the basics of thermodynamics andworkshop machinery.	**PO1**
CO2	Understand the basic knowledge of Refrigeration and Hydraulic Machinery.	**PO2**
CO3	Get the knowledge about power transmission method and device with mechanical properties.	**PO3**
CO4	Know the various concept about NC, CNC Machines.	**PO4**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ETME 101A	Basics of Mechanical Engineering	2	2	2	3									3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETPH151A	ENGINEERING PHYSICS LAB	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Basics of Physics				
Co-requisites	--				

Course Objectives

1. The abstraction from fields using the examples of the gravitational fields, with some applications
2. To learn how interference, diffraction, and polarization of light take place.
3. Consolidate the understanding of fundamental concepts in mechanics more rigorously as needed for further studies in physics, engineering, and technology.
4. Expand and exercise the students' physical intuition and thinking process through the understanding of the theory and application of this knowledge to the solution of practical problems

Course Outcomes:

On completion of this course, the students will be able to

CO1. Acquire fundamental knowledge of mechanics and able to apply on physical systems.

CO2. Better insight aboutwave nature of light.

CO3.Better understanding of data interpretation which enhances problem solving approach.

CO4. Develop the ability to correlates the daily life phenomenon to physics using mathematical tools

Catalog Description:

This course imparts the basic concepts of waves and optics. This course enables learners to solve non-dispersive transverse and longitudinal waves equations. This course helpslearners to analyze propagation of light, geometric and wave optics. The course introduces the basic concepts about lasers and helps learners to design different laser source systems.

Course Content

LIST OF EXPERIMENTS

1) To determine the value of acceleration due to gravity using Bar pendulum.
2) To determine the value of acceleration due to gravity using Kater's pendulum.
3) To determine the wavelength of sodium light using Newton`s ring apparatus.
4) To determine the wavelength of prominent lines of mercury by plane diffraction grating.
5) To determine the refractive index of the material of the prism for the given colours (wavelengths) of mercury light with the help of spectrometer.

6) To determine the specific rotation of cane sugar solution with the help of half shade polarimeter.
7) To determine the wavelength of He-Ne LASER using transmission diffraction grating.

Textbooks

- C. L.Arora, B.Sc Practical Physics (S Chand and Co. Ltd., New Delhi).
- Harnam Singh, Hemne P S, B.Sc. Practical Physics (S. Chand & Co).
- InduPrakash, Ramakrishna, A Text Book of Practical Physics (KitabMahal, New Delhi).

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Acquire fundamental knowledge of mechanics and able to apply on physical systems	**PO1& PO2**
CO2	Better insight aboutwave nature of light.	**PO4**
CO3	Better understanding of data interpretation which enhances problem solving approach.	**PO5**
CO4	Develop the ability to correlates the daily life phenomenon to physics using mathematical tools	**PO6**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ETPH151A	Engineering Physics Lab	2	3		3	3	3							3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETEC 151A	BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING LAB	L	T	P	C
		0	0	2	1
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives:

1. To understand the DC and AC circuit behaviour by application of network theorems.
2. To elaborate complex signals over oscilloscope devices with reading.
3. To be able to perform analysis of forward and reverse V-I characteristics of diode circuits.
4. To analyse the BJT inbuild circuits as per practical application point of view.
5. To gain basic insight of truth table-based logic gate decisions and to provide application-based output using seven segment display.

Course Outcomes:

On completion of this course, the students will be able to

CO1	Get an exposure to common electrical components and their ratings.
CO2	Determines proper electrical connections as per wires of appropriate ratings.
CO3	Understand the usage of common electrical measuring instruments.
CO4	Ability to discover applications related to seven segment display type of devices

Catalog Description:

The aim of the course is to acquaint the students with basics of AC and DC circuits. Identification of tools and devices to provide demonstration capabilities involved after learning AC in waveform format. Proofing of Complex AC waveform with practical circuit calculations. Basic topics included are AC and DC circuits, Cathode Ray Oscilloscope, Function Generator, LC, RL circuits, Superposition Theorems, Zener diode, Truth table verification with seven segment displays. All along with their application in real time situations.

Course Content

1. To get familiar with the working knowledge of the following instruments:
   a) Cathode ray oscilloscope (CRO)
   b) Multi meter (Analog and Digital)
   c) Function generator

d) Power supply

2. To measure phase difference between two waveforms using CRO. To measure an unknown frequency from Lissajous figures using CRO
3. To Verify the Thevenin' s and Norton's theorem
4. To Verify the Superposition theorem
5. To measure voltage, current and power in an A.C. circuit by LCR impedance method
6. To study the frequency response curve in series and parallel R-L-C circuit
7. a) Plot the forward and reverse V-I characteristics of P-N junction diode
b) Calculation of cut-in voltage c) Study of Zener diode in breakdown region
8. To plot and study the input and output characteristics of BJT in common-emitter configuration.
9. Verification of truth tables of logic gates (OR, AND, NOT, NAND, NOR).
10. To get familiar with the working and use of seven-segment display.

Reference Books for Lab Studies:

3. Electrical Engineering Fundamentals, V.Del Toro
4. Problems in Electrical Engineering – Parker Smith.S.

3. Sedra A S and Smith K C, "Microelectronic Circuits" 4th Ed., New York, Oxford University Press, New York.

4. Tocci R J and Widmer N S, "Digital Systems – Principles and Applications", 8th Ed., Pearson Education India, New Delhi.

5. A.K. Sawhney, "A course in Electrical & Electronics Measurements & Instrumentation", Dhanpat Rai & Sons.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	Get an exposure to common electrical components and their ratings.	PO1

CO2	Determines proper electrical connections as per wires of appropriate ratings.	**PO2**
CO3	Understand the usage of common electrical measuring instruments.	**PO2**
CO4	Ability to discover applications related to seven segment display type of devices	**PO12**

Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETEC 151A	BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING LAB	3	2										3	3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETME151A	**Basics of Mechanical Engineering Lab**	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Basic concepts of Physics				
Co-requisites	--				

Course Objectives

1. To calculate the Mechanical Advantage, Velocity Ratio and Efficiency of Single Start & Double Start Worm & Worm Wheel, Differential Wheel & Axle.
2. To study simple screw jack and compound screw jack and determine their efficiency.

3. To verify the law of Moments using Parallel Force apparatus. (Simply supported type)
4. To evaluate the co-efficient of friction between wood and various surface (like Leather, Wood, Aluminium) on an inclined plane.
5. To Study Two-Stroke & Four-Stroke Diesel Engines and Petrol Engines.
6. To Study the vapor compression Refrigeration System and Window Room Air Conditioner.

Course Outcomes:

Upon the completion of this course the students will be able to:

CO1 Understand the Mechanical Advantage, Velocity Ratio and Efficiency of various systems.
CO2 Understand concepts of screw jack, friction, law of moments.
CO3 Understand the Two-Stroke & Four-Stroke Diesel Engines and Petrol Engines.
CO4 Get the knowledge of various Refrigeration and Air- Conditioning Systems.

Catalog Description:

This course complements ETME151A. It enables and introduces the students to the study of various mechanical engineering concepts and prepares the student for further studies and better understanding of engineering subjects like Engineering Thermodynamics, strength of materials and theory of machines, etc. through practical exposure.

List of Experiments (Indicative)

1	To verify the law of Force Polygon.	**2 lab hours**
2	To verify the law of Moments using Parallel Force apparatus. (Simply supported type)	**2 lab hours**
3	To determine the co-efficient of friction between wood and various surface (like Leather, Wood, Aluminum) on an inclined plane.	**2 lab hours**
4	To find the forces in the members of Jib Crane.	**2 lab hours**
5	To determine the mechanical advantage, Velocity ratio and efficiency of a screw jack.	**2 lab hours**
6	To determine the mechanical advantage, Velocity ratio and Mechanical efficiency of the Wheel and Axle	**2 lab hours**
7	To verify the law of moments using Bell crank lever.	**2 lab hours**

8	To calculate the Mechanical Advantage, Velocity Ratio and Efficiency of Single Start, Double Start and Triple Start Worm & Worm Wheel.	**3 lab hours**
9	To Study Two-Stroke & Four-Stroke Diesel Engines.	**2 lab hours**
10	To Study Two-Stroke & Four-Stroke Petrol Engines.	**2 lab hours**
11	To Study the vapor compression Refrigeration System.	**2 lab hours**

Modes of Evaluation: Quiz/Oral practical oral exam/presentation/projects/Practical Examination

Examination Scheme:

Components	**Quiz**	**Attendance**	**Mid Term Exam**	**Presentation/ Projects/ etc.**	**End Term Exam**
Weightage (%)	**10**	**10**	**20**	**10**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand the Mechanical Advantage, Velocity Ratio and Efficiency of various systems.	**PO1**
CO2	Understand concepts of screw jack, friction, law of moments.	**PO4**
CO3	Understand the Two-Stroke & Four-Stroke Diesel Engines and Petrol Engines.	**PO5**
CO4	Get the knowledge of various Refrigeration and Air-Conditioning Systems	**PO2**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ETME 151A	Basics of Mechanical Engineering Lab	2	2		3	3								3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

SEMESTER II

ETMA104A	APPLIED MATHEMATICS-II	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

1. Provide the brief idea to students of Laplace transformation.
2. To understand Curl, divergence and gradient with their applications and have the idea of directional derivatives and derive the equations of tangent planes and normal lines.
3. Apply the Green, Stoke and Gauss Theorem to find the area and volume of the object.
4. Recognize and implement the concept of differential equations and learn various methods to solve ordinary differential equations
5. Apply the method of characteristics to solve first order partial differential equations.

Course Outcomes

- On completion of this course, the students will be able to
- CO1 Understand and able to apply the basic concept of Laplace transform.
- CO2 Recognize and able to apply the concepts of vector function, vector field, scalar field, gradient, divergence, and curl.
- CO3 Demonstrate the Green, Stoke and Gauss Theorem to find the area and volume of the object in real world.
- CO4 Learn the concepts of orthogonally diagonalise symmetric matrices and quadratic forms.
- CO5 Determine and find Extend the concept of series solutions to solve differential equations and learn orthogonality about the functions.
- CO6 Demonstrate knowledge and understanding partial differential equations and how they relate to different modeling situations.

Catalog Description

Applied mathematics-II is the mathematical study of general scientific concepts, principles, and phenomena that, because of their widespread occurrence and application, relate or unify various disciplines. The core of the program the following principles and their mathematical formulations: Linear transformation, partial differential equations, ordinary differential equations and vector calculus. The concepts of applied mathematics-II are extremely useful in physics, economics and social sciences, natural sciences, and engineering. Due to its broad range of applications, linear algebra is one of the most widely taught subjects in college-level mathematics important objectives of the linear algebra are to develop and strengthen the students' problem-solving skills and to teach them to read, write, speak, and think in the language of mathematics. Students learn how to apply the tools of calculus to a variety of problem situations.

Course Content

Unit I: **09 lecture hours**

Laplace Transformation: Existence condition, Laplace transform of standard functions, Properties, Inverse Laplace transform of functions, Convolution theorem, solving linear differential equations using Laplace transform. Heaviside unit step function, Impulse function, Periodic function and their transforms.

Unit II: **10 lecture hours**

Vector Calculus: Scalar and vector point functions, Gradient, Divergence, Curl with their physical significance, Directional derivatives, Properties, Line integrals, Surface integrals and Volume integrals, Gauss theorem, Green's theorem and Stoke's theorem (without proof).

Unit III: **10 lecture hours**

Ordinary Differential Equations: Exact differential equations of first order and first degree, Linear differential equations of higher order with constant coefficients, Variation of parameters, Solution of simultaneous linear differential equations, Solution of homogeneous differential equations - Cauchy and Legendre forms.

Unit IV: **10 lecture hours**

Partial Differential Equations and its applications: Formation of partial differential equations, Lagrange's linear equation, Charpit's method of non-linear partial differential equations, Method of separation of variables, Solution of wave and heat conduction equations, Initial and boundary value problems.

Text Books

1. Kresyzig, "Advanced Engineering Mathematics", John Wiley and Sons.
2. Jain and Iyengar, "Advanced Engineering Mathematics", Narosa Publication

Reference Books/Materials

1. B.S.Grewal, " Higher Engineering Mathematics", Khanna Publishers.
2. H.K. Dass, "Advanced Engineering Mathematics", S. Chand & Company.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Quiz I	Quiz II	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	Understand and able to apply the basic concept of Laplace transform.	PO1
CO2	Recognize and able to apply the concepts of vector function, vector field, scalar field, gradient, divergence, and curl.	PO8
CO3	Demonstrate the Green, Stoke and Gauss Theorem to find the area and volume of the object in real world.	PO2
CO4	Learn the concepts of orthogonally diagonalise symmetric matrices and quadratic forms.	PO4
CO5	Determine and find Extend the concept of series solutions to solve differential equations and learn orthogonality about the functions.	PO3
CO6	Demonstrate knowledge and understanding partial differential equations and how they relate to different modelling situations.	PO1

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ETMA104 A	Applied Mathematic s-II	2	3	2	3				2					3		

1= weakly mapped
2= moderately mapped
3= strongly mapped

ETCS104A	**INTRODUCTION TO COMPUTERS AND PROGRAMMING IN PYTHON**	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	Advanced of Computer communication				
Co-requisites	--				

Course Objectives

1. Provide an understanding of the role computation can play in solving problems.

2. Master the fundamentals of writing Python scripts.

3. Learn core Python scripting elements such as variables and flow control structures.

4. Discover how to work with lists and sequence data.

5. Position students so that they can compete for projects and excel in subjects with programming components.

Course Outcomes

On completion of this course, the students will be able to

CO 1 To learn the syntax and semantics of Python programming language

CO 2 To use the structural programming approach in solving the problem.

CO 3 To use the object-oriented programming approach in solving problems

CO 4 To handle exceptions gracefully

CO 5 To develop searching and sorting algorithms

Catalog Description

Introduction to Computer and Programming in Python is intended for students with little or no programming experience. It aims to provide students with an understanding of the role computation can play in solving problems and to help students, regardless of their major, feel justifiably confident of their ability to write small programs that allow them to accomplish useful goals. The class will use the Python 3.5 programming language.

Course Content

UNIT I 12 **LECTURE HOURS**

Introduction to Programming: Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.)

Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm:

Flowchart / Pseudo code with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code

UNIT II **8 LECTURE HOURS**

Introduction to Python: The basic elements of python, Branching Programs, Control Structures, Strings and Input, Iteration, String Manipulation, Guess and Check, Approximations, Bisection, Functions, Scoping and Abstraction: Functions and scoping, Specifications, Recursion, Global variables, Modules, Files

UNIT III **10 LECTURE HOURS**

Classes and Object: Oriented Programming: Abstract Data Types and Classes, Inheritance, Encapsulation and Information Hiding, Handling Exceptions, Decorators

UNIT IV **10 LECTURE HOURS**

Simple Algorithms and Data structures: File Handling, Search Algorithms, Sorting, Algorithms, Hash Tables

TEXT BOOKS:

1. John V Guttag. “Introduction to Computation and Programming Using Python”, Prentice Hall of India

Reference Books

1. R. Nageswara Rao, “Core Python Programming”, Dreamtech

2. Wesley J. Chun. “Core Python Programming, Second Edition”, Prentice Hall

3. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, “Data Structures and Algorithms in Python”, Wiley

4. Kenneth A. Lambert, “Fundamentals of Python,First Programs”, CENGAGE Publication

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz I	Quiz II	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	To learn the syntax and semantics of Python programming language	PO1, PO2
CO2	To use the structural programming approach in solving the problem.	PO3, PO4
CO3	To use the object oriented programming approach in solving problems	PO10
CO4	To handle exceptions gracefully	PSO1
CO5	To develop searching and sorting algorithms	PSO2

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
ETCS104A	Introduction to Computer Science and Programming in Python	2	2	2	2						2			3	3	

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETCH119A	**Engineering Chemistry**	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	12^{th} Standard Chemistry				
Co-requisites	--				

Course Objectives:

- To acquire knowledge of engineering materials and about fuels.
- To develop the interest among the students regarding chemistry andtheir applications in engineering.
- To develop an intuitive understanding of chemistry by emphasizing the related branches of engineering.
- To develop confidence among students about chemistry, how the knowledge of chemistry is applied in technological field.
- To acquire knowledge about desalination of brackish water and treatment of municipal water.
- To gain the knowledge of conducting polymers, bio-degradable polymers and fiber reinforced plastics.

Course Outcomes:

CO1: Develop the understanding of Technology involved in improving quality of water for its industrial use.
CO2: Identify instrumental techniques for analysis and analyze the quality parameters of chemical fuels.
CO3: Develop the understanding of Chemical structure of polymers and its effect on their various properties when used as engineering materials.
CO4: Impart the knowledge of fuels and biofuels with its properties and applications.
CO5: Illustrate the principals involved in thermodynamics and kinetic theory of gases which are used in daily life.
CO6: They can predict potential applications of chemistry and practical utility to become good engineers and entrepreneurs.

Catalog Description

This course introduces chemistry of water and an overview of different methods used for purification of water using various inorganic and organic compounds with detection of major and minor ions present in water. Various techniques used for preparation of fuels, biofuels and techniques used for analysis are reviewed. The purpose of this course is to develop a strong foundation in the principles and methods to understand the kinetic theory of gases, thermodynamics, phase rule, polymer, and biopolymers. There will be an excursion at the end of the semester.

Course Content

Unit I: **16 lecture hours**

Water Technology: Introduction and characteristics of water; Hardness and its determination (EDTA method only); Alkalinity and its determination; Boiler feed water; Boiler problems - scale, sludge, priming & foaming, their causes & prevention; Caustic embrittlement & corrosion -Causes & prevention; Removal of silica & dissolved gases; Water softening processes : Lime - soda process, Ion exchange method, carbonate & phosphate conditioning, colloidal conditioning & calgon treatment; Water for domestic use.

Unit II: **12 lecture hours**

Fuels: Classification; Calorific value of fuel and its determination; Bomb calorimeter; Boy's Gas calorimeter; Solid fuels- Proximate and ultimate analysis, High & Low temperature carbonization, manufacture of coke (Otto-Hoffmann oven); Liquid Fuels - Petroleum-Chemical composition, fractional distillation, Thermal & catalytic cracking, Octane & Cetane No. and its significance; Power alcohol, Analysis of flue gases (Orsat's apparatus).

Unit III: **12 lecture hours**

Gaseous state and thermo chemistry: Gas laws and kinetic theory of gases; Distribution of molecular velocities; Mean free path; Real gases-non ideal behavior; Causes of deviation from ideal behavior; Vander Waal's equation; liquefaction of gases.

Hess's Law; Heat of Reaction; Heat of dilution; Heat of Hydration; Heat of neutralization and Heat of Combustion; Effect of temperature on heat of reaction at constant pressure (Kirchhoff s equation); Flame Temperature

Unit IV: 10 lecture hours

The phase rule and polymers: Definition of various terms, Gibb's Phase rule, Application of phase rule to one component system- The water system and carbon dioxide system, Two component system:Lead-silver,Na2SO4-water.

Polymers and its classification; Mechanism of addition and condensation polymers; Coordination polymerization; Synthesis, properties and uses of urea formaldehyde, phenol formaldehyde, poly vinyl acetate and polythene; Conducting and bio-polymers.**)**

Text Books

1. Chemistry in Engineering & Technology (Vol I & II) (Latest ed.), By J.C. Kuriacose& J. Rajaram
2. Principles of Physical Chemistry, (Latest ed.), Puri B.R., Sharma L.R. and Pathania, M.S.
3. Text book of Engg. Chemistry, S. Chand & Co., (Latest ed.), S.S. Dara

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	Develop the understanding of Technology involved in improving qualityof water for its industrial use.	PO2
CO2	Identify instrumental techniques for analysis and analyze the qualityparameters of chemical fuels.	PO1
CO3	Develop the understanding of Chemical structure of polymers and itseffect on their various properties when used as engineering materials.	PO6
CO4	Impart the knowledge of fuels and biofuels with its propertiesand applications.	PO7
CO5	Illustrate the principles involved in thermodynamicsand kinetic theory of gases which are used in daily life.	PO3

CO6	They can predictpotential applications of chemistry and practical utility in order to become goodengineers and entrepreneurs	**PO1**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ETCH119	Engineering Chemistry	3	3	2			3	2						3	3	

1=weakly mapped
2= moderately mapped
3=strongly mapped

Course Objectives

ETCS150A	**INTRODUCTION TO COMPUTER SCIENCE AND PROGRAMMING IN PYTHON LAB**	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Practical learning				
Co-requisites	--				

Master the fundamentals of writing Python scripts.

Learn core Python scripting elements such as variables and flow control structures.

Discover how to work with lists and sequence data.

Position students so that they can compete for projects and excel in subjects with programming components.

Course Outcomes

On completion of this course, the students will be able to

CO 1 To learn the syntax and semantics of Python programming language

CO 2 To use the structural programming approach in solving the problem.

CO 3 To use the object-oriented programming approach in solving problems

CO 4 To handle exceptions gracefully

CO 5 To develop searching and sorting algorithms

Course Content

List of Experiments

1	Develop programs to implement list	**2 lab hours**
2	Develop programs to implement Dictionary	**2 lab hours**
3	Develop programs to implement tuples	**2 lab hours**
4	Develop programs to understand the control structures of python	**2 lab hours**
5	Develop programs to implement function with stress on scoping	**2 lab hours**
6	Develop programs to implement classes and objects	**2 lab hours**
7	Develop programs to implement exception handling.	**2 lab hours**
8	Develop programs to implement linear search and binary search.	**2 lab hours**
9	Develop programs to implement insertion sort	**2 lab hours**
10	Develop programs to implement bubble sort.	**2 lab hours**
11	Develop programs to implement quick sort.	**2 Labs**
12	Develop programs to implement heap sort.	**2 Labs**

Modes of Evaluation: Quiz/Oral practical oral exam/presentation/projects/Practical Examination
Examination Scheme:

Components	**Quiz I**	**Quiz II**	**Mid Term Exam**	**Presentation/ Projects/ etc.**	**End Term Exam**
Weightage (%)	**10**	**10**	**20**	**10**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	To learn the syntax and semantics of Python programming language	**PO2**
CO2	To use the structural programming approach in solving the problem.	**PO3**
CO3	To use the object-oriented programming approach in solving problems	**PO5**
CO4	To handle exceptions gracefully	**PSO1**
CO5	To develop searching and sorting algorithms	**PO9**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
ETCS 150A	Introduction to computer science and programming in python Lab		2	3		3				3				3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETCH159A	Engineering Chemistry Lab	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Basics of Chemistry				
Co-requisites	--				

Course Objectives

- To acquaint the students with practical knowledge of the basic phenomenon/concepts of chemistry, the student face during course of their study in the industry and engineering field.
- To understand and explain scientifically the various chemistry related problems in the industry/engineering and develop experimental skills for building technical competence.
- To enable the learners to get hands-on experience on the principles discussed in theory sessions and to understand the applications of these concepts in engineering.

Course Outcomes

On completion of this course, the students will be able to
CO1: Analyze & generate experimental skills.
CO2: Enhance the thinking capabilities in the modern trends in Engineering & Technology.
CO3: Learn and apply basic techniques used in chemistry laboratory for small/large scale water analyses/purification.
CO4: Utilize the fundamental laboratory techniques for analyses hardness/ alkalinity of water.
CO5: Employ the basic techniques used in chemistry laboratory for analyses such as volumetric titrations, conductometric, and stalagmometer.
CO6: Learn to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments.

Catalog Description

This course covers the simple synthesis method of resin using polymers. The course gives introduction and hand on experience of analysis of alkalinity/ dissolved oxygen/ hardness of water in an analytical way. An overview of volumetric titration and conductometric titration has been introduced.

List of Experiments (Indicative)

1	Determine the percentage composition of sodium hydroxide in the given mixtureof sodium hydroxide and sodium chloride.	**2 lab hours**
2	Determine the amount of Oxalic acid and Sulphuric acid in one liter of solution,given standard sodium hydroxide and Potassium	**2 lab hours**

	Permanganate.	
3	Determine the amount of copper in the copper ore solution, provided hypo solution.	**2 lab hours**
4	Argent metric titration one each by Vohlard's method and by Mohr's method.	**2 lab hours**
5	Complexometric titrations.	**2 lab hours**
6	Determine the heat of neutralization of strong acid with strong base.	**2 lab hours**
7	Determine the surface tension of a liquid using drop weight method.	**2 lab hours**
8	Determine viscosity of a given liquid (density to be determined).	**2 lab hours**
9	Determine the reaction rate constant for the Ist order reaction.	**2 lab hours**
10	Determine the cell constant of a conductivity cell.	**2 lab hours**
11	Find out strength of given solution of HCl conductometric ally.	**2 lab hours**
12	Preparation of urea formaldehyde and phenol formaldehyde resins.	**2 lab hours**
13	Determination of dissolved oxygen in the given sample of water.	**2 lab hours**
14	Determination of alkalinity in the given sample of water.	**3 lab hours**

Modes of Evaluation: Quiz/Oral practical oral exam/presentation/projects/Practical Examination

Examination Scheme:

Components	**Quiz**	**Attendance**	**Mid Term Exam**	**Presentation/ Projects/ etc.**	**End Term Exam**
Weightage (%)	**10**	**10**	**20**	**10**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Analyze & generate experimental skills.	**PO12**
CO2	Enhance the thinking capabilities in the modern trends in Engineering & Technology.	**PO1**

CO3	Learn and apply basic techniques used in chemistry laboratory for small/large scale water analyses/purification.	**PO3**
CO4	Utilize the fundamental laboratory techniques for analyses hardness/ alkalinity of water.	**PO2**
CO5	Employ the basic techniques used in chemistry laboratory for analyses such as volumetric titrations, conductometric, and stalagmometer.	**PO5**
CO6	Learn to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments.	**PO9**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ETCH159	Engineering Chemistry Lab	3	3	2		2				3			3	3		3

1=weakly mapped
2= moderately mapped
3=strongly mapped

Course Objectives

ETME157A	**WORKSHOP PRACTICE**	L	T	P	C
Version 1.0		0	0	3	1.5
Pre-requisites/Exposure	Basic of mechanical engineering				
Co-requisites	--				

The objective of this course is to develop:

1. Understanding different manufacturing techniques and their relative advantages / disadvantages with respect to different applications
2. The selection of a suitable technique for meeting a specific fabrication need
3. Acquire a minimum practical skill with respect to the different manufacturing methods and develop the confidence to design & fabricate small components for their

project work and also to participate in various national and international technical competitions.

Course Outcomes

Upon the completion of this course the students will be able to:

- CO1.Introduction to different manufacturing methods in different fields of engineering
- CO2. Practical exposure to different fabrication techniques
- CO3. Creation of simple components using different materials
- CO4.Exposure to some of the advanced and latest manufacturing techniques being employed in the industry.

Catalog Description

This course is intended to expose engineering students to different types of manufacturing/ fabrication processes, dealing with different materials such as metals, ceramics, plastics, wood, glass etc. While the actual practice of fabrication techniques is given more weight age, some lectures and video clips available on different methods of manufacturing are also included.

List of Experiments (Indicative)

1	To introduce various shops and common tools used with their safety precautions	**3 lab hours**
2	To make T-joint in carpentry shop	**3 lab hours**
3	To make Bridal-joint in carpentry shop	**3 lab hours**
4	To make Double V-Butt joint in welding shop	**3 lab hours**
5	To make Lap joint in welding shop	**3 lab hours**
6	To make saw - cut filling V-cut taper at the corners, circular cut in fitting shop.	**3 lab hours**
7	To fit square in square, triangle in square using fitting hand tools.	**3 lab hours**
8	To Study various types of welding and perform Arc welding and Oxy-Acetylene Welding.	**3 lab hours**
9	To Study about the micrometer and vernier caliper.	**3 lab hours**

10	To Study about the various machine tools.	**3 lab hours**
11	To make jobs by using various machine tools.	**3 lab hours**

Modes of Evaluation: Quiz/Oral practical oral exam/presentation/projects/Practical Examination

Examination Scheme:

Components	**Quiz I**	**Quiz II**	**Mid Term Exam**	**Presentation/ Projects/ etc.**	**End Term Exam**
Weightage (%)	**10**	**10**	**20**	**10**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Introduction to different manufacturing methods in different fields of engineering	**PO1**
CO2	Practical exposure to different fabrication techniques	**PO4**
CO3	Creation of simple components using different materials	**PO5**
CO4	Exposure to some of the advanced and latest manufacturing techniques being employed in the industry.	**PO2**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ETME 157A	Workshop Practice	3		3	2	3								3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

SEMESTER III

ETME 205A	THERMODYNAMICS	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	Basics of Thermodynamics, Laws of Thermodynamics				
Co-requisites	--				

Course Objectives: The subject expects students to achieve the following objectives.

1. Identify and use units and notations in Thermodynamics.
2. State and illustrate first and second laws of Thermodynamics.
3. Explain the concepts of entropy, enthalpy, reversibility, and irreversibility.
4. Apply the first and second laws of Thermodynamics to various gas processes and cycles.
5. To get conversant with properties of steam, dryness fraction measurement, vapor processes and thermodynamic vapor cycles, performance estimation.

Course Outcomes: Upon the completion of this course the students will be able to:

- CO1.Understand the role of the internal energy, enthalpy, entropy, temperature, pressure, and specific volume thermodynamic properties.
- CO2.Able to explain the concepts of entropy, enthalpy and Ideal gas equation and various gas Laws.
- CO3.Understand the role of thermodynamic cycles, concept of availability and irreversibility.
- CO4.Recognize and understand the different forms of pure substances, quantify the behaviour of the substance and able to read thermodynamics charts and draw P-V and T-S diagrams.

Catalog Description

This course gives introductory knowledge about basic concept about Thermodynamics, Laws of thermodynamics, water vapor and Ideal and real gases. It enables the students to understand the working of these systems. It also enhances the students thinking capability to calculate the efficiency of the systems. This course is also helping students to answer fundamental questions of thermal engineering at the time of the interview.

Course Content

Unit I: **12 lecture hours**

Basic Concepts: Macroscopic and Microscopic Approaches, Thermodynamic Systems, Surrounding and Boundary, Thermodynamic Property – Intensive and Extensive, Thermodynamic Equilibrium, State, Path, Process and Cycle, Quasi-static, Reversible and

Irreversible Processes, Working Substance. Concept of Thermodynamic Work and Heat, Equality of Temperature, Zeroth Law of Thermodynamic and its utility, Problems. First Law of Thermodynamics: Energy and its Forms, Energy and 1st law of Thermodynamics, Internal Energy and Enthalpy, PMMFK, Steady flow energy equation, 1st Law Applied to Non- flow process, Steady Flow Process and Transient Flow Process, Throttling Process and Free Expansion Process. Problems.

Unit II: **08 lecture hours**

Second Law of Thermodynamics: Limitations of First Law, Thermal Reservoir, Heat Source and Heat Sink, Heat Engine, Refrigerator and Heat Pump, Kelvin- Planck and Clausius Statements and their Equivalence, PMMSK. Carnot Cycle, Carnot Heat Engine and Carnot Heat Pump, Carnot Theorem and its Corollaries, Thermodynamic Temperature Scale. Entropy, Clausius Inequality, Principle of Entropy Increase, Temperature Entropy Plot, Entropy Change in Different Processes, Introduction to Third Law of Thermodynamics. Problems.

Availability and Irreversibility: High- and Low-Grade Energy, Availability and Unavailable Energy, Loss of Available Energy Due to Heat Transfer Through a Finite Temperature Difference, Dead state of a system, Availability of a Non-Flow or Closed System, Availability of a Steady Flow System, Helmholtz and Gibb's Functions, Effectiveness, and Irreversibility, Second law efficiencies of processes & cycles. Problems.

Unit III: **12 lecture hours**

Pure Substance: Pure Substance and its Properties, Phase and Phase Transformation, Vaporization, Evaporation and Boiling, Saturated and Superheat Steam, Solid – Liquid – Vapour Equilibrium, T-V, P-V and P-T Plots During Steam Formation, Properties of Dry, Wet and Superheated Steam, Property Changes During Steam Processes, Temperature – Entropy (T-S) and Enthalpy – Entropy (H-S) Diagrams, Throttling and Measurement of Dryness Fraction of Steam. Problems.

Ideal and Real Gases: Concept of an Ideal Gas, Basic Gas Laws, Characteristic Gas Equation, Avogadro's law and Universal Gas Constant, P-V-T surface of an Ideal Gas. Vander Waal's Equation of state, Reduced Co-ordinates, Compressibility factor and law of corresponding states. Mixture of Gases, Mass, Mole and Volume Fraction, Gibson Dalton's law, Gas Constant and Specific Heats, Entropy for a mixture of non-reactive gases. Problems.

Unit IV: **08 lecture hours**

Thermodynamic Relations: Maxwell Relations, Clapeyron Equation, Relations for changes in Enthalpy and Internal Energy & Entropy, Specific Heat Capacity Relations, Joule Thomson coefficient & inversion curve.

Gas power Cycles: Carnot Cycle, Otto Cycle, Diesel Cycle, Dual Cycle, and Stirling Cycle, Ericson cycle, Problems.

TEXTBOOKS:

1. Engineering Thermodynamics –P. K. Nag, TMH.
2. Thermal Engineering- R. K. Rajput, PHI, Publications.

REFERENCE BOOKS:

1. Theory and Problems of Thermodynamics – Y. V.C. Rao, Wiley Eastern Ltd., New Delhi.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	**Quiz**	**Attendance**	**Mid Term Exam**	**Presentation/ Assignment/ etc.**	**End Term Exam**
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand the role of the internal energy, enthalpy, entropy, temperature, pressure, and specific volume thermodynamic properties.	**PO1**
CO2	Able to explain the concepts of entropy, enthalpy and Ideal gas equation and various gas Laws.	**PO2**
CO3	Understand the role of thermodynamic cycles, concept of availability and irreversibility.	**PO3**
CO4	Recognize and understand the different forms of pure substances, quantify the behavior of the substance and able to read thermodynamics charts and draw P-V and T-S diagrams.	**PO4**

Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ETME 205A	Thermodynamics	3	3	2			3							3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETME 215A	STRENGTH OF MATERIALS	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure	Basics of Mechanical Engineering, Material Science				
Co-requisites	--				

Course Objectives: The subject expects students to achieve the following objectives.

1. Define direct normal stress and direct shear stress and compute their values.
2. Understanding of normal strain and shearing strain, strain, stress strain diagram.
3. Describe ductile and brittle behavior of materials, emphasizing design implications.
4. Impart knowledge of bending, torsion and loading of columns.

Course Outcomes: Upon the completion of this course the students will be able to:

a. CO1.Know the concepts of stress and strain and their use in the analysis and design of machine members and structures.
b. CO2.Develop an understanding of material behavior under a condition of pure torsion (twisting moment) on circular shafts.
c. CO3.Develop an understanding of the models and procedures used in the analysis of transversely loaded beams and shafts with various support conditions. Gain the ability to analyze the effect of various loading combinations on a mechanical/structural member.
d. CO4.Understanding of analytic methods used in connection with the structural design of columns, long mechanical members under compression.

Catalog Description: This course makes the students understand the concept of stress and strain in different types of structure/machines under different loading conditions. The course also covers the simple and compound stresses due to forces, stresses, and deflection in beams due to bending, torsion in circular section, strain energy, different theories of failure.

Course Content

Unit I: **12 lecture hours**

Simple Stresses & Strains: Concept & types of Stresses and strains, Poison's ratio, stresses, and strain in simple and compound bars under axial loading, stress strain diagrams, Hooks

law, elastic constants & their relationships, temperature stress & strain in simple & compound bars under axial loading, Numerical.

Compound Stresses & Strains: Concept of surface and volumetric strains, two-dimensional stress system, conjugate shear stress at a point on a plane, principal stresses & strains and principal- planes, Mohr's circle of stresses, Numerical.

Unit II: **08 lecture hours**

Shear Force & Bending Moments: Definitions, SF & BM diagrams for cantilevers, simply supported beams with or without over-hang and calculation of maximum BM & SF and the point of contra-flexure under (i) concentrated loads, (ii) uniformly distributed loads over whole span or a part of it, (iii) combination of concentrated loads and uniformly distributed loads, (iv) uniformly varying loads and (v) application of moments, relation between the rate of loading, the shear force and the bending moments, Problems.

Torsion of Circular Members: Torsion of thin circular tube, Solid and hollow circular shafts, tapered shaft, stepped shaft & composite circular shafts, combined bending and torsion, equivalent torque, effect of end thrust. Numerical.

Unit III: **12 lecture hours**

Bending & Shear Stresses in Beams: Bending stresses in beams with derivation & application to beams of circular, rectangular, I,T and channel sections, composite beams, shear stresses in beams with combined bending, torsion & axial loading of beams Numericals.

Columns & Struts: Column under axial load, concept of instability and buckling, slenderness ratio, derivation of Euler's formulae for the elastic buckling load, Eulers, Rankine, Gordom's formulae Johnson's empirical formula for axial loading columns and their applications, eccentric compression of a short strut of rectangular & circular sections, Numerical.

Unit IV: **08 lecture hours**

Slope & Deflection: Relationship between bending moment, slope & deflection, Mohr's theorem, moment area method, method of integration, Macaulay's method, calculations for slope and deflection of (i) cantilevers and (ii) simply supported beams with or without overhang under concentrated load, uniformly distributed loads or combination of concentrated and uniformly distributed loads, Numerical.

Fixed Beams: Deflections, reactions, and fixing moments with SF & BM calculations & diagrams for fixed beams under (i) concentrated loads, (ii) uniformly distributed load and (iii) A combination of concentrated loads & uniformly distributed load.

TEXTBOOKS:

1. Strength of Materials – G.H.Ryder - Macmillan, India 24

2. Strength of Materials– Andrew Pytel and Fredinand L.Singer, Addison –Wesley

REFERENCE BOOKS:

1. Strength of Materials – Popov, PHI, New Delhi.

2. Strength of Materials A Rudimentary Apprach – M.A. Jayaram, Sapna Book House, Bangalore

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	**Quiz**	**Attendance**	**Mid Term Exam**	**Presentation/ Assignment/ etc.**	**End Term Exam**
Weightage (%)	**10**	**10**	**20**	**10**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Know the basics of thermodynamics and workshop machinery.	**PO1**
CO2	Understand the basic knowledge of Refrigeration and Hydraulic Machinery.	**PO2**
CO3	Get the knowledge about power transmission method and device with mechanical properties.	**PO3**
CO4	Know the various concept about NC, CNC Machines.	**PO4**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ETME 215A	Strength of materials	2	3	2	3									3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETME 217A	FLUID MECHANICS	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure	Basics of Thermodynamics, Fluid Machinery and Power transmission				
Co-requisites	--				

Course Objectives: The subject expects students to achieve the following objectives.

1. Understanding basic laws, principles, and phenomena in fluid mechanics
2. To solve simplified examples of fluid mechanics
3. Theoretical and practical preparation enabling students to apply the acquired knowledge and skills in professional and specialist courses.
4. To understand the basics of fluid flow and its types.

Course Outcomes: Upon the completion of this course the students will be able to:

CO1.Define basic terms, values, and laws in the areas of fluids properties, statics, kinematics and dynamics of fluids, and hydraulic design of pipes,
CO2.Describe methods of implementing fluid mechanics laws and phenomena while analyzing the operational parameters of hydraulic problems, systems, and machines,
CO3.Practically apply tables and diagrams, and equations that define the associated laws.
CO4.Calculate and optimize operational parameters of hydraulic problems, systems and machines,
CO5.Explain the correlation between different operational parameters,
CO6.Select engineering approach to problem solving based on the acquired physics and mathematical knowledge.

Catalog Description

The basic purpose of this course is to introduce the students to the concepts of fluid mechanics. First few lectures will review the fundamentals of fluid mechanics, while subsequent lectures will focus on its applications in various engineering fields. Briefly the course will include microscopic & macroscopic balances, Navier-Stokes' equations, Introduction to turbulence, concept of boundary layer, friction factor, pipe flow, pressure loss in fittings, flow past an immersed body, packed & fluidized beds, pump & compressors.

Course Content

Unit I: 12 lecture hours

Fluid Properties and Fluid Statics: Concept of fluid and flow, ideal and real fluids, continuum concept, and properties of fluids, Newtonian, and non-Newtonian fluids. Pascal's

law, hydrostatic equation, hydrostatic forces on plane and curved surfaces, stability of floating and submerged bodies, relative equilibrium, Problems.

Fluid Kinematics: Eulerian and Lagrangian description of fluid flow; stream, streak, and path lines; types of flows, flow rate and continuity equation, differential equation of continuity in cylindrical and polar coordinates, rotation, vorticity and circulation, stream and potential functions, flow net, Problems.

Unit II: **08 lecture hours**

Fluid Dynamics: Concept of system and control volume, Euler's equation, Bernoulli's equation, pitot tube, venturimeter, orifices, orifice-meter, mouthpieces, kinetic and momentum correction factors, Impulse momentum relationship and its applications, Problems.

Compressible Fluid Flow: Introduction, continuity momentum and energy equation, Problems.

Unit III: **12 lecture hours**

Viscous Flow: Flow regimes and Reynolds's number, Relationship between shear stress and pressure gradient, uni-directional flow between stationary and moving parallel plates, movement of piston in a dashpot, power absorbed in bearings. Problems

Flow Through Pipes: Major and minor losses in pipes, Hagen-Poiseuilli law, hydraulic gradient and total energy lines, series and parallel connection of pipes, branched pipes; equivalent pipe, power transmission through pipes, Problems.

Unit IV: **08 lecture hours**

Boundary Layer Flow: Boundary layer concept, displacement, momentum, and energy thickness, von-karman momentum integral equation, laminar and turbulent boundary layer flows, drag on a flat plate, boundary layer separation and control. Streamlined and bluff bodies lift and drag on a cylinder and an airfoil, Problems.

Turbulent Flow: Shear stress in turbulent flow, Prandtl mixing length hypothesis, hydraulically smooth and rough pipes, velocity distribution in pipes, friction coefficients for smooth and rough pipes, Problems.

Text- Books:

1. Fluid Mechanics – Streeter V L and Wylie E B, Mc Graw Hill
2. Mechanics of Fluids – I H Shames, Mc Graw Hill
3. Fluid Mechanics – Frank M White, Tata McGraw Hill

Reference Books/Materials:

1. Introduction to Fluid Mechanics and Fluid Machines – S.K. Som and G. Biswas, TMH
2. Fluid Mechanics and Fluid Power Engineering – D.S. Kumar, S.K. Kataria and Sons
3. Fluid Mechanics and Machinery – S.K. Agarwal, TMH, New Delhi.
4. Fluid Mechanics and Machinery – Dr. R.K.Bansal – Laxmi Publishers.
5. Fluid Mechanics – Dr. R.K. Rajput – Khanna Publications.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	**Quiz**	**Attendance**	**Mid Term Exam**	**Presentation/ Assignment/ etc.**	**End Term Exam**
Weightage (%)	**10**	**10**	**20**	**10**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand basic laws, principles, and phenomena in the area of fluid mechanics	**PO1**
CO2	To solve simplified examples of fluid mechanics	**PO2**
CO3	Theoretical and practical preparation enabling students to apply the acquired knowledge and skills in professional and specialist courses.	**PO3**
CO4	To understand the basics of fluid flow and its types.	**PO4**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ETME 217A	Fluid Mechanics	2			3	3							2	3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

UCDM 301A	DISASTER MANAGMENT	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure					
Co-requisites	--				

Course Objective:

1. To increase the knowledge and understanding of the disaster phenomenon, its different contextual aspects, impacts and public health consequences.
2. Understanding of the International Strategy for Disaster Reduction (UN-ISDR) and to increase skills and abilities for implementing the Disaster Risk Reduction (DRR) Strategy.
3. To ensure skills and abilities to analyze potential effects of disasters and of the strategies and methods to deliver public health response to avert these effects.
4. To ensure skills and ability to design, implement and evaluate research on disaster**.**

Course Outcomes:

After completing the program, the student will be able to understand

CO1. Capacity to describe, analyze and evaluate the environmental, social, cultural, economic, legal and organizational aspects influencing vulnerabilities and capacities to face disasters.

CO2. The course examines disaster profile of our country and illustrates the role played by various governmental and non- governmental organizations & its effective management.

CO3. It also acquaints learners with the existing legal framework for disaster management.

CO4. Capacity to analyze and evaluate research work on the field of emergencies and disaster while demonstrating insight into the potential and limitations of science, its role in society and people's responsibility for how it is used.

Catalog Description: This course incorporates different types of disasters so that students are well aware of the circumstances around them. We have included one project in the syllabus so that they can thoroughly study the pre & post disastrous situations as well as the role of society in these difficult situations.

Course Content

UNIT I **08 lecture hours**

Introduction to Disasters: Concept and definitions- Disaster, Hazard, vulnerability, resilience, and risks.

Different Types of Disaster: Causes, effects and practical examples for all disasters.

- Natural Disaster: such as Flood, Cyclone, Earthquakes, Landslides etc
- Man-made Disaster: such as Fire, Industrial Pollution, Nuclear Disaster, Epidemic and Biological Disasters, Accidents (Air, Sea, Rail & Road), Structural failures (Building and Bridge), War & Terrorism etc.

UNIT- II **8 lecture hours**

Disaster Preparedness and Response Preparedness

- Disaster Preparedness: Concept and Nature
- Disaster Preparedness Plan
- Prediction, Early Warnings and Safety Measures of Disaster.
- Role of Information, Education, Communication, and Training, Role of Government, International and NGO Bodies.
- Role of IT in Disaster Preparedness
- Role of Engineers on Disaster Management.
- Relief and Recovery
- Medical Health Response to Different Disasters

UNIT III **6 lecture hours**

Rehabilitation, Reconstruction and Recovery:

- Damage Assessment
- Post Disaster effects and Remedial Measures.
- Creation of Long-term Job Opportunities and Livelihood Options,
- Disaster Resistant House Construction
- Sanitation and Hygiene
- Education and Awareness,
- Dealing with Victims' Psychology,
- Long-term Counter Disaster Planning
- Role of Educational Institute
- Reconstruction and Rehabilitation as a Means of Development.

UNIT IV **10 lecture hours**

Disaster Management in India

- **Disaster Management Act, 2005:**

Disaster management framework in India before and after Disaster Management Act, 2005, National Level Nodal Agencies, National Disaster Management Authority

- **Liability for Mass Disaster**
  - Statutory liability
  - Contractual liability
  - Tortiousliability
  - Criminal liability
  - Measure of damages
- **Epidemics Diseases Act, 1897: Main provisions, loopholes.**
- **Project Work**: The project/ field work is meant for students to understand vulnerabilities and to work on reducing disaster risks and to build a culture of safety. Projects must be conceived based on the geographic location and hazard profile of the region where the institute is located.

Reference Books:

- Government of India, Department of Environment, Management of Hazardous Substances Control
- Act and Structure and Functions of Authority Created There under.
- Indian Chemical Manufacturers' Association & Loss Prevention Society of India, Proceedings of the National Seminar on Safety in Road Transportation of Hazardous Materials: (1986).
- Author Title Publication Dr. Mrinalini Pandey Disaster Management Wiley India Pvt. Ltd.
- Tushar Bhattacharya Disaster Science and Management McGraw Hill Education (India) Pvt. Ltd.
- Jagbir Singh Disaster Management: Future Challenges and Opportunities K W Publishers Pvt. Ltd.
- J. P. Singhal Disaster Management Laxmi Publications.
- Shailesh Shukla, ShamnaHussain Biodiversity, Environment and Disaster Management Unique Publications
- C. K. Rajan, NavalePandharinath Earth and Atmospheric Disaster Management: Nature and Manmade B S Publication
- IndianlawInstitute(UpendraBaxiandThomasPaul(ed.),MassDisastersandMultinational Liability: TheBhopalCase(1986)
- IndianLawInstitute,UpendraBaxi(ed.),EnvironmentProtectionAct:AnAgendaforImplementation (1987)
- AsianRegionalExchangeforProf. Baxi.,NothingtoLoseButourLives:EmpowermenttoOppose
- IndustrialHazardsina Transnationalworld(1989)
- GurudipSingh,EnvironmentalLaw: InternationalandNationalPerspectives(1995), Lawman (India)Pvt.Ltd.

- Leela Krishnan,P, TheEnvironmentalLawinIndia, ChaptersVIII,IX andX(1999),Butterworths, NewDelhi.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and Pos		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Capacity to describe, analyze and evaluate the environmental, social, cultural, economic, legal and organizational aspects influencing vulnerabilities and capacities to face disasters.	**PS01**
CO2	The course examines disaster profile of our country and illustrates the role played by various governmental and non- governmental organizations & its effective management.	**P03**
CO3	It also acquaints learners with the existing legal framework for disaster management.	**P012**
CO4	Capacity to analyze and evaluate research work on the field of emergencies and disaster while demonstrating insight into the potential and limitations of science, its role in society and people's responsibility for how it is used.	**PO6**

Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PS03	PSO4	PSO5
UCDM 301A	**Disaster Management**			2			3						2	3				

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETME 253A	**STRENGTH OF MATERIALS LAB**	L	T	P	C
Version 1.0		-	-	2	1
Pre-requisites/Exposure	Basics of Mechanical Engineering, Material Science				
Co-requisites	--				

Course Objectives: The lab expects students to achieve the following objectives.

1. Measuring the properties of the materials such as impact strength, tensile strength, compressive strength, hardness, ductility
2. Understanding Universal testing machine, Torsion testing machine, Impact testing machine, Brinell hardness testing machine, Rockwell hardness testing machine.
3. Describe ductile and brittle behavior of materials, emphasizing design implications.
4. Impart knowledge of bending, torsion.

Course Outcomes: Upon the completion of this course the students will be able to:

CO1. Know the concepts of stress and strain and their use in the analysis and design of machine members and structures.
CO2. Calculate design normal stress and shear stress for various metals and woods under various conditions.
CO3. Calculate bending stress and shear stress at any location along the beam. Calculate maximum bending stress and maximum shear stress.
CO4. Measuring the properties of the materials

Catalog Description

This course makes the students understand measuring the properties of the materials such as impact strength, tensile strength, compressive strength, hardness, ductility is conducted in the lab.
Major Equipment's Strength of Materials Lab: - Universal testing machine, Torsion testing machine, Impact testing machine, Brinell hardness testing machine, Rockwell hardness testing machine, etc.

List of Experiments (Indicative)

1	To study the Brinell hardness testing machine & perform the Brinell hardness test.	**2 lab hours**
2	To study the Rockwell hardness testing machine & perform the Rockwell hardness test.	**2 lab hours**
3	To study the Vickers hardness testing machine & perform the Vickers hardness test.	**2 lab hours**
4	To study the Erichsen sheet metal testing machine & perform the Erichsen sheet metal test.	**2 lab hours**
5	To study the Impact testing machine and perform the Impact tests (Izod & Charpy).	**2 lab hours**
6	To study the Universal testing machine and perform the tensile test UTM.	**2 lab hours**
7	To perform compression & bending tests on UTM	**2 lab hours**
8	To perform the shear test on UTM	**3 lab hours**
9	To study the torsion testing machine and perform the torsion test.	**2 lab hours**
10	To draw shear Force, Bending Moment Diagrams for a simply Supported Beam under Point and Distributed Loads.	**2 lab hours**

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	**Quiz**	**Attendance**	**Mid Term Exam**	**Presentation/ Assignment/ etc.**	**End Term Exam**
Weightage (%)	**10**	**10**	**20**	**10**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Know the concepts of stress and strain and their use in the analysis and design of machine members and structures.	**PO1**
CO2	Calculate design normal stress and shear stress for various metals and woods under various conditions.	**PO2**
CO3	Calculate bending stress and shear stress at any location along the beam. Calculate maximum bending stress and maximum shear stress.	**PO3**
CO4	Measuring the properties of the materials	**PO4**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ETME 253A	STRENGTH OF MATERIALS LAB	2	3	3	3									3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETME255A	FLUID MECHANICS LAB	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Basics of Mechanical Engineering				
Co-requisites	--				

Course Objectives:

1. To determine the coefficient of impact for vanes.
2. To determine coefficient of discharge of an orifice meter, venture-meter.
3. To determine the coefficient of discharge of Notch (V and Rectangular types).
4. To determine the friction factor for the pipes and study major and minor losses in pipe.
5. To verify the Bernoulli's Theorem.
6. To determine the meta-centric height of a floating body.

Course Outcomes: On completion of this course, the students will be able to

CO1. Have a solid foundation in fluid flow principles like Manometry, Buoyancy, etc.

C02. To provide exposure to modern computational techniques in fluid dynamics.

CO3. Given the required flow rate and pressure rise, select the proper pump to optimize the pumping efficiency.

CO4. To analyse practical problems in all power plants and chemical industries related to fluid flow.

Catalog Description: This course complements ETME255A. It is an introductory course where flow behaviour, fluid forces and analysis tools are introduced. The goals of the experiments include determination of forces generated when fluid flow takes place over a solid object, applications of the control volume approach, demonstration of the momentum and energy equations, viscosity measurement and engineering correlations.

List of Experiments (Indicative)

1	To determine the coefficient of impact for vanes.	**2 lab hours**
2	To determine coefficient of discharge of an orifice meter.	**2 lab hours**
3	To determine the coefficient of discharge of Notch (V and Rectangular types).	**2 lab hours**
4	To determine the friction factor for the pipes.	**2 lab hours**
5	To determine the coefficient of discharge of venture-meter.	**2 lab hours**
6	To determine the coefficient of discharge, contraction & velocity	**2 lab hours**

	of an orifice.	
7	To verify the Bernoulli's Theorem.	**2 lab hours**
8	To find critical Reynolds number for a pipe flow.	**2 lab hours**
9	To determine the meta-centric height of a floating body.	**2 lab hours**
10	To determine the minor losses due to sudden enlargement, sudden contraction, and bends.	**2 lab hours**
11	To show the velocity and pressure variation with radius in a forced vertex flow.	**2 lab hours**
12	To verify the momentum equation.	**2 lab hours**

Modes of Evaluation: Quiz/Oral practical oral exam/presentation/projects/Practical Examination

Examination Scheme:

Components	**Quiz**	**Attendance**	**Mid Term Exam**	**Presentation/ Projects/ etc.**	**End Term Exam**
Weightage (%)	**10**	**10**	**20**	**10**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Have a solid foundation in fluid flow principles like Manometry, Buoyancy, etc.	**PO1**
CO2	To provide exposure to modern computational techniques in fluid dynamics.	**PO4**
CO3	Given the required flow rate and pressure rise, select the proper pump to optimize the pumping efficiency.	**PO5**
CO4	To analyse practical problems in all power plants and chemical industries related to fluid flow.	**PO2**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ETME255 A	Fluid Mechanics Lab	2	2		3	3								3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETME159A	**CAD FUNDAMENTAL PROCESSES PART-A**	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Basics of CAD				
Co-requisites	--				

Course Objectives: The subject expects students to achieve the following objectives.

1. To make students understand the 2D and 3D concepts of engineering design.
2. To provide students with the practical approach of engineering drawing subject.
3. To enable students to use 3D software for design and drafting purpose.
4. How to convert 2D to 3D using images of design.

Course Outcomes: Upon the completion of this course the students will be able to:

CO1. Students will gain the experience about the NX platform.
CO2. Introduction to NX software its interface and command use.
CO3. Understanding of design intent, model development and geometry evaluation.
CO4. Students will learn about how to produce 2D drawings and drafting methods.
CO5. Students will learn about how to produce 3D views and Engineering Graphics concepts and drafting methods.

Catalog Description

This course gives introductory knowledge about CAD and application in various field. It enables the students to understand the use of CAD. It also enhances the students thinking capability to design. This course is also helping students to answer fundamental questions about CAD at the time of the interview.

Course Content

List of Experiments (Indicative)

1.	Work with NX part files and NX template files	**2 lab hours**
2.	Understand how to effectively use the NX user interface and workspace	**2 lab hours**
3.	Create sketches to capture design intent	**2 lab hours**
4.	Create reference geometry for model development such as datum planes, axes, and coordinate systems	**2 lab hours**
5.	Create basic features by sweeping and extruding geometry	**2 lab hours**
6.	Analyse feature geometry	**2 lab hours**
7.	Add detail to features such as blends and drafts	**2 lab hours**
8.	Produce assemblies of component parts	**2 lab hours**
9.	Produce annotated 2D drawings of models	**2 lab hours**

TEXTBOOKS:

1. Siemens Online Learning Platform.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	**Quiz**	**Attendance**	**Mid Term Exam**	**Presentation/ Assignment/ etc.**	**End Term Exam**
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (Cos) and Program Outcomes (Pos)

Mapping between Cos and Pos		
	Course Outcomes (Cos)	**Mapped Program Outcomes**
CO1	Students will gain the experience about the NX platform.	**PO5**
CO2	Introduction to NX software its interface and command use.	**PO5**
CO3	Understanding of design intent, model development and geometry evaluation.	**PO1**
CO4	Students will learn about how to produce 2D drawings and drafting methods.	**PO3**

CO5	Students will learn about how to produce 3D views and Engineering Graphics concepts and drafting methods.	**PO9**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ET ME 159 A	CAD Fundamental Processes Part-A	3		2		3				3				3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

SEMESTER IV

ME 230A	**FLUID MACHINES**	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure	Basics of Machineries involved in fluids and Power transmission				
Co-requisites	--				

Course Objectives: The subject expects students to achieve the following objectives.

1. To introduce the concepts of flow measurements and flow through pipes
2. To introduce the flow measuring devices and velocity measuring devices
3. To introduce the concepts of momentum principles
4. To impart the knowledge on pumps and turbines
5. To impart the knowledge of impact of jets.

Course Outcomes: Upon the completion of this course the students will be able to:

CO1. Identify importance of various fluid properties at rest and in transit.
CO2. Derive and apply general governing equations for various fluid flows.
CO3. Understand the concept of boundary layer theory and flow seperation.
CO4. Plot velocity and pressure profiles for any given fluid flow.
CO5. Evaluate the perfomance characteristics of hydraulic turbines and pumps.

Catalog Description

This course offers basic knowledge on fluid statics, dynamics and hydraulic machines. The objective of this course is to enable the student to understand laws of fluid mechanics and evaluate pressure, velocity and acceleration fields for various fluid flows and performance parameters for hydraulic machinery. This course is also helping students to answer fundamental questions of Mechanical Engineering at the time of the interview.

Course Content

UNIT I **08 lecture hours**

Impact of free jets: Impulse – momentum principle, jet impingement - on a stationary flat plate, inclined plate and a hinged plate, at the center of a stationary vane, on a moving flat plate, inclined plate, a moving vane and a series of vanes, Jet striking tangentially at the tip of a stationary vane and moving vane(s), jet propulsion of ships Problems.

Impulse Turbines: Classification – impulse and reaction turbines, water wheels, component parts, construction, operation and governing mechanism of a Pelton wheel, work done, effective head, available head and efficiency of a Pelton wheel, design aspects, speed ratio, flow ratio, jet ratio, number of jets, number of buckets and working proportions, Performance Characteristics, governing of impulse turbines.

UNIT II **12 lecture hours**

Francis Turbines: Component parts, construction and operation of a Francis turbine, governing mechanism, work done by the turbine runner, working proportions and design parameters, slow, medium and fast runners, degree of reaction, inward/outward flow reaction turbines, Performance Characteristics, Problems.

Propeller and Kaplan turbines: Component parts, construction and operation of a Propeller, Kaplan turbine, differences between the Francis and Kaplan turbines, draft tube - its function and different forms, Performance Characteristics, Governing of reaction turbine, Introduction to new types of turbine, Deriaz (Diagonal), Bulb, Tubular turbines, Problems.

UNIT III **08 lecture hours**

Dimensional Analysis and Model Similitude: Dimensional homogeneity, Rayleigh's method and Buckingham's _-theorem, model studies and similitude, dimensionless numbers and their significance. Unit quantities, specific speed and model relationships for turbines, scale effect, cavitations – its causes, harmful effects and prevention, Thomas cavitation factor, permissible installation height, Problems.

Centrifugal Pumps: Classification, velocity vector diagrams and work done, manometric efficiency, vane shape, head capacity relationship and pump losses, pressure rise in impeller, minimum starting speed, design considerations, multi-stage pumps. Similarity relations and specific speed, net positive suction head, cavitation and maximum suction lift, performance characteristics. Brief introduction to axial flow, mixed flow and submersible pumps, Problems.

UNIT IV **12 lecture hours**

Reciprocating Pumps: Construction and operational details, discharge coefficient, volumetric efficiency and slip, work and power input, effect of acceleration and friction on indicator diagram (pressure – stroke length plot), separation, air vessels and their utility, rate of flow into or from the air vessel, maximum speed of the rotating crank, characteristic curves, centrifugal vs reciprocating pumps, brief introduction to screw, gear, vane and radial piston pumps, Problems.

Hydraulic systems: Function, construction and operation of Hydraulic accumulator, hydraulic intensifier, hydraulic crane, hydraulic lift and hydraulic press, Fluid coupling and torque converter, Hydraulic ram, Problems.

TEXT BOOKS:

1. Hydraulics & Fluid Mechanics – Modi & Seth, Pub. - Standard Book House, N.Delhi
2. Hydraulic Machines – Dr R K Bansal -Laxmi Publications New delhi.

REFERENCE BOOKS:

1. Fluid Mechanics and Hydraulic Machines – S S Rattan, Khanna Publishers
2. Introduction to Fluid Mechanics and Fluid Machines – S K Som and G Biswas, Tata McGraw Hill
3. Fluid Mechanics and Fluid Power Engineering – D S Kumar, S K Kataria and Sons

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	To introduce the concepts of flow measurements and flow through pipes	PO1
CO2	To introduce the flow measuring devices and velocity measuring devices	PO4
CO3	To introduce the concepts of momentum principles	PO5
CO4	To impart the knowledge on pumps and turbines	PSO1

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ETME 230A	Fluid Machines	2			3	3								3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETME 220A	**ENGINEERING MECHANICS**	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure	Basics of analyze for the forces, static and dynamics of the particles, Inertia and centroid				
Co-requisites	--				

Course Objectives: The subject expects students to achieve the following objectives.

1. To understand distributed force systems, centroid/ center of gravity and method of finding centroids of composite figures and bodies.
2. To understand the moment of inertia and method of finding moment of inertia of areas and bodies.
3. To understand types of frames and analyze for the forces in the members of the truss by method of joints and method of sections.
4. To understand dynamics of a particle.
5. To interpret the simple given dynamic problems and solve them for positions, velocities and accelerations etc.,

Course Outcomes: Upon the completion of this course the students will be able to:

CO1. Draw free body diagrams and determine the resultant of forces and/or moments. CO2. Determine the centroid and second moment of area of sections.
CO2. Apply laws of mechanics to determine efficiency of simple machines with consideration of friction.
CO3. Analyze statically determinate planar frames.
CO4. Analyze the motion and calculate trajectory characteristics.
CO5. Apply Newton's laws and conservation laws to elastic collisions and motion of rigid bodies.

Catalog Description

This course gives introductory knowledge about the core mechanics that introduces the student to analysis of forces and motion and prepares the student for further studies and better understanding of engineering subjects like strength of materials and theory of machines

Course Content

Unit I: **12 lecture hours**

Force system: Free body diagram, Equilibrium equations and applications.

Friction: Static and Kinetic friction, laws of dry friction, co-efficient of friction, angle of friction, angle of repose, cone of friction, friction lock, friction of flat pivot and collared thrust bearings, Belt drive- derivation of equation. $T1/t_2 = e^{\mu\theta}$ and its application

Unit II: **08 lecture hours**

Structure: Plane truss, perfect and imperfect truss, assumption in the truss analysis, analysis of perfect plane trusses by the method of joints, method of section.

Distributed Force: Determination of center of gravity, center of mass and centroid by direct integration and by the method of composite bodies, mass moment of inertia and area moment of inertia by direct integration and composite bodies method, radius of gyration, parallel axis theorem, Pappus theorems, polar moment of inertia.

Unit III: **12 lecture hours**

Kinematics of Particles: Rectilinear motion, plane curvilinear motion-rectangular coordinates, normal and tangential component.

Kinetics of Particles: Equation of motion, rectilinear motion and curvilinear motion, work energy equation, conservation of energy, impulse and momentum conservation of momentum, impact of bodies, co-efficient of restitution, loss of energy during impact.

Unit IV: **08 lecture hours**

Kinematics of Rigid Bodies: Concept of rigid body, type of rigid body motion, absolute motion, introduction to relative velocity, relative acceleration (Corioli's component excluded) and instantaneous center of velocity, Velocity and acceleration polygons for four bar mechanism and single slider mechanism.

Kinetics of Rigid Bodies: Equation of motion, translatory motion and fixed axis rotation, application of work energy principles to rigid bodies conservation of energy.

Text Books:

1. Engineering Mechanics by A.K.Tayal (Umesh Publications).
2. Engineering Mechanics by Sadhu Singh (Khanna Publishers).
3. Engineering Mechanics by Merriam, J L by John Wiley & Sons.

Reference Books:

1. Engineering Mechanics by Irving H. Shames (PHI publications).
2. Engineering Mechanics by U.C.Jindal (Galgotia Publications).
3. Engineering Mechanics by Beer & Johnston, TMH
4. Engineering Mechanics by Subramanyam

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Draw free body diagrams and determine the resultant of forces and/or moments. CO2. Determine the centroid and second moment of area of sections.	**PO1**
CO2	Apply laws of mechanics to determine efficiency of simple machines with consideration of friction.	**PSO1**
CO3	Analyze statically determinate planar frames.	**PO5**
CO4	Analyze the motion and calculate trajectory characteristics.	**PO4**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ETME 220A	Engineering Mechanics	2			3	3								3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETMC226A	FUNDAMENTALS OF MANAGEMENT	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

1. To be able to Provide understanding of management history and functions of planning,
2. organizing, leading, and controlling. The role of a manager is examined in promoting change, providing effective leadership, motivation, team building, communication, and decision making.
3. To learn & obtain skills to manage production, operations, and inventory control.
4. Develop the 4 P's of marketing: Product, promotion, distribution (place), and pricing.
5. To develop & learn about the accounting, finance, and financial markets within the business world.

Course Outcomes

On completion of this course, the students will be able to

CO1. Analyze & Attain management, leadership, and human resource management skills.

C02. Provide the students with an understanding of the theories, models, problems, issues, and techniques related to the management of production and operations management

CO3.Develop an integrated marketing communications plan for a product, concept, good and/or service based on an identified market need or target.

CO4. Provide the students with a tool for assessing the financial position of an organization

Catalog Description

This course imparts the basic understanding of management history and functions of planning, organizing, leading, and controlling. The role of a manager is examined in promoting change, providing effective leadership, motivation, team building, communication, and decision making. This subject also provides the students with an understanding of the theories, models, problems, issues, and techniques related to the management of production and operations management, marketing & finance.

Course Content

Unit I: 8 lecture hours

Meaning of management, Definitions of Management, Characteristics of management, Management vs. Administration. Management-Art, Science and Profession. Importance of Management. Development of Management thoughts. Principles of Management. The

Management Functions, Inter-relationship of Managerial functions. Nature and Significance of staffing, Personnel management, Functions of personnel management, Manpower planning, Process of manpower planning, Recruitment, Selection; Promotion - Seniority Vs. Merit. Training - objectives and types of training.

Unit II: 12 lecture hours

Production Management: Definition, Objectives, Functions and Scope, Production Planning and Control; its significance, stages in production planning and control. Brief introduction to the concepts of material management, inventory control; its importance and various methods.

Unit III: 12 lecture hours

Marketing Management - Definition of marketing, marketing concept, objectives & Functions of marketing. Marketing Research - Meaning; Definition; objectives; Importance; Limitations; Process. Advertising - meaning of advertising, objectives, functions, criticism.

Unit IV: 8 lecture hours

Introduction of Financial Management, Objectives of Financial Management, Functions and Importance of Financial Management. Brief Introduction to the concept of capital structure and various sources of finance.

Text book [TB]:

Robbins S. P. (2009). Fundamentals of Management (6th Edition). Delhi Pearson.

Reference book(s) [RB]:

Gupta R. S., Sharma B. D., & Bhalla N. S. (2011). Principles and Practice of Management (11th Edition), Kalyani Publishers.

Prasad L.M. (2016). Principles & Practices of Management (1st Edition). Sultan Chand & Sons.

Gupta C. B. (2013). Management: Principles and Practice (3rd Edition). Sultan Chand and Sons.

Tripathi, P.C. & Reddy P. N. (5th Edition). Principles of Management (5th Edition). McGraw Hill Education.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	Analyze & Attain management, leadership, and human resource management skills.	PO1
CO2	Provide the students with an understanding of the theories, models, problems, issues, and techniques related to the management of production and operations management	PO4
CO3	Develop an integrated marketing communications plan for a product, concept, good and/or service based on an identified market need or target.	PO5
CO4	Provide the students with a tool for assessing the financial position of an organization	PO2

Course Code	Course Title	PO1	PO 2	PO 3	PO4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
ETMC226A	Fundamentals of Management	2			3	3								3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETME 226A	THEORY OF MACHINES	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	Basics of Mechanical Engineering.				
Co-requisites	--				

Course Objectives: The subject expects students to achieve the following objectives.

1. To understand the basic components and layout of linkages in the assembly of a system / machine.
2. To provide a foundation for the study of machine design.
3. Development of individual and team skills involving pre- and post-processing and interpretation computer-aided design and analysis data.
4. To understand the basic concepts of toothed gearing and kinematics of gear trains and the effects of friction in motion transmission and in machine components.

Course Outcomes: Upon the completion of this course the students will be able to:

CO1. Discuss the basics of mechanism.
CO2. Calculate velocity and acceleration in simple mechanisms.
CO3. To develop CAM profiles.
CO4. To examine governors and gyroscopes.

Catalog Description

This course makes the students understand a brief knowledge about kinematics mechanism, cams, Gears, gyroscopes and governors.

Course Content

Unit I: 12 lecture hours

Introduction: Links-types, Kinematics pairs-classification, Constraints-types, Degrees of freedom of planar mechanism, Grubler's equation, linkage mechanisms, inversions of four bar chain, slider crank chain and double slider crank chain.

Velocity in Mechanisms: Velocity of point in mechanism, relative velocity method, Velocities in four bar mechanism, slider crank mechanism and quick return motion mechanism, Rubbing velocity at a pin joint, Instantaneous center method, Types & location of instantaneous centers, Kennedy's theorem, Velocities in four bar mechanism & slider crank mechanism.

Unit II: 08 lecture hours

Acceleration in Mechanisms: Acceleration of a point on a link, Acceleration diagram, Coriolis component of acceleration, Crank and slotted lever mechanism, Klein's construction for Slider Crank mechanism and Four Bar mechanism, Analytical method for slider crank mechanism.

Governors: Terminology, Centrifugal governors-Watt governor, Dead weight governors-Porter & Proell governor, Spring controlled governor-Hartnell governor, Sensitivity, Stability, Hunting, Isochronism, Effort and Power of governor, Controlling force diagrams for Porter governor and Spring controlled governors.

Unit III: 12 lecture hours

Gears & Gear Trains: Classification & terminology, law of gearing, tooth forms & comparisons, Systems of gear teeth, Length of path of contact, contact ratio, interference & under cutting in involute gear teeth, minimum number of teeth on gear and pinion to avoid interference, simple, compound, reverted and planetary gear trains, Sun and planet gear.

CAMS: Cams and Followers - Classification & terminology, Cam profile by graphical methods with knife edge and radial roller follower for uniform velocity, simple harmonic and Parabolic motion of followers, Analytical methods of cam design – tangent cam with roller follower and circular cams with flat faced follower.

Unit IV: 08 lecture hours

Balancing of Machines: Static and dynamic balancing, balancing of several masses in the same plane and different planes, Balancing of reciprocating masses, Balancing of primary force in reciprocating engine, Partial balancing of two cylinder locomotives, Variation of tractive force, swaying couple, hammer blow.

Gyroscopic Motion: Principles, Gyroscopic torque, Effect of gyroscopic couple on the stability of aero planes & automobiles.

TEXT BOOKS:

1. Theory of Mechanisms and Machines: Amitabha Ghosh and Ashok kumar Malik, Third Edition Affiliated East-West Press.
2. Theory of Machines and Mechanisms: Joseph Edward Shigley and John Joseph Uicker, Jr. Second Edition, MGH, New York.
3. Theory of Machines- Dr R K Bansal- Laxmi Publication.

REFERENCE BOOKS:

1. Mechanism and Machine Theory: J.S. Rao and R.V. Dukkipati Second Edition New age International.

2. Theory and Machines: S.S. Rattan, Tata McGraw Hill.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Discuss the basics of mechanism.	**PO1**
CO2	Calculate velocity and acceleration in simple mechanisms.	**PO2**
CO3	To develop CAM profiles.	**PO3**
CO4	To examine governors and gyroscopes.	**PO5**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ETME 226A	THEORY OF MACHINES	2	3		3	3								3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETME 252A	FLUID MACHINES LAB	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Manufacturing Technology Lab				
Co-requisites	--				

Course Objectives: The subject expects students to achieve the following objectives.

1. To provide practical knowledge in verification of principles of fluid flow
2. To impart knowledge in measuring pressure, discharge and velocity of fluid flow
3. To understand Major and Minor Losses
4. To gain knowledge in performance testing of Hydraulic Turbines and Hydraulic Pumps at constant speed and Head.

Course Outcomes: On completion of this course, the students will be able to

CO1. Know the fluid flow principles and able for calculating performance analysis in turbines and pumps and can be used in power plants

CO2 Understand to analyze practical problems in all power plants and chemical industries

CO3 Conduct experiments (in teams) in pipe flows and open-channel flows and interpreting data from model studies to prototype cases, as well as documenting them in engineering reports

CO4 Analyze a variety of practical fluid-flow devices and utilize fluid mechanics principles in design

CO5 Given the required flow rate and pressure rise, select the proper pump to optimize the pumping efficiency

Catalog Description: This course complements ETME 252 A. It is an introductory The Practical exposure to the student enable him conduct necessary test to evaluation the performance of various flow measuring equipment and hydraulic turbines and pumps like Pelton wheel turbine, Francis Turbine, Kaplan Turbine, Reciprocating pump & Centrifugal pump.

List of Experiments (Indicative)

1	To study the constructional details of a Pelton turbine and draw its fluid flow circuit.	**2 lab hours**
2	To draw the performance characteristics of Pelton turbine-constant head, constant speed and constant efficiency curves.	**2 lab hours**
3	To study the constructional details of a Francis turbine and draw its fluid flow circuit.	**2 lab hours**

4	To draw the constant head, constant speed and constant efficiency performance characteristics of Francis turbine.	**2 lab hours**
5	To study the construction details of a Kaplan turbine and draw its fluid flow circuit.	**2 lab hours**
6	To draw the constant head, speed and efficiency curves for a Kaplan turbine.	**2 lab hours**
7	To study the constructional details of a Centrifugal Pump and draw its characteristic curves.	**2 lab hours**

Modes of Evaluation: Quiz/Oral practical oral exam/presentation/projects/Practical Examination

Examination Scheme:

Components	**Quiz**	**Attendance**	**Mid Term Exam**	**Presentation/ Projects/ etc.**	**End Term Exam**
Weightage (%)	**10**	**10**	**20**	**10**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	know the fluid flow principles and able for calculating performance analysis in turbines and pumps and can be used in power plants	**PO9**
CO2	understand to analyze practical problems in all power plants and chemical industries	**PO1**
CO3	conduct experiments (in teams) in pipe flows and open-channel flows and interpreting data from model studies to prototype cases, as well as documenting them in engineering reports	**PO4**
CO4	analyze a variety of practical fluid-flow devices and utilize fluid mechanics principles in design	**PO5**
CO5	Given the required flow rate and pressure rise, select the proper pump to optimize the pumping efficiency	**PO2**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ETME 252 A	Fluid Machines Lab	2	2		3	3				2						

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETME 258A	**THEORY OF MACHINES LAB**	L	T	P	C
Version 1.0		-	-	2	1
Pre-requisites/Exposure	Basics of Mechanical Engineering, Material Science				
Co-requisites	--				

Course Objectives: The lab expects students to achieve the following objectives.

1. Analysis of mechanisms,
2. Drawing displacement diagrams for followers with various types of motions,
3. Cam profile drawing for various followers,
4. Estimation of transmission of power by belts and application of various gears and gear trains.

Course Outcomes: Upon the completion of this course the students will be able to:

CO1. Designing a suitable mechanism depending on application
CO2. Drawing displacement diagrams and cam profile diagram for followers executing different types of motions and various configurations of followers,
CO3. Drawing velocity and acceleration diagrams for different mechanisms,
CO4. Selecting gear and gear train depending on application.

Catalog Description:

This course makes the students understand measuring the properties of the materials such as impact strength, tensile strength, compressive strength, hardness, ductility is conducted in the lab. Major Equipment's Strength of Materials Lab: - Universal testing machine, Torsion testing machine, Impact testing machine, Brinell hardness testing machine, Rockwell hardness testing machine, etc

List of Experiments (Indicative)

1.	To study various types of Kinematic links, pairs, chains and Mechanisms.	**2 lab hours**
2.	To study inversions of 4 Bar Mechanisms, Single and double slider crank mechanisms.	**2 lab hours**
3.	To plot slider displacement, velocity and acceleration against crank rotation for single slider crank mechanism.	**2 lab hours**
4.	To find coefficient of friction between belt and pulley.	**2 lab hours**
5.	To study various type of cam and follower arrangements.	**2 lab hours**
6.	To plot follower displacement vs cam rotation for various Cam Follower systems.	**2 lab hours**
7.	To generate spur gear involute tooth profile using simulated gear shaping process.	**2 lab hours**
8.	To study various types of gears – Helical, cross helical worm, bevel gear.	**3 lab hours**
9.	To study various types of gear trains – simple, compound, reverted, epicyclic and differential.	**2 lab hours**
10.	To find co-efficient of friction between belt and pulley.	**2 lab hours**
11.	To study the working of Screw Jack and determine its efficiency.	**2 lab hours**
12.	Create various types of linkage mechanism in CAD and simulate for motion outputs and study the relevant effects.	**2 lab hours**
13.	Creation of various joints like revolute, planes, spherical, cam follower and study the degree of freedom and motion patterns available.	**2 lab hours**
14.	To design a cam profile by using the requirement graph using on-line engineering handbook and verify the same using a 3D mechanism on CAD.	**2 lab hours**

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	**Quiz**	**Attendance**	**Mid Term Exam**	**Presentation/ Assignment/ etc.**	**End Term Exam**
Weightage (%)	**10**	**10**	**20**	**10**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Designing a suitable mechanism depending on application	**PO1**
CO2	Drawing displacement diagrams and cam profile diagram for followers	**PO2**
CO3	executing different types of motions and various configurations of followers,	**PO3**
CO4	Drawing velocity and acceleration diagrams for different mechanisms,	**PO4**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ETME 258A	THEORY OF MACHINES LAB	2	3	2	3									3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETME156A	CAD FUNDAMENTAL PROCESSES PART-B	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Basics of CAD				
Co-requisites	--				

Course Objectives: The subject expects students to achieve the following objectives.

1. To teach students about the various 3D commands.
2. To enable students on assembly CAD design.
3. To teach students about various edit commands in NX software.

Course Outcomes: Upon the completion of this course the students will be able to:

CO1. Introduction to NX software its interface and command use.

CO2. Understanding of design intent, model development and geometry evaluation.

CO3. Students will learn about how to produce 2D drawings and drafting methods.

CO4. Students will learn about how to produce 3D views and Engineering Graphics concepts and drafting methods.

Catalog Description

This course gives introductory knowledge about CAD and application in various field. It enables the students to understand the use of CAD. It also enhances the students thinking capability to design. This course is also helping students to answer fundamental questions about CAD at the time of the interview.

Course Content

List of Experiments (Indicative)

1.	Working with existing parts;	**2 lab hours**
2.	Datum features; Swept features;	**2 lab hours**
3.	Trim Body; Hole features; Expressions.	**2 lab hours**
4.	Coordinate systems; Part Navigator;	**2 lab hours**
5.	Associative copies; Face and edge operations;	**2 lab hours**
6.	Basic freeform Creating and modifying assemblies.	**2 lab hours**
7.	Assembly Constraints; Assembly Arrangements;	**2 lab hours**
8.	Reference Sets; Interpart geometry and references.	**2 lab hours**
9.	Component arrays; Reuse Library;	**2 lab hours**
10.	Revise and replace components.	**2 lab hours**

TEXTBOOKS:

1. Siemens Online Learning Platform.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Introduction to NX software its interface and command use.	**PO2**
CO2	Understanding of design intent, model development and geometry evaluation.	**PO1**
CO3	Students will learn about how to produce 2D drawings and drafting methods.	**PO4**
CO4	Students will learn about how to produce 3D views and Engineering Graphics concepts and drafting methods.	**PO9**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
ETME 156A	CAD Fundamental Processes Part-B	3	2		3					3				3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

SEMESTER V

ETME 309A	MANUFACTURING TECHNOLOGY	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure	Basics of conventional manufacturing technologies, jigs and fixtures with NC machine tools				
Co-requisites	--				

Course Objectives: The subject expects students to achieve the following objectives.

1. Understanding basic technologies in manufacturing Processes.
2. Understand advanced/ new approaches of manufacturing technology.
3. Understanding working Principles of conventional machining and supporting devices.
4. Impart knowledge of involvement of computer in manufacturing with other impactful technologies of mechanical system.

Course Outcomes: Upon the completion of this course the students will be able to:

CO1. Understanding basic mechanism of metal cutting, tool nomenclature, cutting fluids with properties.
CO2. Have a understanding of conventional machining processes, jigs and fixtures.
CO3. Understanding the working principles of NC machine tool with codes and languages.
CO4. Impart knowledge of group technology and part families in manufacturing.

Catalog Description:

This course gives introductory knowledge about laws of machining, conventional machining, fixtures and jigs, cutting tool materials and the basics of NC and group technology. It enables the students to understand the working of these elements. It also enhances the students thinking capability to understand the nomenclature of tools in latest manufacturing technology. This course is also helping students to answer fundamental questions of manufacturing technology at the time of the interview.

Course Content

Unit I: 12 lecture hours

Mechanism of Metal Cutting: Deformation of metal during machining, nomenclature of lathe, milling tools, mechanics of chip formation, built-up edges, mechanics of orthogonal and oblique cutting, Merchant cutting force circle and shear angle relationship in orthogonal

cutting, factors affecting tool forces. Cutting speed, feed and depth of cut, surface finish, Temperature distribution at tool chip interface, Numerical on cutting forces and Merchant circle

Cutting Tool Materials & Cutting Fluids: Characteristics of tool materials, various types of cutting tool materials, coated tools, cutting tool selection, Types of tool wear, tool life, factors governing tool life, Purpose, and types of cutting fluids, basic actions of cutting fluids, effect of cutting fluid on tool life, selections of cutting fluid.

Unit II: 08 lecture hours

Unconventional Machining Processes: Abrasive jet machining: Principles, applications, process parameters. Ultrasonic machining: Principles, applications, analysis of process parameters. Electro-chemical machining and grinding: Principles, classifications, choice of electrolytes, applications. Electric discharge machining: Principles, selection of tools materials and dielectric fluid. Electron beam machining: Generation of electron beam, relative merits and demerits. Laser beam machining: Principles and applications

Jigs & Fixtures: Introduction, location and location devices, clamping and clamping devises, Drill Jigs, Milling Fixtures

Unit III: 12 lecture hours

Numerical Control of Machine Tools: Introduction, Numerical Control & its growth, NC Machines tools, Axes of NC Machines, Classification of NC System, CNC, DNC and Machining Centre. Machine Control unit, NC tools & Tool changer, Manual Part Programming; coordinate, Feed, Speed & Tool, Preparation & Miscellaneous functions, Examples of two axes part programming for Turning and Milling Operations.

Unit IV: 08 lecture hours

Group Technology: Definition and concept, Group and Family, working of group technology, Stages for Adopting Group Technology, Advantages of Group Technology, Components Classification and Coding, Personnel and Group Technology, Planning the introduction of Group Technology, Group Technology layout.

Textbooks:

1. Manufacturing Technology – Vol. - 2, P.N. Rao, T.M.H, New Delhi
2. Computer Aided Manufacturing: S Kumar & B Kant Khan, Satya Prakashan, New Delhi
3. Process and Materials of Manufacture -- Lindberg, R.A. Prentice Hall of India, New Delhi.
4. Principles of Manufacturing Materials and Processes - Campbell, J.S.- McGraw-Hill

Reference Books/Materials:

1. Principles of Machine Tools – G.C. Sen & A. Bhattacharya, Tata McGraw Hill, New Delhi
2. Modern Machining Processes: P.C. Pandey & H.S. Shan, T.M.H. Company, New Delhi
3. Text Book of Production Engineering: P.C. Sharma, S.Chand & Sons.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Know the basics of metal cutting, tool nomenclature, cutting fluids with properties	**PO1**
CO2	Understand the basic knowledge of conventional machining processes, jigs and fixtures.	**PO2**
CO3	Get the knowledge about NC machine tool with codes and languages.	**PO3**
CO4	Know the various concept about group technology, part families and concept of planning in manufacturing.	**PO4**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ETME 309A	Manufacturing Technology	2			3	3						3		3	3	

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETME 319A	INTERNAL COMBUSTION ENGINE	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure	Basics of engine, parts of engine, fuel, Testing and performance, Air pollution measures, lubrication, carburation, ignition and cooling of engine etc				
Co-requisites	--				

Course Objectives: The subject expects students to achieve the following objectives.

1. Understanding the principal and working of basic engines based on different cycle and mechanical theories.
2. Understand air standard cycles and thermodynamics involved in carburation and injection etc
3. Understanding working principles of different parts of engines involves in combustion, cooling, and lubrications.
4. Impart knowledge of air standards; pollution levels with compressors and turbines involves in engine.

Catalog Description

This course gives introductory knowledge about engine thermodynamics, cycles based on engine, Fuel injection, combustion, cooling, carburation, engine testing parameters, air pollution measures, Lubrication SAE rating, compressor, and gas turbines. It enables the students to understand the brief technical concept of these systems. It also enhances the students thinking capability to calculate the efficiency and energy and fuel consumption capacity of the engine. This course is also helping students to answer fundamental questions of internal combustion and gas turbine at the time of the interview.

Course Content

Unit I: 12 lecture hours

Air Standard Cycles: Internal and external combustion engines; classification of I.C. Engines, Cycles of operation in four stroke and two stroke I.C. Engines, Wankel Engines, Assumptions made in air standard cycle; Otto cycle, Diesel cycle, dual cycle, comparison of Otto, diesel and dual combustion cycles, sterling and Ericsson cycles, air standard efficiency, specific work output, specific weight; work ratio; mean effective pressure; deviation of actual engine cycle from ideal cycle. Problems

Carburetion, fuel Injection and Ignition systems: Mixture requirements for various operating conditions in S.I. Engines; elementary carburetor, Requirements of a diesel injection system; types of inject systems; petrol injection, Requirements of ignition system; types of ignition systems ignition timing; spark plugs. Problems

Unit II: **08 lecture hours**

Combustion in I.C. Engines: S.I. engines; Ignition limits; stages of combustion in S.I. Engines; Ignition lag; velocity of flame propagation; detonation; effects of engine variables on detonation; theories of detonation; octane rating of fuels; pre-ignition; S.I. engine combustion chambers, Stages of combustion in C.I. Engines; delay period; variables affecting delay period; knock in C.I. engines, Cetane rating; C.I. engine combustion chambers.
Lubrication and Cooling Systems: Functions of a lubricating system, Types of lubrication system; mist, wet sump, and dry sump systems; properties of lubricating oil; SAE rating of lubricants, engine performance and lubrication, Necessity of engine cooling; disadvantages of overcooling; cooling systems; air-cooling, water cooling; radiators.

Unit III: **12 lecture hours**

Engine Testing and Performance: Performance parameters: BHP, IHP, mechanical efficiency, brake mean effective pressure and indicative mean effective pressure, torque, volumetric efficiency; specific fuel consumption (BSFC, ISFC), thermal efficiency; heat balance; Basic engine measurements; fuel and air consumption, brake power, indicated power and friction power, heat lost to coolant and exhaust gases; performance curves, Problems
Air pollution from I.C. Engine and Its remedies: Pollutants from S.I. and C.I. Engines, Methods of emission control; alternative fuels for I.C. Engines; the current scenario on the pollution front.

Unit IV: **08 lecture hours**

Rotary Compressors: Root and vane blowers; Static and total head values; Centrifugal compressors- Velocity diagrams, slip factor, ratio of compression, pressure coefficient, pre-whirl; Axial flow compressor- Degree of reaction, polytropic efficiency, surging, choking, and stalling, performance characteristics, Problems.
Gas Turbines: Brayton cycle; Components of a gas turbine plant; open and closed types of gas turbine plants; Optimum pressure ratio; Improvements of the basic gas turbine cycle; multistage compression with inter-cooling; multistage expansion with reheating between stages; exhaust gas heat exchanger, Applications of gas turbines. Problems

Textbooks:

1. Internal Combustion Engines –V. Ganesan, Pub.-Tata McGraw-Hill.
2. Gas Turbines - V. Ganesan, Pub.- Tata McGraw Hill.
3. Engineering fundamental of the I.C.Engine – Willard W. Pulkrabek Pub.-PHI,India

Reference Books/Materials:

1. Internal Combustion Engines & Air pollution- Obert E.F, Pub.-Hopper & Row Pub., New York
2. Internal Combustion Engines Fundamentals- John B. Heywood, Pub.-McGra

3. **Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination**

Examination Scheme:

Components	**Quiz**	**Attendance**	**Mid Term Exam**	**Presentation/ Assignment/ etc.**	**End Term Exam**
Weightage (%)	**10**	**10**	**20**	**10**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Know the basics of two stroke, four stroke, Diesel, Otto cycle with carburation and fuel injection in basic engines	**PO1**
CO2	Understand the basic knowledge combustion in CI and SI engine with lubrication concept in engine	**PO2**
CO3	Get the knowledge about various engine parameters involved in testing of engine and air pollution from engine with testing and remedies	**PO3**
CO4	Know the various concepts rotatory and other type of compressor with gas turbines.	**PO4**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ETME 319A	Internal Combustion Engine and Gas Turbine	2	3		3		3	3						3	3	

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETME213A	CAD ADVANCED PROCESSES	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure	Basics of CAD Advanced Process				
Co-requisites	--				

Course Objectives: The subject expects students to achieve the following objectives.

1. To teach students about the design intent followed in industry.
2. To understand various geometry building techniques and design optimization.
3. To enable students on synchronous modelling and modifications.

Course Outcomes: Upon the completion of this course the students will be able to:

CO1. Students will gain the experience about the NX platform on advance commands.
CO2. Introduction to sketch to model and raster image development.
CO3. Understanding of face and edge operations and basics of freeform.
CO4. Students will learn assembly in models and using reference set

Catalog Description

The course structure will be focusing entirely on the specialised techniques and its inputs on the latest technology provided by SIEMENS. The courses will be entirely focused on the CAD, CAE and BENCHMARKING domains of the application process.

Course Content

Unit I: **08 lecture hours**

Documenting design intent (Feature Groups, Product Interfaces); Editing parametric models (Replace features, Suppression by Expression, model updates); Associative curve operations (Project, Join, Intersect, Wrap/Unwrap, Text)

Unit II: **08 lecture hours**

Emboss geometry (Emboss Body, Emboss, Offset Emboss); Blending techniques (Advanced Edge Blend options, Face blends); Interpart references (Interpart Expressions, Overriding Expressions) Capturing part shape variations (Deformable Parts); Design optimization (Optimization Study, Local and Global algorithms)

Unit III: **08 lecture hours**

Intro to Synchronous modeling (Move, Pull, Replace, Delete Face); Modifying detail features using Synchronous (Resize Blend, Chamfer, Replace Blend); Reusing and relating faces using Synchronous (Pattern Face, Copy/Paste Face, Dimensions); Optional: History-Free Synchronous (Optimize Face, Adaptive

Unit IV: **08 lecture hours**

Mechanical Freeform Modeling: Create curves and derived curves used in creating freeform features; Analyze curves and faces; Create freeform shapes through curves; Create freeform shapes by sweeping sections along curves; Create transition and blend shapes; Extend and offset faces; Create thicken and draft faces.

TEXTBOOKS:

1. Siemens Online Learning Platform.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	**Quiz**	**Attendance**	**Mid Term Exam**	**Presentation/ Assignment/ etc.**	**End Term Exam**
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Students will gain the experience about the NX platform on advance commands.	**PO1**
CO2	Introduction to sketch to model and raster image development.	**PO3**
CO3	Understanding of face and edge operations and basics of freeform.	**PO6**
CO4	Students will learn assembly in models and using reference set.	**PO4**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ETME 213A	CAD ADVANCED PROCESSES	3		2	3		4							3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETME228A	**CAD SHEET METAL/SURFACES MODELLING**	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure	Basics of CAD Sheet Metal/Surfaces Modelling				
Co-requisites	--				

Course Objectives: The subject expects students to achieve the following objectives.

1. To teach students about various type of plastics used in automotive industry.
2. To enable students on understanding the plastic parts and terminologies of automotive.
3. To teach students on difference of exterior and interior plastics.
4. To let students absorb knowledge related to plastic manufacturing and feature building.

Course Outcomes: Upon the completion of this course the students will be able to:

CO1.The students will be able to apply knowledge related to plastic component design.
CO2.Students will gain knowledge related to various plastic tooling and manufacturing techniques.
CO3.Students will be enabled to understand the basics and advance of plastic engineering and material handling.

Catalog Description

This course gives introductory knowledge about sheet metal design and its application in various field. It enables the students to understand the working of these systems. It also enhances the students thinking capability to design various components.

Course Content

Unit I: **08 lecture hours**

Door Claddings, Fog Bezels, Mud Flaps, Door Claddings, Spoilers, Roof Rails

Unit II: **08 lecture hours**

Outer Rear View Mirrors, Headlamp, Tail lamp

Unit III: **08 lecture hours**

Cowl Top Garnish, Sun Visors, Front Grille

Unit IV: **08 lecture hours**

Front Bumper, Rear Bumper

TEXTBOOKS:

Siemens Online Learning Platform.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	The students will be able to apply knowledge related to plastic component design.	**PO5**

CO2	Students will gain knowledge related to various plastic tooling and manufacturing techniques.	**PO2**
CO3	Students will be enabled to understand the basics and advance of plastic engineering and material handling.	**PO 1**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
ETME 228A	CAD SHEET METAL/SURFACES MODELLING	3	2			2								2		

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETMC 421A	**ENTREPRENEURSHIP DEVELOPMENT**	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure	Basics of Business Organization and Management				
Co-requisites	--				

Course Objectives

1. To understand the basic concepts in the area of entrepreneurship
2. To understand the role and importance of entrepreneurship for economic development, developing personal creativity and entrepreneurial initiative,
3. To adopting of the key steps in the elaboration of business idea
4. To understand the stages of the entrepreneurial process
5. To explore the resources needed for the successful development of entrepreneurial ventures.

Course Outcomes

On completion of this course, the students will be able to

CO1. Analyze the business environment in order to identify business opportunities

C02. To identify the elements of success of entrepreneurial ventures and its elements

CO3. Will be able to evaluate the effectiveness of different entrepreneurial strategies.

CO4. Will be able to specify the basic performance indicators of entrepreneurial activity and interpret their own business plan

Catalog Description

Term, the aim and content items. Conceptual definition of entrepreneurs and entrepreneurship. Entrepreneurship in economic theory. Historical development of entrepreneurship. Entrepreneurial practice. The importance of small business. Entrepreneurial economy. Entrepreneurship and Economic Development. Type of Entrepreneurship. Entrepreneur and small business. Features and types of businesses and entrepreneurs. Sources of business ideas. The role of entrepreneurship in economic development. Terms of entrepreneurship. Innovation and entrepreneurship. Entrepreneurship and small business. The life cycle of a small company. Small business sector in Croatia. Forms of entrepreneurial organization. Sources of capital. Entrepreneurial process. Entrepreneurial strategies. Starting a new company. Buying an existing business. Franchising. Family business. Entrepreneurial project: an entrepreneurial venture and entrepreneurial development chain. Defining the business concept. Writing a business plan. Basics of Venture Marketing. Fundamentals of entrepreneurial management. Small business enterprises. Business process: product design, operational art, stock management. Technical and technological analysis of entrepreneurial projects. Designing a business investment. Knowledge Economy. Entrepreneur biographies - the actual successes and failures. Business results in SMEs.

Course Content

Unit I: **10 lecture hours**

Entrepreneurship- Concept, Knowledge and skills requirement, characteristics of successful Entrepreneurs, role of entrepreneurship in economic development, entrepreneurship process, factors impacting emergence of entrepreneurship, managerial vs. entrepreneurial approach and emergence of entrepreneurship

Unit II: **10 lecture hours**

Creating entrepreneurial venture- Environmental scanning, competitor and industry analysis; feasibility study-market feasibility, technical/operational feasibility, financial feasibility; drawing business plan; preparing project report; presenting business plan to investor

Unit III: **10 lecture hours**

Source of Finance- Debt or equity financing, commercial banks, venture capital; financial Institution supporting entrepreneurs; legal issues-intellectual property rights-patents , trademark, copyright, trade secrets, licensing, franchising

Unit IV: 10 lecture hours

Role of Central and State Government in Promoting entrepreneurship: various incentives, subsidies, fiscal and tax concessions; agencies in entrepreneurial development – District Industries Centres , Small Industries Service Institute, Entrepreneurship Development Institutes of India; Women Entrepreneurs- role, problems , prospects.

Text Books

1. Udyamita (in Hindi) by Dr. MMP. Akhouri and S.P Mishra, pub. By National Institute for Entrepreneurship and Small Business Development (NIESBUD), NSIC-PATC Campus,Okhla
2. Anderson and Markides (2007). Strategic Innovation at Base of the Pyramid, SMR
3. Prahalad (2004). The fortune at the bottom of the pyramid. Pearson Publications

Reference Books/Materials

1. Small scale industries and entrepreneurship, Dr. Vasant Desai, Himalayan Publishing House
2. Management of small scale industries, Dr. Vasant Desai, Himalayan Publishing House
3. Management of small scale industries, J.C. Saboo Megha Biyani, Himalayan Publishing House
4. Dynamics of entrepreneurial development and Management, Dr. Vasant Desai, Himalayan Publishing
5. Entrepreneurship development, Moharanas and Dash C.R., RBSA Publishing, Jaipure
6. Beyond entrepreneurship, Collins and Lazier W, Prentice Hall, New Jersey, 1992
7. Entrepreneurship, Hisrich Peters Sphephard, Tata McGraw Hill
8. Fundamentals of entrepreneurship, S.K. Mohanty, Prentice Hall of India
9. A Guide to Entrepreneurship, David Oates, Jaico Publishing House, Mumbai, Edn 2009

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz I	Quiz II	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Analyze the business environment in order to identify business opportunities	**PO1,PO3,PO7,PO8**
CO2	To identify the elements of success of entrepreneurial ventures and its elements	**PO4,PO1,PO6,PO8**
CO3	Will be able to evaluate the effectiveness of different entrepreneurial strategies	**PO5,PO4,PO6,PO7**
CO4	Will be able to specify the basic performance indicators of entrepreneurial activity and interpret their own business plan	**PO1,PO2,PO8,P09**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ETMC 421 A	ENTREPRENEURSHIP DEVELOPMENT															
	CO1	2		1				2	3					2		
	CO2	3			2		2		2					2		
	CO3				1	2	2	2								3
	CO4	2	2						2	3						2

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETME 315A	DESIGN OF MACHINE ELEMENTS	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	Basics of Machine Elements, Different Types of Joints				
Co-requisites	--				

Course Objectives: The subject expects students to achieve the following objectives.

1. To teach students how to apply the concepts of stress analysis, theories of failure and material science to analyse, design and/or select commonly used machine components.
2. To illustrate to students the variety of mechanical components available and emphasize the need to continue learning.
3. To teach students how to apply mechanical engineering design theory to identify and quantify machine elements in the design of commonly used mechanical systems.
4. To teach students how to apply computer-based techniques in the analysis, design and/or selection of machine components.

Course Outcomes: Upon the completion of this course the students will be able to:

CO1.Demonstrate understanding of various design considerations.
CO2.Illustrate basic principles of machine design.
CO3.Design machine elements for static as well as dynamic loading
CO4.Design machine elements based on strength/ rigidity concepts.
CO5.Use design data books in designing various components.
CO6.Acquire skill in preparing production drawings pertaining to various designs.

Catalog Description: This course gives introductory knowledge about design philosophy and material selections, different types of joint, clutch and transmission system. It enables the students to understand the design procedure of machines components. It also enhances the students thinking capability to calculate the impact of components of the systems. This course is also helping students to answer fundamental questions Machine Design at the time of the interview.

Course Content

Unit I: 12 lecture hours

Steady stresses and variable stresses in machine members:
Introduction to the design process – factors influencing machine design, selection of materials based on mechanical properties – Preferred numbers, fits and tolerances – Direct, Bending and torsional stress equations – Impact and shock loading – calculation of principle stresses for various load combinations, eccentric loading – curved beams – crane hook and

'C' frame- Factor of safety – theories of failure – Design based on strength and stiffness – stress concentration – Design for variable loading.

Unit II: 08 lecture hours

Shafts and couplings: Design of solid and hollow shafts based on strength, rigidity, and critical speed – Keys, keyways, and splines – Rigid and flexible couplings.
Bearings: Sliding contact and rolling contact bearings – Hydrodynamic journal bearings, Sommerfeld Number, Raimondi, and Boyd graphs, — Selection of Rolling Contact bearings.

Unit III: 12 lecture hours

Temporary and Permanent Joints: Threaded fastners – Bolted joints including eccentric loading, Knuckle joints, Cotter joints – Welded joints, riveted joints for structures – theory of bonded joints.

Unit IV: 08 lecture hours

Energy Storing Elements and Engine Components: Various types of springs, optimization of helical springs – rubber springs – Flywheels considering stresses in rims and arms for engines and punching machines- Connecting Rods and crank shafts.

TEXTBOOKS:

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", 9th Edition, Tata McGraw-Hill, 2011.

REFERENCE BOOKS:

1. Engineering design – George Dieter, MGH, New York.
2. Product Design and Manufacturing, A.K.Chitale and R.C.Gupta, PHI.
3. Machine Design An Integrated Approach: Robert L.Norton, Addison Wesley.
4. Machine Design : S.G. Kulkarini - Tata MacGraw Hill.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Demonstrate understanding of various design considerations.	**PO1**
CO2	Illustrate basic principles of machine design.	**PO2**
CO3	Design machine elements for static as well as dynamic loading	**PO4**
CO4	Design machine elements based on strength/ rigidity concepts.	**PO5**
CO5	Use design data books in designing various components.	**PO3**
CO6	Acquire skill in preparing production drawings pertaining to various designs.	**PO6**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ETME 315A	Design of Machines Elements	3	3	3	3	2	3							3	3	

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETME 381A	PRACTICAL TRAINING-I	L	T	P	C
Version 1.0		0	0	0	1
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

1. To provide an exposure to real life industry environment.
2. To help student learn about the projects.

Course Outcomes

On completion of this course, the students will be able to

CO1. Learn the practical aspects of the mechanical industry.

CO2. Learn to work over projects for the development of students.

Catalog Description

This course complements ETME381A. Minimum of four weeks in industry or appropriate workplace/ academic and research institutions in India/abroad. The summer internship should give exposure to the practical aspects of the discipline. In addition, the student may also work on a specified task or project which may be assigned to him/her. The outcome of the internship should be presented in the form of a report.

Modes of Evaluation: Quiz/Oral practical oral exam/presentation/projects/Practical Examination

Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Projects/ etc.	End Term Exam
Weightage (%)	**10**	**10**	**20**	**10**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and Pos		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	To Learn the practical aspects of the mechanical industry.	**PO1, PO2**
CO2	To Learn to work over projects for the development of students.	**PO4, PO5**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ETME381 A	Practical Training-I	2	2		3	3								3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETME 357 A	**MANUFACTURING TECHNOLOGY LAB**	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Manufacturing Technology Lab				
Co-requisites	--				

Course Objectives

1. To impart hands-on practical exposure on manufacturing processes and equipment.
2. To determine various parts, nomenclature and process of the basic machines used in manufacturing industry.
3. The student will be trained to implement similar features in preparation of jobs can be extended to implement in the preparation of complicated jobs.
4. To provide the elementary knowledge of modern mechanical tool like CNC and NC.
5. At the end of the lab learn preparation of various jobs using various manufacturing process.

Course Outcomes

On completion of this course, the students will be able to

CO1. Illustrate principles of basic metal forming processes.
CO2 Demonstrate applications of various types of welding processes.
CO3 Differentiate chip forming processes such as turning, milling, drilling, etc.
CO4 Illustrate the concept of CNC and NC for manufacturing components.
CO5 Distinguish between the conventional and modern machine tools.

Catalog Description

This course complements ETME 357A. It is an introductory course where basic machines like lathe its parts and other machine-like drill machine, milling and CNC and NC machines are introduced. The goals of the experiments include determination of accuracy according to inputs and dimensions with conventional and modern machine tools.

List of Experiments (Indicative)

1	Study and Practice of Orthogonal & Oblique Cutting on a Lathe	**2 lab hours**
2	Machining time calculation and comparison with actual machining time while cylindrical turning on a Lathe and finding out cutting efficiency.	**2 lab hours**
3	Study of Tool Life while milling a component on the Milling Machine.	**2 lab hours**
4	Study of Tool Wear of a cutting tool while drilling on a Drilling Machine	**2 lab hours**
5	Study of Speed, Feed, Tool, Preparatory (Geometric) and miscellaneous functions for N. C part programming.	**2 lab hours**
6	Part Programming and proving on a NC lathe for:- **a.** Outside Turning **b**. Facing and Step Turning **c.** Taper Turning **d.** Drilling **e.** Outside Threading	**2 lab hours**
7	Part Programming and Proving on a NC Milling Machine:- **a**. Point to Point Programming **b.** Absolute Programming **c.** Incremental Programming	**2 lab hours**
8	Study of welding joints like butt joint, lap joint, face joint etc. through different welding process	**2 lab hours**

Modes of Evaluation: Quiz/Oral practical oral exam/presentation/projects/Practical Examination

Examination Scheme:

Components	**Quiz**	**Attendance**	**Mid Term Exam**	**Presentation/ Projects/ etc.**	**End Term Exam**
Weightage (%)	**10**	**10**	**20**	**10**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Illustrate principles of basic metal forming processes	**PO9**
CO2	Differentiate chip forming processes such as turning, milling, drilling, etc.	**PO1**
CO3	Demonstrate applications of various types of welding and forming processes	**PO4**
CO4	Illustrate the concept of CNC and NC for manufacturing components	**PO5**
CO5	Distinguish between the conventional and modern machine tools	**PO2**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ETME 357 A	Manufacturing Technology Lab	2	2		3	3				2						

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETME 363 A	INTERNAL COMBUSTION ENGINE LAB	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Internal Combustion Engine and Gas Turbine Lab				
Co-requisites	--				

Course Objectives

1. To determine the efficiency of IC engine.
2. To determine various parameters of the engine performance in single cylinder/multi cylinder engine.
3. To determine the IHP through Morse test and Analysis of exhaust gases from emissions through orsat apparatus.
4. To determine the intensity of smoke through different methods.
5. To prepare the heat balance sheet for different engine conditions.
6. To determine the emissions of CO, hydrocarbons from exhaust.

Course Outcomes

On completion of this course, the students will be able to

CO1. Have a solid foundation in engine parts like engine shell, carburettor, flywheel, crankcase, connecting rod, dead centres etc.

C02. To measure the IHP through Morse test for the single cylinder/multi cylinder engine.

CO3. Measure the intensity of smoke, CO and hydrocarbons emissions through the different single cylinder/multi cylinder IC engine.

CO4. To analyse practical problems in all engines and preparation of heat balanced sheet.

Catalog Description

This course complements ETME 363A. It is an introductory course where engine, its parts and lubrication are introduced. The goals of the experiments include determination of efficiency, heat balance sheet and fuel consumption when start the engine at varying conditions of load, type of engine, viscosity dependence of fuel with octane and other ratings.

List of Experiments (Indicative)

1	To study the constructional details & working principles of two-stroke/ four stroke petrol engine.	**2 lab hours**
2	To study the constructional detail & working of two-stroke/ four	**2 lab hours**

	stroke diesel engine	
3	Analysis of exhaust gases from single cylinder/multi cylinder diesel/petrol engine by Orsat Apparatus.	**2 lab hours**
4	To prepare heat balance sheet on multi-cylinder diesel engine/petrol engine.	**2 lab hours**
5	To find the indicated horse power (IHP) on multi-cylinder petrol engine/diesel engine by Morse Test.	**2 lab hours**
6	To prepare variable speed performance test of a multi-cylinder/single cylinder petrol engine/diesel engine and prepare the curves (i) bhp, ihp,fhp, vs speed (ii) volumetric efficiency & indicated specific specific fuel consumption vs speed.	**2 lab hours**
7	To find fhp of a multi-cylinder diesel engine/petrol engine by Willian's line method & by motoring method	**2 lab hours**
8	To perform constant speed performance test on a single cylinder/multi-cylinder diesel engine & draw curves of (i) bhp vs fuel rate, air rate and A/F and (ii) bhp vs mep, mech efficiency & sfc.	**2 lab hours**
9	To measure CO & Hydrocarbons in the exhaust of 2- stroke / 4-stroke petrol engine.	**2 lab hours**
10	To find intensity of smoke from a single cylinder / multi-cylinder diesel engine.	**2 lab hours**
11	To draw the scavenging characteristic curves of single cylinder petrol engine.	**2 lab hours**
12	To study the effects of secondary air flow on bhp, sfc, Mech. Efficiency & emission of a two-stroke petrol engine.	**2 lab hours**

Modes of Evaluation: Quiz/Oral practical oral exam/presentation/projects/Practical Examination

Examination Scheme:

Components	**Quiz**	**Attendance**	**Mid Term Exam**	**Presentation/ Projects/ etc.**	**End Term Exam**
Weightage (%)	**10**	**10**	**20**	**10**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Have a introduction with engine parts like engine shell, carburettor, flywheel, crankcase, connecting rod, dead centres etc.	**PO1**
CO2	To measure the IHP through Morse test for the single cylinder/multi cylinder engine	**PO4**
CO3	Measure the intensity of smoke, CO and hydrocarbons emissions through the different single cylinder/multi cylinder IC engine	**PO5**
CO4	To analyze practical problems in all engines and preparation of heat balanced sheet.	**PO2**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ETME 363A	Internal Combustion Engine Lab	2	2		3	3								3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

SEMETER VI

ETME 302A	HEAT TRANSFER	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	Thermodynamics				
Co-requisites	--				

Course Objectives: The subject expects students to achieve the following objectives.

1. To impart in depth understanding of the principles of thermodynamics and heat transfer.
2. To understand the application of basic fluid mechanics, thermodynamic, and heat transfer principles and techniques, including the use of empirical data.
3. To the analysis of representative fluid and thermal energy components and systems encountered in the practice of electrical, electronic, industrial, and related disciplines of engineering.
4. To learn about application of heat transfer in industries and to evaluate the changes in properties of substances in various heat transfer processes.

Course Outcomes: Upon the completion of this course the students will be able to:

CO1. The students will be able to apply energy balance to systems and control volumes, in situations involving heat and work interactions.
CO2 Students can evaluate changes in thermodynamic properties of substances in various heat transfer processes.
CO3. The students will be able to evaluate the performance of energy conversion devices.
CO4. The students will be able to analyze the applicant fields of heat transfer phenomenon.

Catalog Description

Heat Transfer has very wide applications as basis of thermal engineering. Almost all process and engineering industries, agriculture, transport, commercial and domestic activities use thermal engineering. But energy technology and power sector are fully dependent on the energy transfer modes and processes involved. For example: Central thermal power plants, captive power plants based on coal, nuclear power plants, Gas turbine power plants, Engines for automobiles, ships, airways, space crafts, Direct energy conversion devices: Fuel cells, thermionic, thermoelectric engines, Air conditioning, heating, cooling, ventilation plants, Domestic, commercial, and industrial lighting, agricultural, transport and industrial machines. All the above engines and power consuming plants are designed using laws of heat transfer.

Course Content

Unit I: **10 lecture hours**

Basics and Laws: Definition of Heat Transfer, Reversible and irreversible processes, Modes of heat flow, Combined heat transfer system and law of energy conservation.
Steady State Heat Conduction: Introduction, I-D heat conduction through a plane wall, long hollow cylinder, hollow sphere, and Conduction equation in Cartesian, polar and spherical co-ordinate systems, Numerical.

Unit II: **12 lecture hours**

Steady State Conduction with Heat Generation: Introduction, 1 – D heat conduction with heat sources, Extended surfaces (fins), Fin effectiveness 2-D heat conduction, Numerical
Transient Heat Conduction: Systems with negligible internal resistance, Transient heat conduction in plane walls, cylinders, spheres with convective boundary conditions, Chart solution, Relaxation Method, Numerical

Unit III: **08 lecture hours**

Convection: Forced Convection-Thermal and hydro-dynamic boundary layers, Equation of continuity, Momentum and energy equations, Some results for flow over a flat plate and flow through tube, Fluid friction and heat transfer (Colburn analogy), Free convection from a vertical flat plate, Empirical relations for free convection from vertical and horizontal o\planes & cylinders, Numerical.
Thermal Radiation: The Stephen-Boltzmann law, the black body radiation, Shape factors and their relationships, Heat exchange between non-black bodies, Electrical network for radiative exchange in an enclosure of two or three grey bodies, Radiation shields, numerical**.**

Unit IV: **10 lecture hours**

Heat Exchangers: Classification, Performance variables, Analysis of a parallel/counter flow heat exchanger, Heat exchanger effectiveness, numerical.
Heat Transfer with Change of Phase: Laminar film condensation on a vertical plate, Drop-wise condensation, boiling regimes, Free convective, Nucleate and film boiling, numerical.

TEXTBOOKS:

1. Heat Transfer – J.P. Holman, John Wiley & Sons, New York.
2. Fundamentals of Heat & Mass Transfer–Incropera, F.P. & Dewitt, D.P –John Willey New York.
3. Heat Transfer-Principles & Applications-Binay K. Dutta, PHI, New Delhi

REFERENCE BOOKS:

1. Conduction of Heat in Solids – Carslow, H.S. and J.C. Jaeger – Oxford Univ. Press.
2. Conduction Heat Transfer – Arpasi, V.S. – Addison – Wesley.
3. Compact Heat Exchangers – W.M. Keys & A.L. Landon, Mc. Graw Hill.
4. Thermal Radiation Heat Transfer – Siegel, R. and J.R. Howell, Mc. Graw Hill.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	**Quiz**	**Attendance**	**Mid Term Exam**	**Presentation/ Assignment/ etc.**	**End Term Exam**
Weightage (%)	**10**	**10**	**20**	**10**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	The students will be able to apply energy balance to systems and control volumes, in situations involving heat and work interactions.	**PO1**
CO2	Students can evaluate changes in thermodynamic properties of substances in various heat transfer processes.	**PO2**
CO3	The students will be able to evaluate the performance of energy conversion devices.	**PO3**
CO4	The students will be able to analyze the applicant fields of heat transfer phenomenon	**PO4**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ETME 302A	Heat Transfer	2	3	2	3									3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETME 322A	ROBOTICS AND AUTOMATION	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure	Programming in a high-level language and its use in solving engineering problems, Motion of rigid bodies and kinematics of mechanisms, Dynamics				
Co-requisites	--				

Course Objectives: The subject expects students to achieve the following objectives.

1. To introduce the concepts of programmable controllers control automation
2. To learn how electronics, circuits and sensors effect automation controls
3. To learn why hydraulics and pneumatics move industrial robots
4. Align, fit and assemble robot component parts
5. To test robotic assembles
6. To develop robotic path motions

Course Outcomes: Upon the completion of this course the students will be able to:

CO1. Demonstrate knowledge of the relationship between mechanical structures of industrial robots and their operational workspace characteristics.

CO2. Demonstrate an ability to apply spatial transformation to obtain forward kinematics equation of robot manipulators.

CO3. An ability to solve inverse kinematics of simple robot manipulators and to obtain the Jacobean matrix and use it to identify singularities

CO4. Knowledge of robot controllers and an ability to generate joint trajectory for motion planning

Catalog Description

This course offers basic knowledge to mechanics and control of robotic manipulators. Topics include spatial transformations, kinematics, dynamics, trajectory generation, actuators and control, and relations to product design and flexible automation. This course is also helping students to answer fundamental questions of Mechanical Engineering at the time of the interview.

Course Content

UNIT I **10 Lecture Hours**

Fundamentals of robot technology: Robot anatomy. Work volume. Drive systems. Control systems and dynamic performance. Accuracy and repeatability. Sensors in robotics. Robot reference frames and coordinates and robot kinematics, Path control.

UNIT II **08 Lecture Hours**

Robot kinematics: Matrix representation. Homogeneous transformations. Forward and inverse kinematics.
Robot dynamics: Differential motions of a frame. Jacobian, static force analysis.

UNIT III **08 Lecture Hours**

Configuration of a robot controller: End effectors. Mechanical and other types of grippers. Tools as end effectors. Robot and effector interface. Gripper selection and design. Introduction to robot languages.

UNIT IV **07 Lecture Hours**

Applications for manufacturing: Flexible automation. Robot cell layouts. Machine interference. Other considerations in work cell design. Work cell control, interlocks. Robot cycle time analysis. GraPrentice Hall Indiacal simulation of robotic work cells.
Typical applications of robots in material transfer, machine loading/unloading; processing operations; assembly and inspection.

Text Books:

1. Saeed B. Niku, "Introduction to Robotics analysis, Systems & Applications", Pearson Education Singapore P. Ltd.
2. S.R. Deb, "Robotic Technology and Flexible Automation", Tata McGraw Hill Publishing Co. Ltd.
3. R.K. Mittal, I.J. Nagrath, "Robotics & Control", Tata McGraw & Hills,

Reference Books:

1. Robert J. Schilling, "Fundamentals of Robotics, analysis & Control", Prentice Hall of India P.Ltd.,
2. John J.Craig; "Introduction to Robotics Mechanics & Control", Pearson Education.
3. Allison Druin & James Hendler; "Robots Exploring New Technologies for learning for kids", Morgan Kaufmann Publishers.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Demonstrate knowledge of the relationship between mechanical structures of industrial robots and their operational workspace characteristics.	**PO1**
CO2	Demonstrate an ability to apply spatial transformation to obtain forward kinematics equation of robot manipulators.	**PO4**
CO3	an ability to solve inverse kinematics of simple robot manipulators and to obtain the Jacobean matrix and use it to identify singularities	**PO5**
CO4	knowledge of robot controllers and an ability to generate joint trajectory for motion planning	**PSO1**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ETME 322 A	Robotics and Automation	2			3	3								3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETME 326A	AUTOMOBILE ENGINEERING	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure	Basics of Automobile Engineering				
Co-requisites	--				

Course Objectives: The subject expects students to achieve the following objectives.

1. To impart adequate knowledge in both practically and theoretically, covering the various types of systems of Automobile vehicles
2. To familiarize the students with the fundamentals of vehicle, Chassis, and suspension system, braking and transmission system, and cooling system.
3. To acquaint with the operation, maintenance, and repairs of all components of the various transportation vehicles.

Course Outcomes: Upon the completion of this course the students will be able to:

CO1. List different types of Engines and their classifications, Judge firing order for multi-cylinder engines for igniting of fuels.
CO2. Develop concept and define working of Automobile Engine cooling and lubrication system, describe functioning of Transmission train, conventional and non-conventional drives, Clutches, Gear boxes, Synchromesh device, Propeller shaft, Differential axle, braking system and Suspension systems.
CO3. Describe functioning of steering system, steering geometry wheel alignment and wheel angles for modern Automobile.
CO4. Explain the need of Catalytic converter and their functioning.

Catalog Description

This course provides a brief knowledge about Power Transmission, Suspension Systems, Automotive Brakes, Tyres & Wheels. Almost all process and engineering industries, agriculture, transport, commercial and domestic activities use automobiles for processing.

Course Content

Unit I: **08 lecture hours**

Introduction to Automobiles: Classification, Components, Requirements of Automobile Body; Vehicle Frame, Separate Body & Frame, Unitised Body, Car Body Styles, Bus Body & Commercial Vehicle Body Types; Front Engine Rear Drive & Front Engine Front Drive Vehicles, Four Wheel Drive Vehicles, Safety considerations; Safety features of latest vehicle; Future trends in automobiles.

Clutches: Requirement of Clutches – Principle of Friction Clutch – Wet Type & Dry Types; Cone Clutch, Single Plate Clutch, Diaphragm Spring Clutch, Multi plate Clutch, Centrifugal Clutches, Electromagnetic Clutch, Over Running Clutch; Clutch Linkages.

Unit II: **08 lecture hours**

Power Transmission: Requirements of transmission system; General Arrangement of Power Transmission system; Object of the Gear Box; Different types of Gear Boxes; Sliding Mesh, Constant Mesh, Synchro- mesh Gear Boxes; Epi-cyclic Gear Box, Freewheel Unit. Overdrive unit-Principle of Overdrive, Advantage of Overdrive, Transaxle, Transfer cases. Drive Lines, Universal Joint, Differential and Drive Axles: Effect of driving thrust and torque reactions; Hotchkiss Drive, Torque Tube Drive, and radius Rods; Propeller Shaft, Universal Joints, Slip Joint; Constant Velocity Universal Joints; Front Wheel Drive; Principle, Function, Construction & Operation of Differential; Rear Axles, Types of loads coming on Rear Axles, Full Floating, three quarter Floating and Semi Floating Rear Axles.

Unit III: **08 lecture hours**

Suspension Systems: Need of Suspension System, Types of Suspension; factors influencing ride comfort, Suspension Spring; Constructional details and characteristics of leaf springs.
Steering System: Front Wheel geometry & Wheel alignment viz. Caster, Camber, King pin Inclination, Toe-in/ Toe-out; Conditions for true rolling motions of Wheels during steering; Different types of Steering Gear Boxes; Steering linkages and layout; Power steering – Rack & Pinion Power Steering Gear, Electronics steering.

Unit IV: **08 lecture hours**

Automotive Brakes, Tyres & Wheels: Classification of Brakes; Principle and constructional details of Drum Brakes, Disc Brakes; Brake actuating systems; Mechanical, Hydraulic, Pneumatic Brakes; Factors affecting Brake performance, Power & Power Assisted Brakes; Tyres of Wheels; Types of Tyre & their constructional details, Wheel Balancing, Tyre Rotation; Types of Tyre wear & their causes.
Emission Control System & Automotive Electrical: Sources of Atmospheric Pollution from the automobile, Emission Control Systems – Construction and Operation of Positive Crank Case Ventilation (PVC) Systems, Evaporative Emission Control, Heated Air Intake System, Exhaust Gas Recirculation (ECR) Systems, Air Injection System and Catalytic Converters; Purpose construction & operation of lead acid Battery, Capacity Rating & Maintenance of Batteries; Purpose and Operation of Charging Systems, Purpose and Operations of the Starting System; Vehicle Lighting System.

TEXTBOOKS:

1. Automobile Engineering by Anil Chhikara, Satya Prakashan, New Delhi.

2. Automobile Engineering by Dr. Kirpal Singh, standard Publishers Distributors.

REFERENCE BOOKS:

1. Automotive Mechanics – Crouse / Anglin, TMH.

2. Automotive Technology – H.M. Sethi, TMH, New Delhi.

3. Automotive Mechanics – S.Srinivasan, TMH, New Delhi.

4. Automotive Mechanics – Joseph Heitner, EWP.

5. Motor Automotive Technology by Anthony E. Schwaller – Delmer Publishers, Inc.

6. The Motor Vehicle – Newton steeds Garrett, Butter Worths

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	List different types of Engines and their classifications, Judge firing order for multi-cylinder engines for igniting of fuels.	PO1
CO2	Develop concept and define working of Automobile Engine cooling and lubrication system, describe functioning of Transmission train, conventional and non-conventional drives, Clutches, Gear boxes, Synchromesh device, Propeller shaft, Differential axle, braking system and Suspension systems.	PO2
CO3	Describe functioning of steering system, steering geometry wheel alignment and wheel angles for modern Automobile.	PO3
CO4	Explain the need of Catalytic converter and their functioning.	PO4

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ETME 326A	AUTOMOBILE ENGINEERING	2	3	2	3									3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETME317A	**CAD MOLD WIZARD FUNDAMENTAL PROCESSES**	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure	Basics of CAD Mold Wizard				
Co-requisites	--				

Course Objectives: The subject expects students to achieve the following objectives.

1. To teach students about various type of metals used in automotive industry.
2. To enable students on understanding the metal and sheet metal parts and terminologies of automotive.
3. To teach students on difference of underbody and exterior sheet metal.
4. To let students, absorb knowledge related to sheet metal manufacturing and feature building.

Course Outcomes: Upon the completion of this course the students will be able to:

CO1.The students will be able to apply knowledge related to sheet metal component design.
CO2.Students will gain knowledge related to various sheet metal tooling and manufacturing techniques.
CO3.Students will be enabled to understand the basics and advance of BIW engineering and material handling.

Catalog Description

This course gives introductory knowledge CAD Mold Wizard Fundamental Processes in various field. It enables the students to understand the working of these systems. This course is also helping students to answer fundamental questions of CAD Mold Wizard Fundamental Processes at the time of the interview.

Course Content

Unit I: **08 lecture hours**

Side Body: CAD mold wizard for Side Body Panels, Door Trims, Latches

Unit II: **08 lecture hours**

Under Body: Under body Panel, A, B, C Pillars, Rear Door

Unit III: **08 lecture hours**

Roof: Front Fender, Rear Fender, Roof

Unit IV: **08 lecture hours**

Bonnet: Hood/Bonnet (Outer), Hood/Bonnet (Inner)

Teaching –Learning Process

1. Classroom Learning using Board, ppt, modelling and Videos.
2. Students learning through lecture, Assignment, Test, Presentation, and project

TEXTBOOKS:

Siemens Online Learning Platform.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	The students will be able to apply knowledge related to sheet metal component design.	**PO5**
CO2	Students will gain knowledge related to various sheet metal tooling and manufacturing techniques.	**PO2**
CO3	Students will be enabled to understand the basics and advance of BIW engineering and material handling.	**PO3**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ET ME 317 A	CAD MOLD WIZARD FUNDAMENTAL PROCESSES		3	3		2								2		

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETME 328A	ELECTRIC VEHICLE ENGINEERING DESIGN	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure	Basics of Electric Vehicle Engineering Design				
Co-requisites	--				

Course Objectives: The subject expects students to achieve the following objectives.

1. The course will enable students to learn the basics of electric vehicle frames.
2. The course will help students to understand the terminologies and their use in automotive industry.
3. The course will enable students on understanding the electronic component & control study of modern automotive.

Course Outcomes: Upon the completion of this course the students will be able to:

CO1.This program will enable students to design the electric vehicle.
CO2.The completion of this course will make students understand better the electric vehicle packaging.
CO3.The course will create a library for students in terms of various electrical components, battery management etc.

Catalog Description:

This course gives introductory knowledge about designs of the Electric Vehicle Basic Components. It provides the detailed study of electronic components & control study of modern automotive.

Course Content

Unit I: **08 lecture hours**

Chassis Components Design: Design of Mono-coque/ Double Trellis electric vehicle chassis, Electric Vehicle Packaging, and components

Unit II: **08 lecture hours**

Drive Train Design: Design & Study of Drive Train, Noise, Vibration and Harshness Damping

Unit III: **08 lecture hours**

Battery and Motor System Design: Battery Management System Design, Battery Heat Dissipation systems, Motor Heat Dissipation systems

Unit IV: **08 lecture hours**

ECU design: Electric Control Unit Processing Design, Study of Controllers and Regulators in EV

Teaching –Learning Process

1. Classroom Learning using Board, ppt, modeling and Videos.
2. Students learning through lecture, Assignment, Test, Presentation and project

TEXTBOOKS:

1. Siemens Online Learning Platform

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	This program will enable students to design the electric vehicle.	**PO5**
CO2	The completion of this course will make students understand better the electric vehicle packaging.	**PO2**
CO3	The course will create a library for students in terms of various electrical components, battery management etc.	**PO11**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ETME 328A	ELECTRIC VEHICLE ENGINEERING DESIGN		3			3						2			2	

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETME352A	HEAT TRANSFER LAB	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Basic concepts of Heat Transfer				
Co-requisites	--				

Course Objectives

The objective of this course includes:

1. To determine the thermal conductivity of a metallic rod, insulating power, hot plate method.
2. To find the effectiveness of a pin fin in a rectangular duct natural and forced convective condition and plot temperature distribution along its length.
3. To determine the surface heat transfer coefficient for a heated vertical tube under natural convection and plot the variation of local heat transfer coefficient along the length of the tube. Also compare the results with those of the correlation.
4. To find overall heat transfer coefficient and effectiveness of a heat exchange under parallel and counter flow conditions. Also plot the temperature distribution in both the cases along the length of heat of heat exchanger.
5. To verify the Steffen-Boltzmann constant for thermal radiation.
6. To demonstrate the super thermal conducting heat pipe and compare its working with that of the best conductor i.e., copper pipe. Also, to plot temperature variation along the length with time or three pipes
7. To study the two phases heat transfer unit.
8. To determine the water side overall heat transfer coefficient on a crossflow heat exchanger.

Course Outcomes

Upon the completion of this course the students will be able to:

CO1. Evaluate heat transfer through lagged pipe, insulating powder, and Drop and Film wise condensation.

CO2. Experiment the Thermal conductivity of a given metal Rod.

CO3. Measure the Heat transfer coefficient for Pin Fin, forced convection, Natural Convection, and parallel and counter flow heat exchanger and to Experiment on Transient heat conduction. CO4. Test Emissivity, Stefan Boltzmann Constant and Critical Heat flux.

Catalog Description: This lab course is designed to introduce a basic study of the phenomena of heat transfer, to develop methodologies for solving a wide variety of practical engineering problems, and to provide useful information concerning the performance and design of particular systems and processes. A knowledge-based design problem requiring the formulations of solid conduction and fluid convection to gain experience in designing experiments for thermal systems will be attempted as part of laboratory requirements.

List of Experiments (Indicative)

1	To determine the thermal conductivity of a metallic rod.	**2 lab hours**
2	To determine the thermal conductivity of an insulating power.	**2 lab hours**
3	To determine the thermal conductivity of a solid by the guarded hot plate method.	**2 lab hours**
4	To find the effectiveness of a pin fin in a rectangular duct natural convective condition and plot temperature distribution along its length.	**2 lab hours**
5	To find the effectiveness of a pin fin in a rectangular duct under forced convective and plot temperature distribution along its length.	**2 lab hours**
6	To determine the surface heat transfer coefficient for a heated vertical tube under natural convection and plot the variation of local heat transfer coefficient along the length of the tube. Also compare the results with those of the correlation.	**2 lab hours**
7	To determine average heat transfer coefficient for a externally heated horizontal pipe under forced convection & plot Reynolds and Nusselt numbers along the length of pipe. Also compare the results with those of the correlations.	**2 lab hours**
8	To measure the emissivity of the gray body (plate) at different temperature and plot the variation of emissivity with surface temperature.	**2 lab hours**
9	To find overall heat transfer coefficient and effectiveness of a heat exchange under parallel and counter flow conditions. Also plot the temperature distribution in both the cases along the length of heat of heat exchanger.	**2 lab hours**
10	To verify the Stefen-Boltzmann constant for thermal radiation.	**2 lab hours**
11	To demonstrate the super thermal conducting heat pipe and compare its working with that of the best conductor i.e. copper pipe. Also plot temperature variation along the length with time or three pipes.	**2 lab hours**
12	To study the two phases heat transfer unit.	**2 lab hours**
13	To determine the water side overall heat transfer coefficient on a crossflow heat exchanger.	**2 lab hours**

Modes of Evaluation: Quiz/Oral practical oral exam/presentation/projects/Practical Examination

Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Projects/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Evaluate heat transfer through lagged pipe, insulating powder, and Drop and Film wise	**PO1**
CO2	Experiment the Thermal conductivity of a given metal Rod.	**PO2**
CO3	Measure the Heat transfer coefficient for Pin Fin, forced convection, Natural Convection, and parallel and counter flow heat exchanger and to Experiment on Transient heat conduction.	**PO3**
CO4	Test Emissivity, Stefan Boltzmann Constant and Critical Heat flux	**PO4**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ETME 352A	Heat Transfer Lab	2	2	3	3									3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETME 354 A	ROBOTICS AND AUTOMATION LAB	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Robotics and Automation Lab				
Co-requisites	--				

Course Objectives

The subject expects students to achieve the following objectives.

1. Explain the fundamentals of robotics and its components
2. Illustrate the kinematics and dynamics of robotics
3. Elucidate the need and implementation of related Instrumentation & control in robotics
4. Illustrate the movement of robotic joints with computers/microcontrollers.
5. Explain sensors and instrumentation in robotics

Course Outcomes

On completion of this course, the students will be able to

CO1. Demonstrate knowledge of the relationship between mechanical structures of industrial robots and their operational workspace characteristics.

CO2. Demonstrate an ability to apply spatial transformation to obtain forward kinematics equation of robot manipulators.

CO3. An ability to solve inverse kinematics of simple robot manipulators and to obtain the Jacobean matrix and use it to identify singularities

CO4. Knowledge of robot controllers and an ability to generate joint trajectory for motion planning

Catalog Description:

This course complements ETME 354 A. This course offers basic knowledge to control the robotic manipulators. The Robotics & Automation Lab is an arrangement of numerous robotic arms and industrial devices such as conveyor belts and sensors. The lab focuses on interfacing robotic systems with computers and PLC units so that they produce a specific motion based on inputs received from different types of sensors. Topics include spatial transformations, kinematics, dynamics, trajectory generation, actuators and control, and relations to product design and flexible automation. This course is also helping students to answer fundamental questions of Mechanical Engineering at the time of the interview.

List of Experiments (Indicative)

1	Demonstration of Cartesian/ cylindrical/ spherical robot.	**2 lab hours**
2	Demonstration of Articulated/ SCARA robot.	**2 lab hours**
3	Virtual modelling for kinematic and dynamic verification any one robotic structure using suitable software.	**2 lab hours**
4	Design, modelling and analysis of two different types of grippers.	**2 lab hours**
5	Study of sensor integration.	**2 lab hours**
6	Two programs for linear and non-linear path.	**2 lab hours**
7	Study of robotic system design.	**2 lab hours**

Modes of Evaluation: Quiz/Oral practical oral exam/presentation/projects/Practical Examination
Examination Scheme:

Components	**Quiz**	**Attendance**	**Mid Term Exam**	**Presentation/ Projects/ etc.**	**End Term Exam**
Weightage (%)	**10**	**10**	**20**	**10**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	know the fluid flow principles and able for calculating performance analysis in turbines and pumps and can be used in power plants	**PO1**
CO2	understand to analyze practical problems in all power plants and chemical industries	**PO3**
CO3	conduct experiments (in teams) in pipe flows and open-channel flows and interpreting data from model studies to prototype cases, as well as documenting them in engineering reports	**PO4**
CO4	analyze a variety of practical fluid-flow devices and utilize fluid mechanics principles in design	**PO5**
CO5	Given the required flow rate and pressure rise, select the proper pump to optimize the pumping efficiency	**PO9**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ETME 354 A	Robotics and Automation Lab	2		2	3	3				2						

1= Weakly mapped
2= Moderately mapped
3= Strongly mapped

ETME356A	**AUTOMOBILE ENGINEERING LAB**	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Basic concepts of Automobile Engineering				
Co-requisites	--				

Course Objectives

The Objective of this course includes:

1. To enable the students to understand the basic principles of steering,
2. To understand the principle of fluid coupling, Torque convertor
3. To know about the different types of clutches through theoretical and experimental means.

Course Outcomes

Upon the completion of this course the students will be able to:

CO1 Understand the working of Different types of clutches.

CO2.Understand the working different types of steering system.

CO3. Distinguish between the working of different type's clutch and gear transmissions.

CO4.Understand the working of Different types of Brakes in automobile Engineering.

Catalog Description

This course enables and introduces the students to the study of various automobile engineering concepts and prepares the student for further studies and better understanding of

automobile engineering concepts like Engines, Clutches, and their materials, etc. through practical exposure.

List of Experiments (Indicative)

1	To study and prepare report on the constructional details, working principles and operation of the following Automotive Engine Systems & Sub Systems. a. Multi-cylinder: Diesel and Petrol Engines. b. Engine cooling & lubricating Systems. c. Engine starting Systems. d. Contact Point & Electronic Ignition Systems.	**2 lab hours**
2	To study and prepare report on the constructional details, working principles and operation of the following Fuels supply systems: a. Carburettors b. Diesel Fuel Injection Systems c. Gasoline Fuel Injection Systems.	**2 lab hours**
3	To study and prepare report on the constructional details, working principles and operation of the following Automotive Clutches. a. Coil-Spring Clutch b. Diaphragm – Spring Clutch. c. Double Disk Clutch.	**2 lab hours**
4	To study and prepare report on the constructional details, working principles and operation of the following Automotive Transmission systems. a. Synchromesh – Four speed Range. b. Transaxle with Dual Speed Range. c. Four Wheel Drive and Transfer Case. d. Steering Column and Floor – Shift levers	**2 lab hours**
5	To study and prepare report on the constructional details, working principles and operation of the following Automotive Drive Lines & Differentials. a. Rear Wheel Drive Line. b. Front Wheel Drive Line. c. Differentials, Drive Axles and Four-Wheel Drive Line.	**2 lab hours**
6	To study and prepare report on the constructional details, working principles and operation of the following Automotive Suspension Systems. a. Front Suspension System. b. Rear Suspension System.	**2 lab hours**

7	To study and prepare report on the constructional details, working principles and operation of the following Automotive Steering Systems. a. Manual Steering Systems, e.g., Pitman –arm steering, Rack & Pinion steering. b. Power steering Systems, e.g., Rack and Pinion Power Steering System. c. Steering Wheels and Columns e.g., Tilt & Telescopic steering Wheels, Collapsible Steering Columns	**2 lab hours**
8	To study and prepare report on the constructional details, working principles and operation of the following Automotive Tyres & wheels. a. Various Types of Bias & Radial Tyres. b. Various Types of wheels.	**2 lab hours**
9	To study and prepare report on the constructional details, working principles and operation of the Automotive Brake systems. a. Hydraulic & Pneumatic Brake systems. b. Drum Brake System. c. Disk Brake System. d. Antilock Brake System. e. System Packing & Other Brakes.	**2 lab hours**
10	To study and prepare report on the constructional details, working principles and operation of Automotive Emission / Pollution control systems.	**2 lab hours**
11	Modeling of any two automotive systems on 3D CAD using educational software's (e.g., 3D modeling package/Pro Engineering/I-Deas/ Solid edge etc.)	**2 lab hours**
12	Crash worthiness of the designed frame using Hyper mesh and LS-Dyna solver or other software.	**2 lab hours**

Modes of Evaluation: Quiz/Oral practical oral exam/presentation/projects/Practical Examination

Examination Scheme:

Components	**Quiz**	**Attendance**	**Mid Term Exam**	**Presentation/ Projects/ etc.**	**End Term Exam**
Weightage (%)	**10**	**10**	**20**	**10**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand the working of Different types of clutches.	**PO1**
CO2	Understand the working different types of steering system.	**PO2**
CO3	Distinguish between the working of different type's clutch and gear transmissions.	**PO6**
CO4	Understand the working of Different types of Brakes in automobile Engineering.	**PO7**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ETME 356A	Automobile Engineering Lab	3	2				3	2						3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

SEMESTER VII

ETME 425A	REFRIGERATION AND AIR-CONDITIONING	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure	Basics of Refrigeration and Air-conditioning system				
Co-requisites	--				

Course Objectives:

The subject expects students to achieve the following objectives.

1. Discuss basics of refrigeration and air conditioning, compare the properties of refrigerants and analyze the air refrigeration& aircraft refrigeration systems.
2. Explain the working of single stage and multistage vapour compression refrigeration systems.
3. Describe the working of vapour absorption refrigeration system, steam jet refrigeration system, pulse tube refrigeration system, thermoelectric refrigeration system and solar refrigeration systems.
4. Describe various principles of psychrometry.
5. Estimate the cooling loads of an air-conditioned building, list different equipment used in air conditioning plant and learn different applications of R&A/C.

Course Outcomes:

Upon the completion of this course the students will be able to:

CO1.Demonstrate fundamental principles of refrigeration and air conditioning.
CO2.Identify and locate various important components of the refrigeration and air conditioning system.
CO3.Illustrate various refrigeration and air conditioning processes using psychometric chart.
CO4.Design Air Conditioning system using cooling load calculations.
CO5.Estimate air conditioning system parameters and demonstrate understanding of duct design concepts.

Catalog Description

This course gives introductory knowledge about Refrigeration and air-conditioning system, application of refrigeration and air conditioning in various field. It enables the students to understand the working of these systems. It also enhances the students thinking capability to calculate the efficiency and COP of the systems. This course is also helping students to answer fundamental questions of Refrigeration and Airconditioning at the time of the interview.

Course Content

Unit I: **08 lecture hours**

Introduction: Definition of refrigeration & air conditioning; Necessity; Methods of refrigeration; Unit of refrigeration; Coefficient of performance (COP), Fundamentals of air-conditioning system; Refrigerants- Definition, Classification, Nomenclature, Desirable properties, Comparative study, secondary refrigerants, Introduction to eco-friendly Refrigerants; Introduction to Cryogenics.

Air Refrigeration System: Carnot refrigeration cycle. Temperature Limitations; Brayton refrigeration or the Bell Coleman air refrigeration cycle; Necessity of cooling the aero plane; Air craft refrigeration systems, Simple cooling and Simple evaporative types, Boot strap and Boot strap evaporative types, Regenerative type and Reduced Ambient type system, Comparison of different systems, problems.

Unit II: **12 lecture hours**

Vapour Compression (VC) Refrigeration Systems: (A) Simple Vapour Compression (VC) Refrigeration systems-Limitations of Reversed Carnot cycle with vapour as the refrigerant; Analysis of VC cycle considering degrees of sub cooling and superheating; VC cycle on p-v, t-s and p-h diagrams; Effects of operating conditions on COP; Comparison of VC cycle with Air Refrigeration cycle.

(B) Multistage Ref. Systems- Necessity of compound compression, Compound VC cycle , Inter-cooling with liquid sub –cooling and / or water inter cooler: Multistage compression with flash inter-cooling and / or water inter-cooling; systems with individual or multiple expansion valves; Individual compression system with individual or multiple expansion valves; Individual compression systems with individual or multiple expansion valves but with and without intercoolers.

Other Refrigeration Systems: (A) Vapour Absorption Refrigeration Systems – Basic Systems, Actual COP of the System, Performance, Relative merits and demerits; Properties of aqua ammonia; Electrolux Refrigeration; Problems.

(B) Steam Jet Refrigerating System- Introduction, Analysis, Relative merits and demerits, Performance Applications, Problems.

(C) Cascade Refrigerating Systems-Necessity Selection of Pairs of refrigerants for the system, Concept of cascade temperature, Analysis, Multistaging, Comparison with V.C. systems, Applications, Problems.

Unit III: **12 lecture hours**

Psychrometry of Air & Air Conditioning Processes: Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temp., Thermodynamics wet bulb temp.,

Psychrometric chart; Psychrometry of air-conditioning processes, Mixing Process, Basic processes in conditioning of air; Psychrometric processes in air washer, Problems.

Air- Conditioning Load Calculations: Outside and inside design conditions; Sources of heating load; Sources of cooling load; Heat transfer through structure, Solar radiation, Electrical applications, Infiltration and ventilation, Heat generation inside conditioned space; Apparatus selection; Comfort chart, Problems.

Unit IV: 8 lecture hours

Air Conditioning Systems with Controls & Accessories: Classifications, Layout of plants; Equipment selection; Air distribution system; Duct systems Design; Filters; Refrigerant piping; Design of summer air-conditioning and Winter air conditioning systems; Temperature sensors, Pressure sensors, Humidity sensors, Actuators, Safety controls; Accessories; Problems.

Refrigeration and Air Conditioning Equipment's: Type of compressors and their performance curves; Types of Condensers, Heat transfer in condensers; Types of expansion devices; types of evaporators, Cooling and Dehumidifying coils, Problems.

TEXTBOOKS:

1. 1. Refrigeration & Air conditioning –R.C. Jordan and G.B. Priester, Prentice Hall of India.
2. 2. Refrigeration & Air conditioning –C.P. Arora, TMH, New Delhi.

REFERENCE BOOKS:

1. A course in Refrigeration & Air Conditioning – Arora & Domkundwar, Dhanpat Rai & Sons.
2. Refrigeration & Air conditioning –W.F. Stocker and J.W. Jones, TMH, New Delhi.
3. Refrigeration & Air conditioning- Manohar Prasad Wiley Estern limited, New Delhi.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Demonstrate fundamental principles of refrigeration and air conditioning.	**PO1**
CO2	Identify and locate various important components of the refrigeration and air conditioning system.	**PO2**
CO3	Illustrate various refrigeration and air conditioning processes using psychometric chart.	**PO3**
CO4	Design Air Conditioning system using cooling load calculations.	**PO4**
CO5	Estimate air conditioning system parameters and demonstrate understanding of duct design concepts.	

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
ETME 425A	Refrigeration and air-conditioning	3	3	2			3							3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETME 404 A	ADDITIVE MANUFACTURING	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure	Reverse engineering, Rapid Prototyping technologies, fuel, Testing and performance, object stereo lithography and Mathematical models				
Co-requisites	--				

Course Objectives: The subject expects students to achieve the following objectives.

1. To understand the concept of reverse engineering, rapid prototyping, and Manufacturing.
2. To familiar with different types of materials used for AM.
3. To understand the technologies involved in AM.
4. To understand the reach of AM process plan including building strategies and post-processing
5. To teach students about mechanical properties and geometric issues relating to specific rapid prototyping applications

Course Outcomes: Upon the completion of this course the students will be able to:

CO1.Demonstrate the knowledge of Additive Manufacturing and Rapid Prototyping technologies.
CO2.Understand the reverse engineering.
CO3.Familiar with the materials of Additive Manufacturing
CO4.Select the technologies for Additive Manufacturing.
CO5.Solve problems on mathematical models for AM.

Catalog Description

This course gives introductory knowledge about additive manufacturing, prototype technologies, micro and nano process etc. It enables the students to understand the brief technical concept of additive manufacturing systems. It also enhances the students thinking capability to calculate the effectiveness through the mathematical models. This course is also helping students to answer fundamental questions related to transformations in additive manufacturing at the time of the interview.

Course Content

Unit I: **08 lecture hours**

Introduction to Additive Manufacturing (AM) - Reverse engineering, Different AM processes and relevant process physics, AM process chain, Application level: Direct processes – Rapid

Prototyping, Rapid Tooling, Rapid Manufacturing; Indirect Processes - Indirect Prototyping, Indirect Tooling, Indirect Manufacturing.

Unit II: **08 lecture hours**

Materials science for additive manufacturing - multifunctional and graded materials in additive manufacturing, Role of solidification rate, Evolution of non-equilibrium structure, microstructural studies, Structure property relationship

Unit III: **08 lecture hours**

Additive Manufacturing technologies - Powder-based, droplet based, extrusion based, object stereo lithography, Micro- and Nano-additive processes.

Unit IV: **08 lecture hours**

Mathematical models for additive manufacturing, Selection of additive manufacturing technologies using decision methods, additive manufacturing process plan, Monitoring and control of defects, transformation.

Textbooks:

1. Ian Gibson, David W. Rosen and Brent Stucker, Additive manufacturing technologies: rapid
   prototyping to direct digital manufacturing, Springer, 2010.
2. C.K. Chua, K.F. Leong and C.S. Lim, Rapid prototyping: Principles and applications, 3 rd
   Edition, World Scientific, 2010.

Reference Books/Materials:

1. Andreas Gebhardt, Understanding additive manufacturing: rapid prototyping, rapid tooling, rapid manufacturing, Hanser Publishers, 2011.
2. J.D. Majumdar and I. Manna, Laser-assisted fabrication of materials, Springer Series in
   Material Science, 2013.
3. L. Lu, J. Fuh and Y. S. Wong, Laser-induced materials and processes for rapid prototyping, Kluwer Academic Press, 2001.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Assignment/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand the basic knowledge about reverse engineering.	**PO1**
CO2	Demonstrate the knowledge of Additive Manufacturing and Rapid Prototyping technologies	**PO5**
CO3	Familiar with the materials of Additive Manufacturing	**PO2**
CO4	Select the technologies for Additive Manufacturing and solve problems on mathematical models for AM.	**PO4**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ETME 404A	Additive Manufacturing	2	3		3	3	3							3	3	

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETME451A	REFRIGERATION AND AIR-CONDITIONING LAB	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Basics of Refrigeration and Air-conditioning				
Co-requisites	--				

Course Objectives:

The subject expects students to achieve the following objectives.

1. Discuss basics of refrigeration and air conditioning, compare the properties of refrigerants, and analyse the air refrigeration& aircraft refrigeration systems.
2. Explain the working of single stage and multistage vapour compression refrigeration systems.
3. Describe the working of vapour absorption refrigeration system, steam jet refrigeration system.
4. Describe various principles of psychrometry.
5. Estimate the cooling loads of an air-conditioned building, list different equipment used in air conditioning plant and learn different applications of R&A/C.

Course Outcomes:

Upon the completion of this course the students will be able to:

CO1.Demonstrate fundamental principles of refrigeration and air conditioning.

CO2.Illustrate various refrigeration and air conditioning processes using psychometric chart.

CO3.Design Air Conditioning system using cooling load calculations.

CO4.Estimate air conditioning system parameters and demonstrate understanding of duct design concepts.

Catalog Description:

This course complements ETME 451A. It enables them to calculate the cooling load estimation of real applications. The list of experiments helps to understand the calculation and working of using real model test Rig. It also discusses about daily problems like air-conditioning, refrigeration, and Heat pump.

List of Experiments (Indicative)

1	To study the vapor compression Refrigeration System and determine its C.O.P. and draw P-H and T-S diagrams.	**2 lab hours**
2	To Study the Mechanical heat pump and find its C.O.P.	**2 lab hours**
3	To study the Air and Water heat pump and find its C.O.P.	**4 lab hours**

4	To study the cut- sectional models of Reciprocating and Rotary Refrigerant compressor.	**2 lab hours**
5	To study the various controls used in Refrigerating & Air Conditioning systems.	**2 lab hours**
6	To study the Ice- plant, its working cycle and determine its C.O.P and capacity.	**4 lab hours**
7	To study the humidification, heating, cooling, and dehumidification processes and plot them on Psychrometric charts.	**2 lab hours**
8	8. To determine the By-pass factor of Heating & Cooling coils and plot them on Psychrometric charts on different inlet conditions.	**3 lab hours**
9	9. To determine sensible heat factor of Air on re-circulated air-conditioning set up.	**3 lab hours**
10	10. To study the chilling plant and its working cycle.	**3 lab hours**

Modes of Evaluation: Quiz/Oral practical oral exam/presentation/projects/Practical Examination

Examination Scheme:

Components	**Quiz**	**Attendance**	**Mid Term Exam**	**Presentation/ Projects/ etc.**	**End Term Exam**
Weightage (%)	**10**	**10**	**20**	**10**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Demonstrate fundamental principles of refrigeration and air conditioning.	**PO1**
CO2	Illustrate various refrigeration and air conditioning processes using psychometric chart.	**PO4**
CO3	Design Air Conditioning system using cooling load calculations.	**PO5**
CO4	Estimate air conditioning system parameters and demonstrate understanding of duct design concepts.	**PO2**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ETME 451A	Refrigeration and Air-conditioning Lab	2	2		3	3								3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETME 481A	**PRACTICAL TRAINING-II**	L	T	P	C
Version 1.0		0	0	0	2
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Objectives

1. To provide an exposure to real life industry environment.
2. To help student learn about the projects.

Course Outcomes

On completion of this course, the students will be able to

CO1. Learn the practical aspects of the mechanical industry.

CO2. Learn to work over projects for the development of students.

Catalog Description

This course complements ETME481A. Minimum of four weeks in industry or appropriate workplace/ academic and research institutions in India/abroad. The summer internship should give exposure to the practical aspects of the discipline. In addition, the student may also work on a specified task or project which may be assigned to him/her. The outcome of the internship should be presented in the form of a report.

Modes of Evaluation: Quiz/Oral practical oral exam/presentation/projects/Practical Examination

Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Projects/ etc.	End Term Exam
Weightage (%)	**10**	**10**	**20**	**10**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and Pos		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	To Learn the practical aspects of the mechanical industry.	**PO1**
CO2	To Learn to work over projects for the development of students.	**PO4**

Course Code	Course Title	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ETME481 A	Practical Training-II	2	2		3	3								3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETME453A	MEASUREMENT AND METROLOGY LAB	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Basics of measuring instruments				
Co-requisites	--				

Course Objectives:

The subject expects students to achieve the following objectives.

1. Inspection of engineering parts with various precision instruments.
2. Design of part, tolerances, and fits.
3. Principles of measuring instruments and gauges and their uses
4. Evaluation and inspection of surface roughness. 5. Inspection of spur gear and thread elements.
5. Machine tool testing to evaluate machine tool quality.

Course Outcomes:

Upon the completion of this course the students will be able to:

CO1.Explain the basics of standards of measurement, limits, fits & tolerances industrial applications.

CO2.Identify the uses of gauges and comparators Identify the uses of gauges and comparators.

CO3.Understand the significance of measurement system, errors, transducers, intermediate modifying and terminating devices.

CO4.Interpret measurement of field variables like force, torque, and pressure.

Catalog Description

This course gives introductory knowledge about accuracy, precision, limits fits and tolerance and different comparators. It also enhances the students thinking capability to calculate the height length and width of the components using various comparators. This course is also helping students to answer fundamental questions about Metrology and Measurement at the time of the interview.

List of Experiments (Indicative)

1	Use of Comparators (Mechanical, Opto-Mechanical & Electrical (LVDT)),	**2 lab hours**
2	Projectors (Profile & Tool Maker's Microscope),	**2 lab hours**
3	Angular Measurements using Combination Set,	**2 lab hours**
4	Bevel Protector & Sine Bar,	**2 lab hours**

5	Linear Measurements using Vernier Caliper (Depth Caliper, Height Gauge) and Micrometers (Outside, Inside Rod type, Inside Jaw type & Point / Ball Micrometer), Radius Measurement using Radius Gauge & Profile Projector,	**2 lab hours**
6	Inside Diameter Measurement using Bore Gauge,	**2 lab hours**
7	Measurement of Pitch Diameter of External Threads,	**2 lab hours**
8	Use of Plug & Ring Gauges, Snap Gauge (Fixed & Adjustable both),	**3 lab hours**
9	Working Principle of a Pneumatic Air Gauge,	**2 lab hours**
10	Use of Slip Gauges of various types and their Setup,	**2 lab hours**
11	Gauge Repeatability & Reproducibility Study using the $\bar{X} - R$ Method,	**2 lab hours**
12	Measurement of Surface Roughness parameters such as R_a, R_t and R_z.	**2 lab hours**

Modes of Evaluation: Quiz/Oral practical oral exam/presentation/projects/Practical Examination

Examination Scheme:

Components	**Quiz**	**Attendance**	**Mid Term Exam**	**Presentation/ Projects/ etc.**	**End Term Exam**
Weightage (%)	**10**	**10**	**20**	**10**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Explain the basics of standards of measurement, limits, fits & tolerances industrial applications.	**PO1**
CO2	Identify the uses of gauges and comparators Identify the uses of gauges and comparators.	**PO4**
CO3	Understand the significance of measurement system, errors, transducers, intermediate modifying and terminating devices.	**PO5**

CO4	Interpret measurement of field variables like force, torque and pressure.	**PO2**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ETME453 A	Measurement and Metrology Lab	2	2		3	3								3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

ETME 455A	**PROJECT**	L	T	P	C
Version 1.0		0	0	0	6
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

5. To make student innovative through the hands on / fabrication and practically sound.
6. Demonstrate a sound technical knowledge of their selected project topic.
7. Undertake problem identification, formulation and solution.
8. Conduct an engineering project

Course Outcomes

On completion of this course, the students will be able to

CO1. Undertake problem identification, formulation and solution.
C02. Design solutions to complex problems utilising a system approach.
CO3. Demonstrate the knowledge, skills and attitudes of a professional engineer
CO4. Communicate with engineers and the community at large in written an oral forms

Modes of Evaluation: Quiz/Oral practical oral exam/presentation/projects/Practical Examination

Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Projects/ etc.	End Term Exam
Weightage (%)	10	10	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Demonstrate a sound technical knowledge of their selected project topic	**PO1**
CO2	Undertake problem identification, formulation and solution.	**PO4**
CO3	Design engineering solutions to complex problems utilising a systems approach.	**PO5**
CO4	Demonstrate the knowledge, skills and attitudes of a professional engineer	**PO2**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
ETME 455 A	Project	2	2		3	3										

1=weakly mapped
2= moderately mapped
3=strongly mapped

SEMESTER VIII

ETME 452A	**INTERNSHIP**	L	T	P	C
Version 1.0		0	0	0	12
Pre-requisites/Exposure	Basics of Mechanical Engineering.				
Co-requisites	--				

Course Objectives:

1. To provide an exposure to real life industry environment.
2. To help student learn about the projects.
3. To enhance students' knowledge in one particular technology.
4. To Increase self-confidence of students and helps in finding their own proficiency.
5. To cultivate student's leadership ability and responsibility to perform or execute the given task.
6. To provide learners hands on practice within a real job situation.

Course Outcomes:

On completion of this course, the students will be able to

CO1. Learn the practical aspects of the mechanical industry.
CO2. Learn to work over projects for the development of students.
CO3. Become updated with all the latest changes in technological world.
CO4. Ability to communicate efficiently.
CO5. Knack to be a multi-skilled engineer with good technical knowledge, management, leadership and entrepreneurship skills.
CO6. Capability to acquire and apply fundamental principles of engineering.

Catalog Description:

Minimum of six months Internship in industry or appropriate workplace/ academic and research institutions in India/abroad. The internship should give exposure to the practical aspects of the discipline. The outcome of the internship should be presented in the form of a report.

Modes of Evaluation: Quiz/Oral practical oral exam/presentation/projects/Practical Examination

Examination Scheme:

Components	Quiz	Attendance	Mid Term Exam	Presentation/ Projects/ etc.	End Term Exam
Weightage (%)	**10**	**10**	**20**	**10**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and Pos		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Learn the practical aspects of the Mechanical industry.	**PO1**
CO2	Learn to work over projects for the development of students.	**PO2**
CO3	Become updated with all the latest changes in technological world.	**PO4**
CO4	Ability to communicate efficiently.	**PO5**
CO5	Knack to be a multi-skilled engineer with good technical knowledge,	**PO10**
CO6	management, leadership and entrepreneurship skills.	**PSO01**

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PS O1	PS O2	PS O3
ETME452 A	Internship	2	2		3	3					2			3		

1=weakly mapped
2= moderately mapped
3=strongly mapped