K.R. MANGALAM UNIVERSITY
THE COMPLETE WORLD OF EDUCATION

SCHOOL OF ENGINEERING AND TECHNOLOGY

BACHELOR OF TECHNOLOGY
B.TECH (MECHANICAL ENGINEERING)
B.TECH (ME)
PROGRAM CODE: 02

2020-24

Approved in the 23rd

Meeting of Academic

Council Held on 23 June

2020

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

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PREFACE

The Academic Council in consultation with Deans, Faculty Members, Industry Experts and University Alumni constituted department 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. It is important to lower the credits to 160 across all departments to lower the burden of syllabi and credits.

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 this 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 revised 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

This program prepares the students for conceptualization, design, manufacturing, and testing of a wide range of machines, materials, including automobiles, power plants, structures etc. it also trains the students in the area of Mechatronics, Automation, advanced manufacturing technology, renewable/alternate energy sources, engines for rockets and airplanes, ships, computer integrated manufacturing, CAD/CAM, apart from refrigeration and air conditioning systems, etc. An initiative to make the teaching-learning framework better and enhance the student learning outcomes, 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.

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.

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: **A**erospace Industry, Nuclear power plant, Automotive industry, All government psu's, Indian Defense service.

Program 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 and the syllabus (Unit I to IV), Text book and reference books and modes of evaluation/examination scheme.

Four Years B. Tech Mechanical Engineering Program at a Glance

Semester	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Total**
Courses	9	9	10	9	11	9	9	4	70
Credits	26	25	24	23	21	23	21	15	178

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

Year	**SNo**		**Subject Code**	**Title**	**L**	**T**	**P**	**C**
FIRST								
	1	SE	ETMA105A	Applied Mathematics-I	3	1	-	4
	2	SE	ETPH109A	Engineering Physics	3	1	-	4

	3	SE	ETCH 125A	Environmental Studies	3	-	-	3
	4	SE	ETCS103A	Programming for Problem Solving	3	1	-	4
	5	CC	ETME101A	Basics of Mechanical Engineering	3	1	-	4
	6	OE		Open Elective-I	4	-	-	4
	7	SE	ETPH151A	Engineering Physics Lab	-	-	2	1
	8	SE	ETCS153A	Programming for Problem Solving Lab	-	-	2	1
	9	CC	ETME151A	Basics of Mechanical Engineering Lab	-	-	2	1
					21	**4**	**6**	**26**

SNo		**Subject Code**	**Title**	**L**	**T**	**P**	**C**
1	SE	ETMA104A	Applied Mathematics-II	3	1	-	4
2	SE	ETEC101A	Basics of Electrical & Electronics Engineering	3	1	-	4
3	SE	ETCH119A	Engineering Chemistry	3	1	-	4
4	SE	ETEL145A	Communication Skills	4	-	-	4
5	OE		Open Elective-II	4	-	-	4
6	CC	ETME 155A	Engineering Graphics Lab	-	-	3	1.5
7	SE	ETEC151A	Basics of Electrical & Electronics Engineering Lab	-	-	2	1
8	SE	ETCH159A	Engineering Chemistry Lab	-	-	2	1
9	CC	ETME 157A	Workshop Practices	-	-	3	1.5
				19	**3**	**10**	**25**

SECOND								
	1	SE	ETMA201A	Applied Mathematics-III	3	1	-	4
	2	CC	ETME 205A	Thermodynamics	3	1	-	4
	3	CC	ETME 207A	Strength of Materials	3	-	-	3
	4	CC	ETME 209A	Fluid Mechanics	3	-	-	3
	5	CC	ETME 211A	Material Science & Metallurgy	3	-	-	3
	6	SE	ETCE101A	Disaster Management	3	-	-	3
	7	CC	ETME 257A	Computer Aided Machine Drawing Lab	-	-	2	1
	8	CC	ETME 259A	Project Simulation Lab Using Solid Works/Ansys/Matlab-1	-	-	2	1
	9	CC	ETME 253A	Strenghth of Materials Lab	-	-	2	1
	10	CC	ETME 255A	Fluid Mechanics Lab	-	-	2	1
					18	**2**	**8**	**24**

1	CC	ETME 222A	Manufacturing Process	3	-	-	3
2	CC	ETME 210A	Fluid Machines	2	1	-	3
3	CC	ETME 224A	Energy Conversion	3	-	-	3
4	CC	ETME 220A	Engineering Mechanics	3	1	-	4
5	SE	ETMC 226A	Fundamentals of Management	3	-	-	3
6	CC	ETME 226A	Theory of Machines	3	1	-	4
7	CC	ETME 252A	Fluid Machines Lab	-	-	2	1
8	CC	ETME 258A	Theory of Machines Lab	-	-	2	1
9	SE	ETME 260A	Seminar-I	-	-	2	1
				17	**3**	**6**	**23**

THIRD								
	1	CC	ETME 309A	Manufacturing Technology	3	-	-	3
	2	CC	ETME 311A	Internal Combustion Engine & Gas Turbines	3	-	-	3
	3	CC	ETME 307A	Computer Aided Design	3	-	-	3
	4	SE	ETMC 421A	Entrepreneurship	3	-	-	3
	5	CC	ETME 315A	Design of Machine Elements	3	1	-	4
	6	SE	ETME 381A	Practical Training-I	-	-	-	1
	7	CC	ETME 361A	Project Simulation Lab Using Solid Works/Ansys/Matlab-II	-	-	2	1
	8	CC	ETME 357A	Manufacturing Technology Lab	-	-	2	1
	9	CC	ETME 355A	Internal Combustion Engine & Gas Turbines Lab	-	-	2	1
	10	CC	ETME 353A	Computer Aided Design Lab	-	-	2	1
					17	**1**	**8**	**21**

1	CC	ETME 302A	Heat Transfer	3	1	-	4
2	CC	ETME 306A	Robotics & Automation	3	-	-	3
3	CC	ETME 320A	Automobile Engineering	3	-	-	3
4	CC	ETEC 308A	Instrumentation And Control Systems	3	-	-	3
5	CC	ETME 312A	Non Conventional Energy Resources(PEC)	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	ETME 358A	Seminar-II	-	-	2	1
				15	**1**	**8**	**20**

FOURTH								
	1	CC	ETME 401A	Refrigeration And Air-Conditioning	3	-	-	3
	2	CC	ETMA 403A	Operations Research	3	-	-	3
	3	CC	ETME 405A	Power Plant Engineering (PEC)	3	-	-	3
	4	CC	ETME 417A	Solar Energy (PEC)	3	-	-	3
	5	CC	ETME 409A	Measurement & Metrology	3	-	-	3
	6	SE	ETME 481A	Practical Training-II	-	-	-	2
	7	SE	ETME 457A	Minor Project	-	-	-	2
	8	CC	ETME 451A	Refrigeration And Air-Conditioning Lab	-	-	2	1
	9	CC	ETME 453A	Measurement & Metrology Lab	-	-	2	1
					15	**0**	**4**	**21**

1	CC	ETME 402A	Mechanical Vibrations (PEC)	3	-	-	3
2	CC	ETME 404A	Additive Manufacturing (PEC)	3	-	-	3
3	CC	ETME 412A	Industrial Engineering	3	-	-	3
4	SE	ETME 454A	Major Project	-	-	-	6
				9	**0**	**0**	**15**

OE	OPEN ELECTIVE
CC	CORE COURSE
SE	SKILL ENHANCEMENT

DE	DEPARTMENT ELECTIVE

		SEMESTER I		

ETMA105A	**APPLIED MATHEMATICS - I**	**C** **4**

Course Overview:

This course shows the modelling process in the context of matrix, and differential calculus, from a number of areas such as, economics, electric circuits, mechanical systems, fluid flow, and physics. Analytic methods from the elementary theory of differential equations and calculus will be provided to allow for the analysis of the various models being investigated.

Topics to be covered include: Matrices and their types: 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), Diagonalization of a matrix.

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, Maxima and Minima.

Partial Differentiation: Partial differentiation, Euler's theorem on homogeneous functions, Composite functions, Jacobians, Taylor's theorem of two variables and its application to approximate errors, Maxima-Minima for two variables, Lagrange’s method of undermined multipliers.

B.TECH (ME)

K.R Mangalam University, Gurugram

Scheme of Studies 2020

Multiple Integration: Beta and Gamma integrals, Differentiation under integral sign, Double and Triple integrals computation of surface areas and volumes, change of variables in double and triple integrals.

Objectives and expected outcomes:

Upon successful completion, students will have the knowledge and skills to:

1. Explain the fundamental concepts of matrix and differential calculus and their role in modern applied mathematics and real-world contexts.
2. Demonstrate accurate and efficient use of techniques involved in solving partial differentiation.
3. Apply problem-solving using techniques in differential calculus in diverse situations in physics, engineering and other mathematical contexts.
4. Student will able to solve improper integrals and evaluate multiple integrals in various coordinate systems.

		L	T	P	C
ETMA105A	**APPLIED MATHEMATICS - I**	**3**	**1**	**0**	**4**

UNIT I

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), Diagonalization of a matrix.

UNIT II

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

Calculus of several Variables: Partial differentiation, Euler's theorem on homogeneous functions, Composite functions, Jacobians, Taylor's theorem of two variables and its application to approximate errors, Maxima-Minima for two variables, Lagrange's method of undermined multipliers.

ETPH109A	**ENGINEERING PHYSICS**	**C** **4**

Course Overview:

Oscillations play an important role in the macro- and micro-world. Oscillation cannot be just mechanical. So, for instance, one can consider the oscillations of an electric current in an oscillatory circuit or a magnetic field strength in a dynamo, etc. These can be described by an equation similar to the one that defines mechanical displacements from a position of equilibrium. In spite of this fact, mechanical oscillations are mostly analyzed, keeping in mind their applicability to other types of oscillation. Oscillations originating from any source propagate further in space. The propagating oscillations are referred to as waves. Different waves exist,

such as mechanical, electromagnetic, and acoustic, depending on what physical value is propagated. Mechanical waves can propagate only in an elastic media. If particle vibrations are agitated in a region of an elastic medium (solid, liquid or gaseous), as a consequence of the interaction among particles, this disturbance is transmitted to surrounding particles, which in turn, distributes excitation further. In this manner, the wave appears.

The physics and mathematics of wave motion underlie many important phenomena. The water wave on the sea, the vibration of a violin string, and the quantum mechanical wave associated with an electron can all be described in a similar way. Light too, often displays properties that are wave-like. We will start the course looking at "ray" optics, but then pause for a general treatment of waves of all types. We will start this waves section by reviewing ideas of oscillations and simple harmonic motion, and go on to look at the physics of travelling and standing waves i.e wave motion. We will apply these ideas to various types of wave, and see how all-pervading this topic is in physics.

Optics is the study of light and its uses. Light has long captured the fascination of humankind like Why should light bend upon entering water? Why does light spread out after passing through a narrow gap? How does light travel to us from the sun, through the void of space? These sorts of questions have ensured that optics has a long and engaging history. So in this lecture course we will look at basic ideas of light propagation, interference and diffraction of light, Polarization, and some of the many uses to which light is put.

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Objective and Expected Outcome:

The main objective of this subject is to aware the students about various phenomenon of oscillation, waves and optics. This course first deal with the simple harmonic motion, damped and forced simple harmonic oscillator. It deals with the Non-dispersive transverse and longitudinal waves in one dimension and introduction to dispersion. This course also deals with the propagation of light and geometric optics, wave optics and lasers.

After the completion of the course, Students will be able to understand the physics behind various phenomenon’s in oscillation, waves and optics. Students can understand various phenomenon and the cause or origin of them. They also can understand the physics behind various optical phenomenon’s and various natural phenomenon which is happening in their surroundings.

ETPH109A	ENGINEERING PHYSICS	L	T	P	C
		3	1	0	4

UNIT-I:

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.

Mechanical and electrical simple harmonic oscillators damped harmonic oscillator – heavy,

critical and light damping, energy decay in a damped harmonic oscillator, quality factor.

Mechanical and electrical simple harmonic oscillators damped harmonic oscillator – heavy,

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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:

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:

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, Farunhofer 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:

Lasers

Amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO2), 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

(i) Ian G. Main, Oscillations and waves in physics

(ii) H.J. Pain, The physics of vibrations and waves (iii)E. Hecht, Optics

(iv) A. Ghatak, Optics

(v) O. Svelto, Principles of Lasers

ETCH 125A	**ENVIRONMENTAL STUDIES**	**C**
		3

Course Overview:

Everything that surrounds and affects living organisms is environment. Environment includes all those things on which we are directly or indirectly dependent for our survival, whether it is living or biotic components like animals, plants or non-living or abiotic components like soil, air and water etc. It belongs to all, influences all and is important to all.

Environmental Protection Act (1986) defined “Environment as the sum total of water, air and land, their interrelationship among themselves and with the human beings, other living organisms and materials.” Environmental studies are important since it deals with the most mundane problems of life like hygienic living conditions, safe and clean drinking water, fresh air, healthy food and sustainable development.

The syllabus for Environmental Studies includes conventional classroom teaching as well as field work. In this course the teacher simply acts as a catalyst to infer what the student observes or discovers in his/her own environment. Involvement of students in project work is one of the most effective learning tools for environmental issues. This syllabus is beyond the scope of textbook teaching and also the realm of real learning by observing the surroundings. The content of this course provides an overview of introduction to environment, concept of an ecosystem, various renewable and non-renewable resources, how various biodiversity occur and different means to conserve these. This course also includes various types of pollution and environmental policies & practices related with environs. Finally, it also highlights the relationship of human population with environment. The course further integrates to project work such as visit to an area to document environmental assets river/ forest/ grassland/ hill/ mountain, visit to a local polluted site-Urban/Rural/Industrial/Agricultural, study of common plants, insects, birds, and study of simple ecosystems. These studies are as imperative as it forms a unique synergistic tool for comprehensive learning process. This will help students to recognize and appreciate how the technological advancement at global level, exponential growth of human population and their unlimited demands has put the environment at stake and has contaminated the environment worldwide.

Objective and expected Outcome:

The main objective of the course is to create consciousness among the students with the idea about healthy and safe environment. This course is aimed to explain students that the rapid

industrialization, crazy consumerism and over-exploitation of natural resources have resulted in degradation of earth at all levels. These changes need the discussion, concern and recognition at national and international level with respect to formulate protection acts and sustainable developments policies. It can be possible only if every citizen of the nation is environmentally educated and gets involved into this matter at the grass root level to mitigate pollution.

After studying the course, the learners will be able to comprehend and become responsive regarding environmental issues. They 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. This is the only inheritance which every genera of specie passes to their future generation.

		L	T	P	C
ETCH 125A	**ENVIRONMENTAL STUDIES**	**3**	**0**	**0**	**3**

UNIT I

Introduction of Environmental Studies: Multidisciplinary nature of environmental studies; Scope and importance; Concept of sustainability and sustainable development.

Natural Resources: Renewable and Non-renewable Resources

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

Ecosystems: 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: Levels of 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

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.

Environmental Policies and practices: 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. International agreements: Montreal & Koyoto protocol and convention on biological diversity. Nature reserves, tribal population and rights, human wild life conflicts in Indian context.

UNIT IV

Human Communities and the Environment: 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, Bishnois 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).

Field work:

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.

TEXT BOOKS:

1. Erach Bharucha, Textbook of Environmental Studies, Universities Press (P) Ltd., Hyderabad, India.
2. Anubha Kaushik and C. P. Kaushik, Environmental Studies, New Age International Publishers (P) Ltd. New Delhi.

REFERENCE BOOKS:

1. A.K. De, Environmental Chemistry, New Age International Publishers (P) Ltd. New Delhi.
2. P. H. Raven, D. M. Hassenzahl & L. R. Berg, Environment, John Wiley & Sons, New Delhi.
3. J. S. Singh, S. P. Singh and S. R. Gupta, Ecology, Environmental Science and Conservation, S. Chand Publication, New Delhi.

ETCS103A	**PROGRAMMING FOR PROBLEM SOLVING**	**C**
		4

Course Overview:

Computer software plays an important role in our daily lives: Our mobile phones, laptop computers, online banking, Internet applications such as YouTube, video games and movies, cars, and almost all aspects of daily life are touched by software. In your personal and professional life, you will utilize computer software. It is also likely that you will select, or even influence the design of, software that is used in your professional or personal life. This thematic sequence will give you a deep understanding of how software works and is created, its limitations, and its potential. You will be able to read software and therefore be able to make informed decisions when selecting or participating in the design of business, scientific, or information systems that utilize computer software. This is a course in which you learn computer programming concepts that are fundamental in nearly any computer programming language. These concepts can then be used in other courses to help you create computer applications that can be used to solve real-world problems

Objectives and Expected Outcomes:

The student will learn

1. To formulate simple algorithms for arithmetic and logical problems.
2. To translate the algorithms to programs (in C language).
3. To test and execute the programs and correct syntax and logical errors.
4. To implement conditional branching, iteration and recursion.
5. To decompose a problem into functions and synthesize a complete program using divide and conquer approach.
6. To use arrays, pointers and structures to formulate algorithms and programs.
7. To apply programming to solve matrix addition and multiplication problems and searching and sorting problems.

8. To apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration.

ETCS103 A	PROGRAMMING FOR PROBLEM SOLVING	L	T	P	C
		3	1	0	4

UNIT I

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 / Pseudocode 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- Arithmetic expressions and precedence

UNIT II

Conditional Branching and Loops, Writing and evaluation of conditionals and consequent branching, Iteration and loops. Arrays: Arrays (1-D, 2-D), Character arrays and Strings

UNIT III

Basic Algorithms: Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)

Function: Functions (including using built in libraries), Parameter passing in functions, call by

value, passing arrays to functions: idea of call by reference.

Recursion: Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function, Quick sort or Merge sort.

UNIT IV

Structure**:** Structures, Defining structures and Array of Structures

Pointers: Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)

Suggested Text Books

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill

	C

ETME 101A	**BASICS OF MECHANICAL ENGINEERING**

4

Course Overview:

This is one of the core subjects that introduces the student 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.

Objectives and expected outcomes:

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

1. To analyse, design and improve practical thermal and/or mechanical systems.
2. To give students practice in applying their knowledge of mathematics, science, and engineering and to expand this knowledge into the vast area of mechanical engineering.
3. To enhance students' ability to design by requiring the solution of open ended problems.
4. To prepare the students for higher level courses such as courses in Mechanics of Solids, Thermodynamics, Manufacturing, etc.

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

1. Know the basics of machine tool and their material properties.
2. Understand the basic concepts of thermodynamics and Refrigeration.
3. Get the knowledge of application of hydraulic turbines and pumps in various fields.
4. Know various Power Transmission Methods and Devices.

5. Understand the concept of Stress & Strain which is useful in various streams of engineering.

		L	T	P	C
ETME 101A	**BASICS OF MECHANICAL ENGINEERING**	**3**	**1**	**0**	**4**

UNIT I

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

Basic concept of thermodynamics: Introduction, States, Work, Heat, Temperature, Zeroth, 1st, 2^{nd} and 3^{rd} law of thermodynamics, Concept of internal energy, enthalpy and entropy. Problems Properties of Steam & Steam Generator Formation of steam at constant pressure, Thermodynamic properties of Steam, Use of steam tables, Measurement of dryness fraction by throttling calorimeter.

UNIT II

Refrigeration & Air-conditioning: Introduction to refrigeration and air -conditioning, Rating of refrigeration machines, Coefficient of performance, Simple refrigeration vapor compression cycle, Psychrometric charts and its use, Human comforts.

Hydraulic Turbines & Pumps: Introduction, Classification, Construction details and working of Pelton, Francis and Kaplan turbines, Specific speed and selection of turbines, Classification of water pumps and their working.

UNIT III

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, stresses and strains in simple and compound bars under axial, flexure & torsional loading, Stress-strain diagrams, Hooks law, Elastic constants & their relationships.

UNIT IV

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

Text Books:

1. Elements of Mechanical Engineering – R.K.Rajput Lakmi 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:

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.

OPEN ELECTIVE – I

There are three open electives offered by other departments / schools in first SEMESTER. The department will permit student to opt one open elective based on choice of student and consent of the course advisor.

ETPH 151A	**ENGINEERING PHYSICS LAB**	**C** **1**

Course Overview:

This course gives an experimental understanding of the different phenomena of oscillation, waves and optics which students have encountered in theory course. Without experimental understanding it is very difficult to realize the theoretical concepts. This course contains experiments of oscillation, waves and optics.

Objective and Expected Outcome:

The objective of this course is to make students more familiar with the concepts of various phenomenons of oscillation, waves and optics through hands on experience. After this course students can gain knowledge about how we can find the value of acceleration due to gravity, wave length of a give source of light, refractive index of material of a given prism and specific rotation by the concept of polarization of light.

ETPH 151A	**ENGINEERING PHYSICS LAB**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

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.

Suggested Reference Books

- 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).
- Indu Prakash, Ramakrishna, A Text Book of Practical Physics (Kitab Mahal, New Delhi).

ETCS153A	**PROGRAMMING FOR PROBLEM SOLVING LAB**	**C** **1**

Course Overview:

This course emphasizes solving problems using the language, and introduces standard programming techniques like alternation, iteration and recursion. It will briefly glimpse the basics of software engineering practices like modularization, commenting, and naming conventions which help in collaborating and programming in teams. This course is enabled the students to formulate algorithms for arithmetic and logical problems, convert these algorithms to C language programs. It also aims on using arrays, pointers and structures to formulate algorithms and programs. In addition to that, apply programming to solve matrix addition and multiplication problems and searching and sorting problems.

Objectives and Expected Outcomes:

At the end of the course, the students should be able to:

- To understand the various steps in program development
- To learn the syntax and semantics of C programming language
- To use the structural programming approach in solving the problem.

ETCS153A	**PROGRAMMING FOR PROBLEM SOLVING**	**L**	**T**	**P**	**C**
	LAB	**0**	**0**	**2**	**1**

LIST OF EXPERIMENTS

Lab1: Familiarization with programming environment

Lab 2: Simple computational problems using arithmetic expressions

Lab 3: Problems involving if-then-else structures

Lab 4: Iterative problems e.g., sum of series

Lab 5: 1D Array manipulation

Lab 6: Matrix problems, String operations

Lab 7: Simple functions

Lab 8 and 9: Programming for solving Numerical methods problems

Lab 10: Recursive functions

Lab 11: Pointers and structures

Lab 12: File operations

C

ETME 151A

1

BASICS OF MECHANICAL ENGINEERING LAB

Course Overview:

This is one of the core lab subjects that introduces the student 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.

Objective and Expected Outcome:

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, Aluminum) 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.
7. To study the constructional features and working of Pelton wheel Turbine, Francis Turbine and Kaplan Turbine, etc.

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

1. Understand the Mechanical Advantage, Velocity Ratio and Efficiency of various systems.
2. Understand concepts of screw jack, friction, law of moments.
3. Understand the Two-Stroke & Four-Stroke Diesel Engines and Petrol Engines.
4. Get the knowledge of various Refrigeration and Air- Conditioning Systems.
5. Know about the working of various turbines and pumps.

ETME 151A	**BASICS OF MECHANICAL ENGINEERING**	**L**	**T**	**P**	**C**
	LAB	**0**	**0**	**2**	**1**

LIST OF EXPERIMENTS

1. To verify the law of Force Polygon
2. To verify the law of Moments using Parallel Force apparatus. (simply supported type)
3. To determine the co-efficient of friction between wood and various surface (like Leather, Wood, Aluminum) on an inclined plane.

4. To find the forces in the members of Jib Crane.
5. To determine the mechanical advantage, Velocity ratio and efficiency of a screw jack.
6. To determine the mechanical advantage, Velocity ratio and Mechanical efficiency of the Wheel and Axle
7. To verify the law of moments using Bell crank lever.
8. To calculate the Mechanical Advantage, Velocity Ratio and Efficiency of Single Start, Double Start and Triple Start Worm & Worm Wheel.
9. To Study Two-Stroke & Four-Stroke Diesel Engines.
10. To Study Two-Stroke & Four-Stroke Petrol Engines.
11. To Study the vapor compression Refrigeration System.

SEMESTER - II

ETCS112A	**OBJECT ORIENTED PROGRAMMING**	**C**
		4

Course Overview:

This course introduces the concepts of object-oriented programming to students with a background in the procedural paradigm. The course begins with a brief review of control structures and data types with emphasis on structured data types and array processing. It then moves on to introduce the object-oriented programming paradigm, focusing on the definition and use of classes along with the fundamentals of object-oriented design. Other topics include an overview of programming language principles, simple analysis of algorithms, basic searching and sorting techniques, event-driven programming, memory management and an introduction to software engineering issues.

Objectives and Expected Outcomes:

At the end of the course, the students should be able to:

1. Explain the steps in creating an executable program for a computer, including the intermediate representations and their purpose.
2. Manipulate binary patterns and understand the use of binary to represent numbers.

3. Apply good programming style and understand the impact of style on developing and maintaining programs.
4. Effectively use a version control system and the Linux command line tools for incremental development.
5. Explain the benefits of object-oriented design and understand when it is an appropriate methodology to use.
6. Design object-oriented solutions for small systems involving multiple objects.
7. Identify the relative merits of different algorithmic designs.

		L	T	P	C
ETCS112A	**OBJECT ORIENTED PROGRAMMING**	**3**	**1**	**0**	**4**

UNIT I

Introduction: Introducing Object-Oriented Approach related to other paradigms (functional, data decomposition), Characteristics of Object-Oriented Languages.

Basic terms and ideas: Abstraction, Encapsulation, Information hiding, Inheritance, Polymorphism, Review of C, Difference between C and C++, Cin, Cout, new, delete operators.

UNIT II

Classes and Objects: Abstract data types, Object & classes, attributes, methods, C++ class declaration, State identity and behavior of an object, Constructors and destructors, instantiation of objects, Default parameter value, Copy Constructor, Static Class Data, Constant Classes, C++ garbage collection, dynamic memory allocation.

UNIT III

Inheritance and Polymorphism: Inheritance, Types of Inheritance, Class hierarchy, derivation

– public, private & protected, Agrégations, composition vs classification hiérarchies, Polymorphism, Type of Polymorphism – Compile time and runtime, Method polymorphism, Polymorphism by parameter, Operator overloading, Parametric polymorphism, Generic function

– template function, function name overloading, Overriding inheritance methods

UNIT IV

Files and Exception Handling: Persistent objects, Streams and files, Namespaces, Exception

handling, Generic Classes

Standard Template Library: Standard Template Library, Overview of Standard Template Library, Containers, Algorithms, Iterates, Other STL Elements, The Container Classes, General Theory of Operation, Vectors.

TEXT BOOKS:

1. A.R. Venugopal, Rajjkumar, T. Ravishanker “Mastering C++”, TMH

2. R. Lafore, “Object Oriented Programming using C++”, BPB Publications

3. Schildt Herbert, “C++ Programming”, 2nd Edition, Wiley DreamTech.

REFERENCE BOOKS:

1. D. Parasons, “Object Oriented Programming with C++”, BPB Publication
2. Steven C. Lawlor, “The Art of Programming Computer Science with C++”, Vikas Publication
3. Yashwant Kanethkar, “Object Oriented Programming using C++”, BPB

ETEC101A	**BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING**	**C** **4**

Course Overview:

The course is designed to gain the essential knowledge about electrical circuit elements, DC circuits, AC circuits, magnetism, transformers and electrical machines. The undergraduates are familiarized with the basics of installations required for the protection and wiring. The fundamentals of power converters are part of the course.

Learning objectives:

- To understand the circuit behavior on the DC supply
- To analyze the complex circuits using various theorems to resolve it to a simple circuit.
- To understand the circuit behavior on the AC supply
- Analysis of single-phase ac circuits consisting of combinations(series and parallel) elements
- Working and application of transformer
- To analyze the behavior of electrical machines for the losses, efficiency and other parameters.
- To gain basic insight of inverters and boost converters.
- To get acquainted with components of low voltage switchgear

Expected Outcome:

- To understand and analyze basic electric and magnetic circuits
- To study the working principles of electrical machines and power converters.
- To introduce the components of low voltage electrical installations

ETEC101A	**BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING**	**L**	**T**	**P**	**C**
.	.	**3**	**1**	**0**	**4**

UNIT I

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

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

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 Life Time, Continuity Equation.

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

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.

TEXT BOOKS:

1. D.P. Kothari & I J Nagrath , Basic Electrical Engineering , Tata McGraw Hill , New Delhi.

2. B L Thareja – A text book 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

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

ETMA104A	**APPLIED MATHEMATICS - II**	**C** **4**

Course Overview:

The construction of mathematical models to address real-world problems has been one of the most important aspects of each of the branches of engineering and technology. This course is an introduction to Laplace Transformation, vector calculus, ordinary differential equations and Partial Differential Equations.

Topics includes:

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.

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).

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.

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.

Objectives and expected outcomes:

Upon successful completion, students will have the knowledge and skills to:

1. Concepts & properties of Laplace Transforms
2. Solving differential equations using Laplace transform techniques
3. Determine the solution of a PDE by variable separable method

4. Analyze real world scenarios to recognize when ordinary differential equations (ODEs) or systems of ODEs are appropriate, formulate problems about the scenarios, creatively model these scenarios (using technology, if appropriate) in order to solve the problems using multiple approaches, judge if the results are reasonable, and then interpret and clearly communicate the results.
5. Identify an ordinary differential equation and classify it by order or linearity
6. Determine whether or not a unique solution to a first-order initial-value problem exists

		L	T	P	C
ETMA104A	**APPLIED MATHEMATICS - II**	**3**	**1**	**0**	**4**

UNIT I

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

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

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

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.

REFERENCES BOOKS:

1. B.S.Grewal, " Higher Engineering Mathematics", Khanna Publishers.

2. H.K. Dass, "Advanced Engineering Mathematics", S. Chand & Company.

ETEL101A	**COMMUNICATION SKILLS**	**C** **4**

Course Overview:

The world is shrinking into a global village and therefore, communication skills in English have emerged as a major means of empowerment and human resource development. Many professionals fail to make an impact on the global market as they lack the required communicative competence. The course will augment comprehension skills, enhance vocabulary, and enable to acquire impressive writing skills, assist correspondence with others effectively, aid in understanding the non-verbal cues and enrich skills in spoken English through a variety of teaching techniques. The course will be instrumental in acquiring proficiency both in spoken and oral language.

Objectives and Expected Outcomes

The course will help the learners to focus on communication activities in functional and situational contexts as well as enhance the four language skills of reading, writing, listening and

speaking through real-life and professional situations. It will build confidence among the students and encourage them to speak fluently. Through practical learning and delivery, the learners will be able to identify their areas of strengths and weaknesses and improvise their personality and soft skills. The learners will be able to strengthen and broaden their communication skills through various insightful ways.

This learning program with its practice-based learning tasks will facilitate the learners to enhance their communication skills in a modern and globalized context, enhance their linguistic and communicative competence and hone their interpersonal skills.

ETEL101A	COMMUNICATION SKILLS	L	T	P	C
		4	0	0	4

UNIT I

Introduction to Communication: Meaning, Forms & Types of Communication; Process of Communication; Principles of Effective Communication/7Cs, Barriers in Communication; Literature: A Bird Came Down the Walk by Emily Dickinson

UNIT II

Essentials of Grammar: Parts of Speech: Noun, Pronoun, Adjective, Verb, Adverb, Preposition, Conjunction, Interjection; Using tenses; Articles; Types of sentences; Reported Speech; Punctuation; Literature: Stopping by Woods on A Snowy Evening by Robert Frost

UNIT III

Building Vocabulary: Word Formation (by adding suffixes and prefixes); Common Errors; Words Often Confused; One word substitution, Homonyms and Homophones; Antonyms &Synonyms, Phrasal Verbs, Idioms & Proverbs (25 each); Commonly used foreign words(15 in number); Literature: The Gift of Magi by O'Henry

UNIT IV

Personality Development: Etiquette & Manners; Leadership; Inter & intra personal skills;

Attitude, Self-esteem & Self-reliance; Public Speaking; Body Language: Posture, Gesture, Eye Contact, Facial Expressions; Presentation Skills/ Techniques; Literature: My Prayer to Thee by Rabindranath Tagore;

TEXT BOOK:

Kumar, Sanjay and Pushplata. Communication Skills. Oxford University Press.

REFERENCE BOOKS / SITES:

1. Tickoo, M.L, Subramanian A. E. and Subramaniam P.R. Intermediate Grammar, Usage and Composition. Orient Blackswan.

2. Mitra, Barun K. Personality Development and Soft Skills. Oxford University Press.

3. “Best Poems”, http://100.best-poems.net/. 20 July 2016.

4. “Classic English Short Stories”, http://www.eastoftheweb.com/short-stories/Collections/ClasEngl.shtml, 20 July 2016.

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C

OPEN ELECTIVE - II

6

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There are three open electives offered by other departments / schools in second SEMESTER. The department will permit student to opt one open elective based on choice of student and consent of the course advisor.

		L	T	P	C
ETEL 171A	**COMMUNICATION SKILLS LAB**	**0**	**0**	**2**	**1**

Communication Skills Lab Activity

Activity 1: Self- introduction: Informal introduction & formal introduction; A detailed write up on formal 'Self Introduction'; Formal Introduction of oneself in front of the group.

Activity 2: News Reading: Introduction to 'online News papers'; Browsing and selecting the preferred Newspaper; Browsing through the News Headlines; Selecting interested News items; Comprehending the content, writing down the essence and reading the News in front of the Group. Discuss 5 to 8 new words or terms, 4 to 5 important personalities of that day's news etc.

Activity 3: JAM: Introduction to 'Just A Minute speech' and the 'Extempore speech'; Preparation of speech on given topic(different topic for each student); delivery of the speech;

Feedback(on content, time management, body language etc. highlighting the positive aspects first.)

Activity 4: News Discussions: Selecting News of the day, Discussing among the group, prepare the news content and prepare the group opinion about the issue and present it in front of the class by the group involving each member; select 5 new words & new usages from the selected news item

Activity 5: Conversation ability: Characteristics of effective conversation; Listening to a few sample conversations; preparing conversation based on the given situation; enacting the situation through effective delivery of the script; feedback & suggestions for improvement.

Activity 6: Role Play: Characteristics of Role Play; assigning roles; developing the content to deliver; enacting the role with effective delivery; feedback & suggestions for improvement.

Activity 7: Public Speaking: Characteristics of effective Public speaking; possible barriers; watching demo online; topic assignment, information gathering & recording; delivery in front of the class; feedback & suggestions for improvement. . (Different topic for each student)

Activity 8: Group Discussion: Importance and characteristics; Dos & Don'ts in GD; Demo display; assign topic for the group, Preparation & performance; feedback & suggestions for improvement.

Activity 9: Debate: Difference between Group Discussion & Debating; Watching demo of Debating; Topic for the group of 2 or 4; preparation and performance; feedback & suggestions for improvement.

Activity 10: .**Interview:** Importance & purpose of Job Interview; Interview etiquettes; Watch demo interview; Appear for formal mock interview; feedback & suggestions for improvement.

ETEC151A	**BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING LAB**	**C**
		1

Course Overview:

The course is designed to gain the essential knowledge about electrical circuit elements, DC circuits, AC circuits, magnetism, transformers and electrical machines. The undergraduates are familiarized with the basics of installations required for the protection and wiring. The fundamentals of power converters are part of the course.

Learning objectives:

- To understand the circuit behavior on the DC supply
- To analyze the complex circuits using various theorems to resolve it to a simple circuit.

- To understand the circuit behavior on the AC supply
- Analysis of single-phase ac circuits consisting of combinations(series and parallel) elements
- Working and application of transformer
- To analyze the behavior of electrical machines for the losses, efficiency and other parameters.

Laboratory Outcomes:

The students are expected to

- Get an exposure to common electrical components and their ratings.
- Make electrical connections by wires of appropriate ratings.
- Understand the usage of common electrical measuring instruments.
- Understand the basic characteristics of transformers and electrical machines.

ETEC151A	BASICS OF ELECTRICAL & ELECTRONICS	L	T	P	C
	ENGINEERING LAB	0	0	2	1

LIST OF EXPERIMENTS

1. To get familiar with the working knowledge of the following instruments:

a) Cathode ray oscilloscope (CRO)

b) Multimeter (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.

C

ETCS166A **OBJECT ORIENTED PROGRAMMING LAB**

1

Course Overview:

This course will give the learner an insight into how everything can be considered an object and how simply we can write code to implement it. It helps us in making programming relatable to real world, as everything around us can be an object (having properties and functionality)

Object-oriented programming aims to implement real world entities like inheritance, hiding, polymorphism etc in programming. The main aim of OOP is to bind together the data and the functions that operate on them so that no other part of code can access this data except that function.

Objective and Expected Outcome:

Students, who have already studied Structural programming like C, would understand how Object-oriented programming would help them in coding in a simpler and better way. For instance, a user of the program should only know what the input is and what is the output, he should not be concerned about the process. The programmer implements the concept through abstraction and information hiding, which are important features of object-oriented programming. The course would help students achieve the following goals:

- Understand fundamentals of programming such as variables, conditional and iterative execution, methods, etc.
- Understand fundamentals of object-oriented programming including defining classes, invoking methods, using class libraries, etc.
- Be aware of the important topics and principles of software development.
- Develop the ability to write a computer program to solve specified problems.

		L	T	P	C
ETCS166A	**OBJECT ORIENTED PROGRAMMING LAB**	**0**	**0**	**2**	**1**

LIST OF EXPERIENTS

Q1. Raising a number n to a power p is the same as multiplying n by itself p times. Write a function called power ( ) that takes a double value for n and an int value for p, and returns the result as double value. Use a default argument of 2 for p, so that if this argument is omitted, the number will be squared. Write a main ( ) function that gets values from the user to test this function.

Q2. A point on the two dimensional plane can be represented by two numbers: an X coordinate and a Y coordinate. For example, (4,5) represents a point 4 units to the right of the origin along the X axis and 5 units up the Y axis. The sum of two points can be defined as a new point whose X coordinate is the sum of the X coordinates of the points and whose Y coordinate is the sum of their Y coordinates.

Write a program that uses a structure called point to model a point. Define three points, and have the user input values to two of them. Than set the third point equal to the sum of the other two, and display the value of the new point. Interaction with the program might look like this: Enter coordinates for P1: 3 4

Enter coordinates for P2: 5 7

Coordinates of P1 + P2 are : 8, 11

Q 3. Create the equivalent of a four function calculator. The program should request the user to enter a number, an operator, and another number. It should then carry out the specified arithmetical operation: adding, subtracting, multiplying, or dividing the two numbers. (It should use a switch statement to select the operation). Finally it should display the result. When it finishes the calculation, the program should ask if the user wants to do another calculation. The response can be 'Y' or 'N'. Some sample interaction with the program might look like this.

Enter first number, operator, second number: 10/ 3

Answer = 3.333333

Do another (Y/ N)? Y

Enter first number, operator, second number 12 + 100
Answer = 112

Do another (Y/ N) ? N

Q4. A phone number, such as (212) 767-8900, can be thought of as having three parts: the area code (212), the exchange (767) and the number (8900). Write a program that uses a structure to store these three parts of a phone number separately. Call the structure phone. Create two structure variables of type phone. Initialize one, and have the user input a number for the other one. Then display both numbers. The interchange might look like this:

Enter your area code, exchange, and number: 415 555 1212

My number is (212) 767-8900

Your number is (415) 555-1212

Q 5. Create two classes DM and DB which store the value of distances. DM stores distances in meters and centimeters and DB in feet and inches. Write a program that can read values for the class objects and add one object of DM with another object of DB.

Use a friend function to carry out the addition operation. The object that stores the results maybe a DM object or DB object, depending on the units in which the results are required.

The display should be in the format of feet and inches or meters and centimeters depending on the object on display.

Q 6. Create a class rational which represents a numerical value by two double values-

NUMERATOR & DENOMINATOR. Include the following public member Functions:

• constructor with no arguments (default).

• constructor with two arguments.

• void reduce( ) that reduces the rational number by eliminating the highest common factor between the numerator and denominator.

• Overload + operator to add two rational number.

• Overload >> operator to enable input through cin.

• Overload << operator to enable output through cout.

Write a main ( ) to test all the functions in the class.

Q 7. Consider the following class definition

```
class father {

protected : int age;

public;

father (int x) {age = x;}

virtual void iam ( )

{ cout < < “I AM THE FATHER, my age is : ”<< age<<
end1:} };
```

Derive the two classes son and daughter from the above class and for each, define iam ( ) to write our similar but appropriate messages. You should also define suitable constructors for these classes.

Now, write a main ( ) that creates objects of the three classes and then calls iam ( ) for them. Declare pointer to father. Successively, assign addresses of objects of the two derived classes to this pointer and in each case, call iam ( ) through the pointer to demonstrate polymorphism in action.

Q 8. Write a program that creates a binary file by reading the data for the students from the terminal. The data of each student consist of roll no., name (a string of 30 or lesser no. of characters) and marks.

Q9. A hospital wants to create a database regarding its indoor patients. The information to store include

a) Name of the patient

b) Date of admission

c) Disease

d) Date of discharge

Create a structure to store the date (year, month and date as its members). Create a base class to store the above information. The member function should include functions to enter information and display a list of all the patients in the database. Create a derived class to store the age of the patients. List the information about all the to store the age of the patients. List the information about all the pediatric patients (less than twelve years in age).

Q 10. Make a class **Employee** with a name and salary. Make a class **Manager** inherit from **Employee**. Add an instance variable, named department, of type string. Supply a method to **toString** that prints the manager's name, department and salary. Make a class **Executive** inherit from **Manager**. Supply a method **to String** that prints the string **"Executive"** followed by the information stored in the **Manager** superclass object. Supply a test program that tests these classes and methods.

Q11. Imagine a tollbooth with a class called toll Booth. The two data items are a type unsigned int to hold the total number of cars, and a type double to hold the total amount of money collected. A constructor initializes both these to 0. A member function called payingCar ( ) increments the car total and adds 0.50 to the cash total. Another function, called nopayCar ( ), increments the car total but adds nothing to the cash total. Finally, a member function called displays the two totals. Include a program to test this class. This program should allow the user to push one key to count a paying car, and another to count a nonpaying car. Pushing the ESC kay should cause the program to print out the total cars and total cash and then exit.

Q12. Write a function called reversit ( ) that reverses a string (an array of char). Use for loop that swaps the first and last characters, then the second and next to last characters and so on. The string should be passed to reversit ( ) as an argument. Write a program to exercise reversit ( ). The program should get a string from the user, call reversit ( ), and print out the result. Use an input method that allows embedded blanks. Test the program with Napoleon's famous phrase, "Able was I ere I saw Elba)".

Q13. Create some objects of the string class, and put them in a Deque-some at the head of the Deque and some at the tail. Display the contents of the Deque using the forEach ( ) function and

a user written display function. Then search the Deque for a particular string, using the first That ( ) function and display any strings that match. Finally remove all the items from the Deque using the getLeft ( ) function and display each item. Notice the order in which the items are displayed: Using getLeft ( ), those inserted on the left (head) of the Deque are removed in “last in

first out" order while those put on the right side are removed in "first in first out" order. The opposite would be true if getRight ( ) were used.

Q 14. Create a base class called shape. Use this class to store two double type values that could be used to compute the area of figures. Derive two specific classes called triangle and rectangle from the base shape. Add to the base class, a member function get_data ( ) to initialize base class data Members and another member function display_area ( ) to compute and display the area of figures. Make display_area ( ) as a virtual function and redefine this function in the derived classes to suit their requirements.

Using these three classes, design a program that will accept dimensions of a triangle or a rectangle interactively and display the area.

Remember the two values given as input will be treated as lengths of two sides in the case of rectangles and as base and height in the case of triangles and used as follows:

Area of rectangle = x * y

Area of triangle = ½ * x * y

ETME 155A	**ENGINEERING GRAPHICS LAB**	**C** **1.5**

Course Overview:

This course covers the fundamentals of engineering graphics including the drawing of orthographic, isometric, and auxiliary projections. Other topics include scaling, sectioning, dimensioning, and drawing documentation. This course uses the latest release of computer-aided design (CAD) software commonly used in industry to introduce students to CAD interface, structure, and commands.

Objective and Expected Outcome:

Course Objectives: The Basic aim of this subject is to: -

1. Increase ability to communicate with people
2. Learn to sketch and take field dimensions.
3. Learn to take data and transform it into graphic drawings.
4. Learn basic Auto Cad skills.
5. Learn basic engineering drawing formats
6. Prepare the student for future Engineering positions for designing

Course Outcomes: After learning the course the students should be able to: -

1. To know and understand the conventions and the method of engineering drawing.
2. Interpret engineering drawings using fundamental technical mathematics.

3. Construct basic and intermediate geometry.
4. To improve their visualization skills so that they can apply these skill in developing new products.
5. To improve their technical communication skill in the form of communicative drawings.
6. Comprehend the theory of projection

		L	T	P	C
ETME 155A	**ENGINEERING GRAPHICS LAB**	**0**	**0**	**3**	**1.5**

UNIT I

Introduction: Drawing Instruments and their uses, BIS conventions, Lettering, Dimensioning line conventions and free hand practicing, AUTO CAD, layout of the software, standard tool bar/menus and description of most commonly used tool bars, navigational tools. Co -ordinate system and reference planes, Definitions of HP, VP, RPP & LPP, Creation of 2D/3D environment, Selection of drawing size and scale, Commands and creation of Lines, Co-ordinate points, axes, poly-lines, square, rectangle, polygons, splines, circles, ellipse, text, move, copy, off-set, mirror, rotate, trim, extend, break, chamfer, fillet, curves, constraints.

Orthographic Projections:

Introduction, Definitions - Planes of projection, reference line and conventions employed, Projections of points in all the four quadrants, Projections of straight lines (located in First quadrant/first angle only), True and apparent lengths, True and apparent inclinations to reference planes.

UNIT II

Orthographic Projections of Plane Surfaces (First Angle Projection Only):

Introduction, Definitions–projections of plane surfaces–triangle, square, rectangle, rhombus, pentagon, hexagon and circle, planes in different positions by change of position method only.

UNIT III

Projections of Solids (First Angle Projection Only):

Introduction, Definitions – Projections of right regular tetrahedron, hexahedron (cube), prisms, pyramids, cylinders and cones in different positions.

Sections and Development of Lateral Surfaces of Solids:

Introduction, Section planes, Sections, Section views, Sectional views, Apparent shapes and True shapes of Sections of right regular prisms, pyramids, cylinders and cones resting with base on HP.

UNIT IV

Isometric Projection (Using Isometric Scale Only)

Introduction, Isometric scale, Isometric projection of simple plane figures, Isometric projection of tetrahedron, hexahedron(cube), right regular prisms, pyramids, cylinders, cones, spheres, cut spheres.

TEXT BOOKS:

1. Engineering Drawing - N.D. Bhatt & V.M. Panchal, Charotar Publishing House, Gujarat

2. Computer Aided Engineering Drawing - S. Trymbaka Murthy, - I.K. International Publishing House Pvt. Ltd., New Delhi, revised edition.

REFERENCE BOOKS:

1. Engineering Graphics - K.R. Gopala Krishna, edition Subash Publishers Bangalore.

2. Fundamentals of Engineering Drawing with an Introduction to Interactive Computer Graphics for Design and Production-Luzadder Warren J., Duff John M., Eastern Economy Edition, -Prentice-Hall of India Pvt. Ltd., New Delhi.

ETME 157A	**WORKSHOP PRACTICES**	**C** **1.5**

Course Overview:

Manufacturing is fundamental to the development of any engineering product. 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 weightage, some lectures and video clips available on different methods of manufacturing are also included.

Objective and Expected Outcome:

Course Objective:

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:

1. Introduction to different manufacturing methods in different fields of engineering
2. Practical exposure to different fabrication techniques
3. Creation of simple components using different materials
4. Exposure to some of the advanced and latest manufacturing techniques being employed in the industry

		L	T	P	C
ETME 157A	**WORKSHOP PRACTICES**	**0**	**0**	**3**	**1.5**

UNIT I

Materials: Spectrography method for finding composition of materials.

Wood Working Shop: Making of various joints, Pattern making.

UNIT II

Foundry Shop: Bench molding with single piece pattern and two piece pattern. Floor moulding

- Making of bend pipe mould etc. Machine moulding - Making of mould using Match-plate pattern. Core making- Making and baking of dry sand cores for placing in horizontal, vertical and hanging positions in the mould cavity

Fitting Shop: Learning use of fitting hand tools, marking tools, marking gauge. Exercises: Jobs made out of MS Flats, making saw - cut filling V-cut taper at the corners, circular cut, fitting square in square, triangle in square.

UNIT III

Welding Shop: Electric Arc Welding, Edge Preparations, Exercises making of various joints. Bead Formation in horizontal, Vertical and Overhead positions. **Gas Welding:** Oxy-Acetylene welding and cutting of ferrous metals.

Soldering: Dip soldering.

Brazing: With Oxy-Acetylene gas.

UNIT IV

Sheet Metal Shop: Learning use of sheet-metal tools, Exercises: Making jobs out of GI sheet metal. Cylindrical, Conical and Prismatic shapes. Project Shop: Extrusion of soft metals, Plastic coating of copper wires, Plastic.

SEMESTER III

ETME 205A	**THERMODYNAMICS**	**C**
		4

Overview:

Thermodynamics 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 laws of thermodynamics. The best way of understanding the concepts of thermodynamics are to relate it with real life processes through industrial visits and departmental based projects in related laboratories. Class room teaching for basic concepts and principles will be used, and afterwards students will be encouraged to undergo for some related projects/ prototypes which will make students more interactive. Presentations will also be encouraged for the topics application based.

Course 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 work and heat interactions, and balance of energy between system and its surroundings.
5. To learn about application of 1^{st} & 2^{nd} law to various energy conversion devices.
6. To evaluate the changes in properties of substances in various processes.
7. To understand the difference between high grade and low grade energies and II law

limitations on energy conversion.

1. After completing this course, the students will be able to apply energy balance to systems and control volumes, in situations involving heat and work interactions.
2. Students can evaluate changes in thermodynamic properties of substances.
3. The students will be able to evaluate the performance of energy conversion devices.
4. The students will be able to differentiate between high grade and low grade energies.

		L	T	P	C
ETME 205A	**THERMODYNAMICS**	**3**	**1**	**-**	**4**

Course Objective: Objective of this course is to impart in depth understanding of the principles of thermodynamics and heat transfer. This course also helps students understand the application of basic fluid mechanics, thermodynamic, and heat transfer principles and techniques, including

the use of empirical data, 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.

UNIT I

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

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

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

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.

TEXT BOOKS:

1. Engineering Thermodynamics –P. K. Nag, TMH.
2. Thermal Engineering- R. K. Rajput, PHI, Publications.
3. Engineering Thermodynamics – Jones and Dugan, PHI, New Delhi.
4. Fundamentals of Engineering Thermodynamics – E. Radhakrishnan, PHI, New Delhi.

REFERENCE BOOKS:

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

ETME 209A	**FLUID MECHANICS**	**C** **4**

Overview:

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.

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

Course Outcomes: On successful completion of this course, student should be able to:

- Define basic terms, values and laws in the areas of fluids properties, statics, kinematics and dynamics of fluids, and hydraulic design of pipes,
- Describe methods of implementing fluid mechanics laws and phenomena while analyzing the operational parameters of hydraulic problems, systems and machines,
- Practically apply tables and diagrams, and equations that define the associated laws

- Calculate and optimize operational parameters of hydraulic problems, systems and machines,
- Explain the correlation between different operational parameters,
- Select engineering approach to problem solving based on the acquired physics and mathematical knowledge.

		L	T	P	C
ETME 209A	**FLUID MECHANICS**	**3**	**1**	**-**	**4**

Course Objective: The objective of Fluid Mechanics subject is that students should understand the, properties of fluids, pressure measurement devices, hydraulic forces on surfaces, bouncy and flotation in fluids, kinematics and static behaviour of fluids, dimension and model analysis, laminar and turbulent flow, flow through pipes and orifices, boundary layer theory

UNIT I

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

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

Compressible Fluid Flow: Introduction, continuity momentum and energy equation, sonic velocity, propagation of elastic waves due to compression of fluid, propagation of elastic waves due to disturbance in fluid, stagnation properties, isentropic flow, effect of area variation on flow properties, isentropic flow through nozzles, diffusers, injectors, Problems.

UNIT III

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

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.

REFERENCES BOOKS

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.

ETME 211A	**MATERIAL SCIENCE & METALLURGY**	**C** **4**

Overview:

Metallurgy and Materials deal with the structure and properties of all materials, which have engineering applications. Metallurgists and Materials Engineers are responsible for designing, producing, examining and testing materials as diverse as metallic engineering alloys, semiconductors and superconductors, ceramics, plastics and composites. This course will help students understand the properties of different types of materials and their applications.

1. This course provides students an understanding of basic structure and crystal arrangement of materials, the phase diagrams, advantages of heat treatment and the method of heat treatment processes, powder metallurgy processes, the need and application of composite materials.
2. To examine and testing of metallic engineering alloys, semiconductors and superconductors, ceramics, plastics and composites.
3. To understand the properties of different types of materials and their applications

Course Outcomes:

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

1. Analyze the Structure of materials at different levels, basic concepts of crystalline materials like unit cell, FCC, BCC, HCP, APF (Atomic Packing Factor), Co-ordination Number etc.

2. Understand concept of mechanical behavior of materials and calculations of same using appropriate equations.
3. Explain the concept of phase & phase diagram & understand the basic terminologies associated with metallurgy.
4. Understand and suggest the heat treatment process & types. Significance of properties Vs microstructure.

	MATERIAL SCIENCE &	**L**	**T**	**P**	**C**
ETME 211A	**METALLURGY**	**4**	**-**	**-**	**4**

Course Objective: Metallurgy and Materials deal with the structure and properties of all materials, which have engineering applications. Metallurgists and Materials Engineers are responsible for designing, producing, examining and testing materials as diverse as metallic engineering alloys, semiconductors and superconductors, ceramics, plastics and composites. This course will help students understand the properties of different types of materials and their applications.

UNIT I

Crystallography: Review of crystal structure, space lattice, crystal planes and crystal directions, co-ordination number, number of atoms per unit cell, atomic packing factor, Numerical related to crystallography.

Imperfection in metal crystals: Crystal imperfections and their classifications, point defects, line defects, edge & screw dislocations, surface defects, volume defects & effects of imperfections on metal properties.

UNIT II

Solid solutions and phase diagram: Introduction to single and multiphase solid solutions and types of solid solutions, importance and objectives of phase diagram, systems, phase and structural constituents, cooling curves, unary & binary phase diagrams, Gibbs's phase rule, Lever rule, eutectic and eutectoid systems, peritectic and peritectoid systems, iron carbon equilibrium diagram and TTT diagram.

Heat Treatment: Principles, purpose, classification of heat treatment processes, annealing,normalizing, stress relieving, hardening, tempering, carburizing, nitriding, cyaniding,flame and induction hardening. Allotropic transformation of iron and steel, Properties of austenite, ferrite, pearlite, martensite.

UNIT III

Deformation of Metal: Elastic and plastic deformation, mechanism of plastic deformation, twinning, conventional and true stress strain curves for polycrystalline materials, yield point phenomena, strain ageing, work hardening, Bauschinger effect, season cracking. Recovery, re-crystallization and grain growth.

Failures of metals: Failure analysis, fracture, process of fracture, types of fracture, fatigue, characteristics of fatigue, fatigue limit, mechanism of fatigue, factors affecting fatigue.

UNIT IV

Creep & Corrosion: Definition and concept, creep curve, mechanism of creep, impact of time and temperature on creep, creep fracture, creep testing and prevention against creep. Corrosion: Mechanism and effect of corrosion, prevention of corrosion. Plastic, Composite and Ceramics: Polymers, formation of polymers, polymer structure and crystallinity, polymers to plastics types, reinforced particles-strengthened and dispersion strengthened composites.

Ceramic materials: Types of ceramics, properties of ceramic, ceramic forming techniques, mechanical behavior of ceramic.

TEXT BOOKS:

1. Elements of Material Science and Engineering: VanVlack, Wesley Pub. Comp.
2. Material Science - Narula, Narula and Gupta. New Age Publishers

REFERENCE BOOKS:

1. Material Science & Engineering –V. Raghvan, Prentice Hall of India Pvt. Ltd, New Delhi.
2. A Text Book of Material Science & Metallurgy – O.P. Khanna, Dhanpat Rai & Sons
3. Material Science and Engineering-An Introduction - Callister; W.D., John Wiley & Sons. Delhi.
4. Engineering Materials: Kenneth G. Budinski, Prentice Hall of India, New Delhi

ETMA 201A	**APPLIED MATHEMATICS - III**	**C** **4**

OVERVIEW:

The construction of mathematical models to address real-world problems has been one of the most important aspects of each of the branches of engineering and technology. The first part of this module extends the theory of Fourier series and Fourier integral transform.

The second part of the module covers a complex variable which includes complex variable, analytic function, Cauchy-Riemann equations, and Residue theorem with their application. Fourier series and its applications: Euler's formulae, Dirichlet's conditions, Change of interval, Fourier expansion of even and odd functions, Fourier expansion of square wave, Rectangular wave; Saw-toothed wave; Half & Full rectified wave functions, Harmonic analysis.

Fourier integrals and Transforms: Fourier integral theorem, Fourier sine integral, Fourier cosine integral, Fourier sine Transform, Fourier cosine transform, Fourier transform and its properties, Finite Fourier sine transform, Finite Fourier cosine transform, Fourier transforms of derivatives.

Functions of Complex Variables: Introduction to complex number, Limit, Continuity and Derivatives of complex functions, Analytic functions, Cauchy-Riemann equations, Harmonic functions, Conformal mapping, Standard mappings (linear, square, inverse and bilinear), Complex

line integral, Cauchy's integral theorem, Cauchy's integral formula, Zeroes and Singularities, Taylor series, Laurent's series, Calculation of residues, Residue theorem, Application of residue theorem to solve real integrals.

OBJECTIVES AND EXPECTED OUTCOMES:

Upon successful completion, students will have the knowledge and skills to:

1. Obtain the Fourier series and Fourier transform for a given function
2. Evaluate real integrals using residue theorem
3. Express analytic functions in terms of Taylor's series and Laurent series.
4. Calculate complex line integrals and some infinite real integrals using Cauchy's integral theorem or residue calculus.
5. Express any periodic function in term of sines and cosines
6. Analyze one dimensional wave and heat equation

		L	T	P	C
ETMA 201A	**APPLIED MATHEMATICS - III**	**3**	**1**	**-**	**4**

Course Objective: The objective of the course is to provide a brief knowledge of Applied Mathematics to the Engineering students. The students will learn about the Fourier series, Fourier transforms, Special functions, Partial differential equations and its engineering applications.

UNIT I

Fourier Series and its applications: Euler's formulae, Dirichlet's conditions, Change of interval, Fourier expansion of even and odd functions, Fourier expansion of square wave, Rectangular wave; Saw-toothed wave; Half & full rectified wave functions, Harmonic analysis.

UNIT II

Fourier integrals and Transforms: Fourier integral theorem, Fourier sine integral, Fourier cosine integral, Fourier sine Transform, Fourier cosine transform, Fourier transform and its properties, Finite Fourier sine transform, Finite Fourier cosine transform, Fourier transforms of derivatives.

UNIT III

Special Functions: Beta and Gamma functions, Bessel's functions, recurrence relations of Bessel's function, Orthogonality of Bessel function, Ber- Bei functions.

UNIT IV

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.

REFERENCES BOOKS:

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

ETME 207A	**STRENGTH OF MATERIALS**	**C**
		4

Course objective: -

The lecture portion of the class will consist of the introduction of the engineering problem solving process, the conceptual material and interactive demonstrations of the engineering concepts.

- Define direct normal stress and direct shear stress and compute their values.
- Define normal strain and shearing strain.
- Define proportional limit, elastic limit, yield strength, ultimate strength, modulus of elasticity, and Hooke's Law.
- Describe ductile and brittle behavior of materials, emphasizing design implications.
- Calculate design normal stress and shear stress for various metals and woods under various conditions.
- Calculate shear stress distribution in solid and hollow round members under torsional loading conditions.
- Design shafts various conditions of power transmission and rotational speed.
- Calculate angle of twist under torsional loading for determining the rigidity of the shaft.

- Determine shear and bending moment diagrams for variously loaded and supported beams, using graphical calculus.
- Calculate bending stress and shear stress at any location along the beam.
- Calculate maximum bending stress and maximum shear stress.
- Determine the maximum deflection on statically determinate beams, using the method of superposition in reflection analysis.
- Design beams based on allowable normal and shear stresses and maximum allowable deflection.
- Determine principal stresses, principal planes and maximum shear stress under various combinations of bending, torsion and axial loads on machine and structural parts using

  Mohr's circle.

- Apply the Euler Equation to calculate axial buckling load for long straight columns of varying end conditions and materials.

Course Outcome:

- Develop an understanding of the concepts of stress and strain and their use in the analysis and design of machine members and structures.

- Develop an understanding of material behavior under a condition of pure torsion (twisting moment) on circular shafts.
- 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.
- Develop an understanding of analytic methods used in connection with the structural design of columns, long mechanical members under compression.

Course Application:

- Pressure-bearing components: pipes and vessels which contain internal pressure (i.e. almost all pipes/vessels) must be designed so that the walls are strong enough to withstand the hoop stress created by applying radial force on the walls.
- Tension-bearing components: suspended pipe used in drilling must support its own hanging weight.
- Compression-bearing components: pilings and drill collars must withstand compressive loads by not buckling and not shearing.
- Compressive shear failure is a direct function of yield strength.
- Bending: pipe drilling in deviated holes, cantilever beams, wellheads under side-loading, etc.

		L	T	P	C
ETME 207A	**STRENGTH OF MATERIALS**	**3**	**1**	**-**	**4**

Course Objective: The objective of this course is to make the students understand the concept of stress and strain in different types of structure/machine 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, stress in thin cylinder thick cylinder and spheres due to external and internal pressure.

UNIT I

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, principle stresses & strains and principal- planes, Mohr's circle of stresses, Numerical.

UNIT II

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. Numericals.

UNIT III

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

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.

TEXT BOOKS:

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

		C
ETEE 201A	ELECTRO MECHANICAL ENERGY CONVERSION	4

COURSE OVERVIEW:

Electric machines are a technology of choice in many modern energy conversion applications, including energy storage systems. Interest in machines is steady increasing due in giant half to the pliability of controls offered by trendy computers and power electronic devices. In this course design of electromechanical energy conversion is developed. Upon completion of the course, a student's engineering talent ought to contain i) associate understanding of the essential principles of static and mechanical device energy conversion, ii) information of the utilization of organization theory applied to the associate analysis of rotating devices and iii) an understanding of the steady-state and dynamic characteristics of induction, static magnet synchronous, and wound rotor synchronous machines.

COURSE OBJECTIVE:

To provide a basic background in static and electromechanical energy conversion devices; intended for students with interests in the control of electrical and electromechanical systems with applications to electric energy systems.

COURSE OUTCOMES:

Students who successfully complete this course will have the ability to:

- Analyze transformers in the power conversion circuits.
- Understand and use the theory of electromechanical energy conversion to analyze actuators and simple electric machines.
- Analyze AC machines, including motors and generators.

- Analyze DC machines, including motors and generators.
- Understanding of torque production in motors.

ETEE 201A	ELECTRO MECHANICAL ENERGY CONVERSION	L	T	P	C
		3	1	0	4

UNIT I

Magnetic Circuit and Induction: Magnetic Circuits, Magnetic Materials and their properties, static and dynamic emfs and force on current carrying conductor, AC operation of Magnetic Circuits, Hysteresis and Eddy current losses.

UNIT II

DC Machine : Basic theory of DC generator, brief idea of construction, emf equation, load characteristics, basic theory of DC motor, concept of back emf, torque and power equations, load characteristics, starting and speed control of DC motors, applications.

UNIT III

Synchronous Machine: Constructional features, Armature winding, EMF Equation, Winding

coefficients, equivalent circuit and phasor diagram, Armature reaction, O. C. & S. C. tests,

Voltage Regulation Synchronous Motor: Starting methods, Effect of varying field current at

different loads, V-Curves.

UNIT IV

Three-phase Transformer & Induction Machine: Three Phase Transformer: Review of Single

phase transformer. Three Phase transformer: Basics & operation Induction Machine: Constructional features, Rotating magnetic field, Principle of operation Phasor diagram, equivalent circuit, torque and power equations, Torque- slip characteristics, no load & blocked rotor tests, efficiency, Induction generator & its applications. Introduction of Single phase Induction Motor, Repulsion motor. AC Commutator Motors: Universal motor, single phase a.c. series compensated motor, stepper motors

TEXT BOOKS:

1. D.P.Kothari & I.J.Nagrath, “Electric Machines”, Tata Mc Graw Hill

2. Ashfaq Hussain“Electric Machines” Dhanpat Rai & Company

REFERENCE BOOKS:

1. P.S.Bimbhra, “Electrical Machines”, Khanna Publisher

2. Fitzerald,A.E.,Kingsley and S.D.Umans “Electric Machinery”, MC Graw Hill

ETME 255A	**FLUID MECHANICS LAB**	**C** **1**

Overview: This lab is an introductory course where flow behavior, 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.

Course Objectives:

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

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

Course Outcomes:

1. To provide the students with a solid foundation in fluid flow principles like Manometry, Buoyancy, etc.
2. To provide the students' knowledge in calculating performance analysis in turbines and pumps and can be used in power plants
3. Students can able to understand to analyze practical problems in all power plants and chemical industries
4. Given the required flow rate and pressure rise, select the proper pump to optimize the pumping efficiency
5. To provide exposure to modern computational techniques in fluid dynamics.

		L	T	P	C
ETME 255A	**FLUID MECHANICS LAB**	**-**	**-**	**2**	**1**

LIST OF EXPERIMENTS

1. To determine the coefficient of impact for vanes.
2. To determine coefficient of discharge of an orifice meter.
3. To determine the coefficient of discharge of Notch (V and Rectangular types).
4. To determine the friction factor for the pipes.
5. To determine the coefficient of discharge of venture-meter.
6. To determine the coefficient of discharge, contraction & velocity of an orifice.
7. To verify the Bernoulli's Theorem.
8. To find critical Reynolds number for a pipe flow.

9. To determine the meta-centric height of a floating body.
10. To determine the minor losses due to sudden enlargement, sudden contraction and bends.
11. To show the velocity and pressure variation with radius in a forced vertex flow.
12. To verify the momentum equation.

ETME 253A	**STRENGTH OF MATERIALS LAB**	**C**
		1

Course Objective:

Demonstrating the basic principles in the area of strength and mechanics of materials and structural analysis to the undergraduate students through a series of experiments is the objective of the strength of materials lab. 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

Course Outcome:

- Calculate design normal stress and shear stress for various metals and woods under various conditions.
- Calculate shear stress distribution in solid and hollow round members under torsional loading conditions.
- Calculate bending stress and shear stress at any location along the beam. Calculate maximum bending stress and maximum shear stress.

Course Applications:

- Calculate design normal stress and shear stress for various metals and woods under various conditions.
- Calculate shear stress distribution in solid and hollow round members under torsional loading conditions.
- Design shafts for various conditions of power transmission and rotational speed.

- Calculate angle of twist under torsional loading for determining the rigidity of the shaft.
- Design beams based on allowable normal and shear stresses and maximum allowable deflection.

		L	T	P	C
ETME 253A	**STRENGTH OF MATERIALS LAB**	**-**	**-**	**2**	**1**

LIST OF EXPERIMENTS

1. To study the Brinell hardness testing machine & perform the Brinell hardness test.
2. To study the Rockwell hardness testing machine & perform the Rockwell hardness test.
3. To study the Vickers hardness testing machine & perform the Vickers hardness test.
4. To study the Erichsen sheet metal testing machine & perform the Erichsen sheet metal test.
5. To study the Impact testing machine and perform the Impact tests (Izod & Charpy).
6. To study the Universal testing machine and perform the tensile test UTM.
7. To perform compression & bending tests on UTM.
8. To perform the shear test on UTM.

9. To study the torsion testing machine and perform the torsion test.

10. To draw shear Force, Bending Moment Diagrams for a simply Supported Beam under Point and Distributed Loads.

C

ETME 257A COMPUTER AIDED MACHINE DRAWING LAB **1**

Overview

Technical Graphics is used to communicate the necessary technical information required for manufacture and assembly of machine components. These drawings follow rules laid down in national and International Organizations for Standards (ISO).

Hence the knowledge of the different standards is very essential. Students have to be familiar with industrial drafting practices and thorough understanding of production drawings to make them fit in industries. The following topics have been covered to fulfill the above objectives.

Objective and Expected Outcome

Course Objectives:

1. To acquire the knowledge of drafting software.

2. To provide hands on experience to develop 2D models of machine components. Course Outcomes:

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

1. Develop engineering drawings for the machine components as per Indian Standard Code of practice using drafting software.

2. Prepare assembly drawings from part drawings.

ETME 257A	COMPUTER AIDED MACHINE	L	T	P	C
	DRAWING LAB	-	-	2	1

Introduction: Graphic language classification of drawing, principal of drawing, IS codes for machine drawing, lines, scales, section dimensioning, standard abbreviation, – Limits, fits and Tolerance (Dimensional and Geometrical tolerance), Surface finish, Gears : Gear terminology, I.S. convention representation of assembly of spur gears, helical gears, bevel gears, worm and worm wheel.

Orthographic projections: Principle of first and third angle projection, orthographic views from isometric views of machine parts / components. Drawing of sectional views: - Coupling, Crankshaft, Pulley, Piston and Connecting rod, Cotter and Knuckle joint. Riveted Joint and Welded Joint.

Free hand sketching: Need for free hand sketching of standard parts and simple machines components, Assembly drawing with sectioning and bill of materials from given detailed drawings of assemblies: Lathe Tail stock, Machine vice, Pedestal bearing, Assembly drawing

with sectioning and bill of materials from given detailed drawings of assemblies Steam stop valve, Stuffing box, Drill jigs and Milling fixture.

SEMESTER IV

ETME 204A	**KINEMATICS OF MACHINES**	**C**
		4

Overview: Design, selection, and evaluation of mechanisms for various applications. Topics include planar and spatial linkages, cams, gears, planetary and non-planetary gear systems, linkage synthesis, linkage dynamics.

Course 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.

1. Discuss the basics of mechanism.
2. Calculate velocity and acceleration in simple mechanisms
3. To develop CAM profiles
4. Solve problems on gears and gear trains
5. Examine friction in machine elements

ETME 204A	KINEMATICS OF MACHINES	L	T	P	C
		3	1	-	4

Course Objective: the objective of this course is to provide a brief knowledge about kinematics mechanism, cams, Gears.

UNIT I

Introduction: mechanism and machines, kinematics links, kinematics pairs, kinematics chains, degree of freedom, Grubler's rule, kinematics inversion, equivalent linkages, four link planar mechanisms, straight line mechanisms, steering mechanisms, pantograph, problems.

Kinematics Analysis of Plane Mechanisms: displacement analysis, velocity diagram, velocity determination, relative velocity method, instantaneous center of velocity, Kennedy's theorem, graphical and analytical methods of velocity and acceleration analysis, problems.

UNIT II

Cams: Classification of cams and followers, disc cam nomenclature, construction of displacement, velocity and acceleration diagrams for different types of follower motions, analysis of follower motions, determination of basic dimension, synthesis of cam profile by graphical methods, cams with specified contours, problems.

Gears: fundamental law of gearing, involute spur gears, characteristics of involute and cycloidal action, Interference and undercutting, center distance variation, path of contact, arc of contact, nonstandard gear teeth, helical, spiral bevel and worm gears, problems.

UNIT III

Gear Trains: synthesis of simple, compound and reverted gear trains, analysis of epicylic gear trains, problems.

Kinematics synthesis of Mechanisms: function generation, path generation, Freudenstein's equation, two and three position synthesis of four bar and slider crank mechanisms by graphical and analytical methods, , precision positions, structural error; Chebychev spacing, transmission angle, problems.

UNIT IV

Friction : Types of friction, laws of friction, motion along inclined plane, screw threads, efficiency on inclined plane, friction in journal bearing, friction circle and friction axis, pivots and collar friction, uniform pressure and uniform wear.

Belts and pulleys: Open and cross belt drive, velocity ratio, slip, material for belts, crowning of pulleys, law of belting, types of pulleys, length of belts, ratio of tension, centrifugal tension,

power transmitted by belts and ropes, initial tension, creep, chain drives, chain length, classification of chains.

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.

ETME 220A	**ENGINEERING MECHANICS**	**C** **4**

Overview:

Engineering Mechanics is one of the core subjects 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 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.,
6. To understand the kinetics of the rigid bodies and solve simple problems using work-energy method.
7. To understand virtual work method and solve simple problems.

1. Draw free body diagrams and determine the resultant of forces and/or moments. Determine the centroid and second moment of area of sections.

2. Apply laws of mechanics to determine efficiency of simple machines with consideration of friction.

3. Analyze statically determinate planar frames.

4. Analyze the motion and calculate trajectory characteristics. Apply Newton's laws and conservation laws to elastic collisions and motion of rigid bodies.

		L	T	P	C
ETME 220A	**ENGINEERING MECHANICS**	**3**	**1**	**-**	**3**

Course Objective: Engineering Mechanics is one of the core subjects 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.

UNIT I

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. $T1/T2 = e\mu^{\theta}$ and its application

UNIT II

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

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

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

ETME 210A	FLUID MACHINES	C
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Course Objective: The objective of Fluid Machinery subject is that students should understand the properties of fluids, dynamic behavior of fluids, dimension and model analysis, turbulent flow, flow through open channels, different types of machines.

Course outcome: After completing the program the student will able to understand the concept of different types of turbines as well as Pumps. Students will able deal with importance of dimensionless numbers and its significance. Moto of this subject is to provide the information on the function of behavior of fluids & flow through open channel.

Applications: Learned basic properties and characteristics of incompressible fluid. Understood basic fundamental theorems governing fluid flows i.e., continuity, energy and momentum. Learned the measurement of different fluid properties using various type of equipments like measurement of flow, pressure velocity and head loss. Learned the analysis of flow phenomenon through open channels

		L	T	P	C
ETME 210A	**FLUID MACHINES**	**3**	**1**	**-**	**4**

Course Objective: the objective of this course is to provide a brief knowledge about Pelton turbine, Kaplan turbine, Francis turbine, reciprocating pumps, and centrifugal pumps.

UNIT I

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. Problems

UNIT II

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

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

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

ETME 214A	**TURBOMACHINES**	**C**
		4

Overview: The overview of this course is to provide a brief knowledge about introduction of Gas Turbines, Steam Nozzle and turbines, compressors.

Course Objectives

1. Imparting knowledge of working / operation of axial flow compressors and demonstration of application of principles of fluid flow and thermodynamics in prediction of their performance.
2. Illustrating the use of Dimensional Analysis in the identification of the relevant dimensionless performance parameters.
3. Impart knowledge of basic principles of operation of various types of Turbo machines (Turbines and Pumps).
4. Elucidating the role of Dimensionless performance parameters in design and selection of the turbo machines.

Course Outcomes: After taking this course the students should be able to

1. Classify the Gas Turbines on the basis of their principles of operation.
2. Classify the steam Turbines on the basis of their principles of operation.
3. List different Non-Dimensional groups and its use in Modeling and Similitude.
4. Predict performance of centrifugal and axial flow compressors.

ETME 214A	TURBOMACHINES	L	T	P	C
		3	1	-	4

Course Objective: the objective of this course is to provide a brief knowledge about introduction of Gas Turbines, Nozzle, and Compressible flow and Steam turbines.

UNIT I

Introduction: Prime Movers, Gas Turbines, Review of Basic principles – Thermodynamics, Fluid Dynamics and Heat Transfer, Fundamentals of Rotating Machines – Energy Equation, Dimensional Analysis, Airfoil Theory.

UNIT II

Centrifugal Compressors: Centrifugal Compressors- Principle of Operation, T-s diagram, Energy equation, velocity triangles, types of blades. Analysis of Flow, Performance Characteristics

Axial Flow Compressors: Axial Flow Compressors – Construction, Principle of Operation, T-s diagram, Energy equation, velocity triangles, Analysis of Flow, Work done factor, Stage efficiency, Degree of reaction, Performance characteristics.

UNIT III

Compressible Flow: Stagnation Properties, Speed of sound and Mach number, one dimensional Isentropic flow, isentropic flow through nozzles, shock waves and expansion waves, Fanno line Rayleigh line flow, air flow and steam flow through nozzles, Area- velocity relationship, Mass flow rate, Choking of Nozzles, Performance characteristics of Nozzles, Super saturated flow.
Gas Turbines: Axial Flow Gas Turbines – Impulse and reaction Turbines, Single Impulse stage, Single Reaction stage, Performance characteristics.

UNIT IV

Steam Turbines: Steam Turbines – Impulse and reaction Turbines, Compounding of steam turbines, multistage reaction Turbines, Reheat factor and Efficiency, Governing of Steam Turbines.

Rankine Cycle: Properties of Pure Substances, Property diagrams, Steam Power plant Layout, Rankine Cycle- Analysis, Modified Rankine Cycle, and Combined Cycle

Text Books:

1. Ganesan, V., Gas Turbines 3/e, Tata McGraw Hill Book Company, New Delhi.

2. Vasandani, V.P. and Kumar, D.S., Treatise on Heat Engineering, Chand and Co Publishers, New Delhi.

3. Saravanmuttoo, H.I.H., Rogers, G.F.C. and Cohen H., Gas Turbine Theory, 6/e. Pearson Prentice Education.

Reference Books

1 Kearton, W. J., Steam Turbine Theory and Practice, CBS Publishers and Distributors, New Delhi.

2 Joel, R., Basic Engineering Thermodynamics, Pearson Education, New Delhi.

3 Yahya, S. M., Turbines, Compressors & Fans, Tata McGraw Hill, New Delhi.

4 Dixon, S. L., Fluid Mechanics and Thermodynamics of Turbomachinery, Butterworth-Heinemann, London.

ETMC 226A	**FUNDAMENTALS OF MANAGEMENT**	**C**
		3

COURSE OVERVIEW

Technical skills alone do not meet the real world work and the business requirements; they have to be supplemented by management training. In fact, most of the people find that their success depends as much on general management skills and understanding operational systems as on their technical expertise. To become complete professional, students need a firm foundation in these basic managerial skills.

Fundamentals of Management are a basic introductory and foundational management course for under graduates. This course is designed for students to equip themselves with key knowledge, skills and competencies in various aspects of management. This course enables the students to develop an understanding of management and organization and focuses on important management functions such as planning, organizing, leading and controlling for successful managerial activities. The students will learn how successful managers use organizational resources through organizational functions in order to effectively and efficiently achieve organizational objectives.

Specific techniques related to managerial functions are explored as well as the broad issues and trends influence the practice of contemporary management, globalization, technology, diversity, and competitive advantage. Special emphasis is on basics of all the departments in the organization like Human Resource Management, Marketing Management, Productions and Operations Management and Financial Management.

COURSE OBJECTIVE

The objective of this course is for each student to be able to know, comprehend, apply, analyze, synthesize and evaluate the basic fundamentals of managing organizations. Through the learning of this course on fundamentals of management, students will gain fundamental knowledge and skills for management in contemporary organizations. These include the “How to” and “Why”.

Students will also develop analytical and critical thinking skills in the context of contemporary organizations. This focuses on the entire organization from both a short term and long term perspective for strategic vision, objectives, crafting a strategy and implementing it.

COURSE OUTCOMES

Specifically the learning objectives for the students are:

- Demonstrate basic knowledge of management and organization.
- Demonstrate a basic understanding of management functions such as planning, organizing, leading and controlling; and how successful managers effectively and efficiently use these functions and their business resources to achieve organizational objectives.
- Develop knowledge of fundamental management concepts and skills.
- Identify the key competencies needed to be an effective manager.
- Identify the most important components of human resource planning; outline a model of organizational staffing; recruitment; selection; orientation; human resource planning and training.

		L	T	P	C
ETMC 226A	FUNDAMENTALS OF MANAGEMENT	3	-	-	3

Course Objective: the objective of this course is to provide a brief knowledge about Management aspects, Production Management, Marketing Management, Marketing Research**.**

UNIT I

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

Production Management: Definition, Objectives, Functions and Scope, Production Planning and Control; its significance, stages in production planning and control.

M**aterial Management:** Brief introduction to the concepts of material management, inventory

control; its importance and various methods**.**

UNIT III

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

Financial Management: 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 BOOKS:

1. Principles and Practice of Management - R.S. Gupta, B.D.Sharma, N.S. Bhalla. (Kalyani Publishers)

2. Organisation and Management - R.D. Aggarwal (Tata Mc Graw Hill)

1. Principles & Practices of Management – L.M. Prasad (Sultan Chand & Sons)

2. Management – Harold, Koontz and Cyrilo Donell (Mc.Graw Hill).

3. Marketing Management – S.A. Sherlikar (Himalaya Publishing House, Bombay).

4. Financial Management - I.M. Pandey (Vikas Publishing House, New Delhi)

ETME 218A	**MANUFACTURING TECHNOLOGY I**	**C**
		4

Overview:

This subject is designed to make the student understand the basic manufacturing processes like casting, welding and forming. This subject is of outmost importance in mechanical engineering processes and use of machining tools.

Course Objectives:

The main objective of this course is to emphasize the importance manufacturing sciences in the day-to-day life, and to study the basic manufacturing processes and tools used. The course is delineated particularly to understand the conventional manufacturing processes like casting, metal forming, and welding process.

Course Outcomes: Upon the completion of this course the students will be able to Select appropriate Manufacturing Processing to manufacture any component, Interpret foundry practices like pattern making, mold making, Core making and Inspection of defects, Differentiate various metal forming processes such as Hot and Cold Working, Rolling, Forging, Extrusion and Drawing Processes, Classify different plastic molding processes, Extrusion of Plastic and Thermoforming, Select appropriate Joining Processes to join Work piece and design different sheet metal working processes, Demonstrate operation such as Turning, Facing, Threading, Knurling and Grooving on Centre Lathe.

ETME 218A	**MANUFACTURING TECHNOLOGY I**	**L**	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objective: This subject is designed to make the student understand the basic manufacturing processes like casting, welding and forming. This subject is of outmost importance in mechanical engineering processes and use of machining tools.

Unit-I

Metal Cutting & Tool Life: Introduction, basic tool geometry, single point tool nomenclature, chips types and their characters tics, mechanics of chips formation, theoretical and experimental determination of shear angle, orthogonal and oblique metal cutting, metal cutting theories, relationship of velocity, forces, and power consumption, cutting speed, feed and depth of cut, coolant, temperature profile in cutting, tool life relationship, tailor equation of tool life, tool material and mechanism

Economics of Metal Machining: Introduction, elements of machining cost, tooling economics, machining, economics and optimization, geometry of twist, drills and power calculation in drills.

Unit-II

Metal forming Jigs and Fixtures: Introduction, Metal blow condition, theories of plasticity, conditions of plane strains, friction, conditions in metal working, wire drawing, theory of forging, rolling theory, no slip angle, and foreword slip, types of tools, principles of locations, locating and clamping devices, jigs bushes, drilling jigs, milling fixtures, turning fixtures, boring and broaching fixtures, welding fixtures, different materials, for jigs and fixtures, economics of jigs and fixtures.

Metrology: Measurement, linear and angular simple measuring instruments, various clampers, screw gauge, sine bar, auto-collimator, comparator- mechanical, electrical, optical, surface finish and its measurements, micro and macro deviation, factors influencing surface finish and evaluation of surface finish.

Unit-III

Machine tools: Introduction, constructional features, specialization, operations and devices of basic machine tools such as lathe, shaper, planner, drilling machining, and milling machine, indexing in milling operation, working principles of capstan and turret lathes.

Metal Casting Process: Introduction, Foundry: Introduction to Casting Processes, Basic Steps in Casting Processes. Pattern: Types of Pattern and Allowances. Sand Casting: Sand Properties, Constituents and Preparation, Mould & Core making with assembly and its Types, Gating System, Melting of Metal, Furnaces and Cupola, Metal Pouring, Fettling, Casting Treatment, Inspection and Quality Control, Sand Casting Defects & Remedies.

Unit-IV

Welding: Introduction to Welding, Classification of Welding Processes, Gas Welding: Oxy-

Acetylene Welding, Resistance Welding; Spot and Seam Welding, Arc Welding: Metal Arc, TIG

& MIG Welding, Submerged arc welding (SAW), resistance welding principles, electrode types and selection, thermit welding, electro slag welding, electron beam welding, laser beam welding, forge welding, friction welding, Welding Defects and remedies, brazing & soldering.

Forming Processes: Basic Principle of Hot & Cold Working, Hot & Cold Working Processes, Rolling, Extrusion, Forging, Drawing, Wire Drawing and Spinning, Sheet Metal Operations: Measuring, Layout marking, Shearing, Punching, Blanking, Piercing, Forming, Bending and Joining.

TEXT BOOKS:

1. Manufacturing Engineering Technology, K. Jain, Pearson Education

2. Manufacturing Technology: Foundry, Forming and Welding by P.N.Rao, TMH.

3. Principles of Manufacturing Materials and Processes, James S.Campbell, TMH.

4. Welding Metallurgy by G.E.Linnert, AWS.

5. Production Engineering Sciences by P.C.Pandey and C.K.Singh, Standard Publishers Ltd.

6. Manufacturing Science by A.Ghosh and A.K.Mallick, Wiley Eastern

ETME 252A	**FLUID MACHINES LAB**	**C** **1**

Course Objectives: To impart practical exposure on the performance evaluation methods of various flow measuring equipment and hydraulic turbines and pumps.

Course Outcomes: 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.

Applications:

1. To gain knowledge in performance testing of Hydraulic Turbines and Hydraulic Pumps at constant speed and Head

2. To provide the students' knowledge in calculating performance analysis in turbines and pumps and can be used in power plants

3. 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

		L	T	P	C
ETME 252A	**FLUID MACHINES LAB**	**-**	**-**	**2**	**1**

LIST OF EXPERIMENTS

1. To study the constructional details of a Pelton turbine and draw its fluid flow circuit.

2. To draw the performance characteristics of Pelton turbine-constant head, constant speed and constant efficiency curves.

3. To study the constructional details of a Francis turbine and draw its fluid flow circuit.

4. To draw the constant head, constant speed and constant efficiency performance characteristics of Francis turbine.

5. To study the construction details of a Kaplan turbine and draw its fluid flow circuit.

6. To draw the constant head, speed and efficiency curves for a Kaplan turbine.

7. To study the constructional details of a Centrifugal Pump and draw its characteristic curves.

8. To study the constructional details of a Reciprocating Pump and draw its characteristics curves.

9. To study the construction details of a Gear oil pump and its performance curves.

10. To study the constructional details of a Hydraulic Ram and determine its various efficiencies.

11. To study the constructional details of a Centrifugal compressor.

12. To study the model of Hydro power plant and draw its layout.

ETME 254A	**KINEMATICS OF MACHINES LAB**	**C**
		1

Overview

Kinematics of Machine lab provides the practical knowledge to the students about various mechanisms & their applications in machineries. This enables student to learn various experiments of different mechanism like cam-follower mechanism, gears, gear train etc. In this way students will understand the practical applications of basic principles in day to day life

Objective and Expected Outcome

Course Objectives:

Student will acquire acknowledge in

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:

Student will demonstrate knowledge in

1. Designing a suitable mechanism depending on application

2. Drawing displacement diagrams and cam profile diagram for followers executing different types of motions and various configurations of followers,

3. Drawing velocity and acceleration diagrams for different mechanisms,

4. Selecting gear and gear train depending on application.

ETME 254A	KINEMATICS OF MACHINES LAB	L	T	P	C
		-	-	2	1

LIST OF EXPERIMENTS

1. To study various types of Kinematic links, pairs, chains and Mechanisms.

2. To study inversions of 4 Bar Mechanisms, Single and double slider crank mechanisms.

3. To plot slider displacement, velocity and acceleration against crank rotation for single slider crank mechanism.

4. To find coefficient of friction between belt and pulley.

5. To study various type of cam and follower arrangements.
6. To plot follower displacement vs cam rotation for various Cam Follower systems.

7. To generate spur gear involute tooth profile using simulated gear shaping process.

8. To study various types of gears – Helical, cross helical worm, bevel gear.

9. To study various types of gear trains – simple, compound, reverted, epicyclic and differential.

10. To find co-efficient of friction between belt and pulley.

11. To study the working of Screw Jack and determine its efficiency.

12. Create various types of linkage mechanism in CAD and simulate for motion outputs and study the relevant effects.

13. Creation of various joints like revolute, planes, spherical, cam follower and study the degree of freedom and motion patterns available.

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.

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SEMESTER V

ETME 301A	**DYNAMICS OF MACHINES**	**C**
		4

Overview:

Dynamics: is that branch of theory of machines which deals with the forces and their effects, while acting upon the machine parts in motion. Dynamics of Machines is a fundamental subject for Mechanical engineers to understand the working principals of any machine. This course is essential to understand the motion, transmission of the motion and the forces responsible for the motion.

Course Objectives:

1. To equip the student with fundamental knowledge of dynamics of machines so that student can appreciate problems of dynamic force balance, transmissibility of forces, isolation of systems, vibrations.
2. To develop knowledge of analytical and graphical methods for calculating balancing of rotary and reciprocating masses.
3. To develop understanding of vibrations and its significance on engineering design.
4. To develop understanding of dynamic balancing, flywheel analysis, gyroscopic forces and moments.

Course Outcomes: On successful completion of this course, student should be able to:

1. To analyze stabilization of sea vehicles, aircrafts and automobile vehicles.

2. To compute frictional losses, torque transmission of mechanical systems.

3. To analyze dynamic force analysis of slider crank mechanism and design of flywheel.

4. To understand how to determine the natural frequencies of continuous systems starting from the general equation of displacement.

5. Understand balancing of reciprocating and rotary masses.

		L	T	P	C
ETME 301A	**DYNAMICS OF MACHINES**	**3**	**1**	**-**	**4**

Course Objective: the objective of this course is to provide a brief knowledge about Balancing of Rotating Component, Governors, Gyroscope.

UNIT I

Static and Dynamic Force Analysis: Static force analysis of planer mechanisms, dynamic force analysis including inertia and frictional forces of planer mechanisms.

Dynamics of Reciprocating Engines: engine types, indicator diagrams, gas forces, equivalent masses, inertia forces, bearing loads in a single cylinder engine, crankshaft torque, engine shaking forces.

UNIT II

Balancing of Rotating Components: Static balance, dynamic balance, balancing of rotating masses, two plane balancing, graphical and analytical methods, balancing of rotors, balancing machines, field balancing, Balancing of Reciprocating Parts: Balancing of single cylinder engine, balancing of multi cylinder; inline, radial and V type engines, firing order.

UNIT III

Governors: Introduction, types of governors, characteristics of centrifugal governors, gravity controlled and spring controlled centrifugal governors, hunting of centrifugal governors, inertia governors. Dynamometers: types of dynamometers, Prony brake, rope brake and band brake dynamometers, belt transmission dynamometer, torsion dynamometer, hydraulic dynamometer.

UNIT IV

Gyroscope: Gyroscopes, gyroscopic forces and couples, gyroscopic stabilization, ship stabilization, stability of four wheel and two wheel vehicles moving on curved paths.

TEXT BOOKS:

1. Theory of Mechanisms and Machines: Amitabh Ghosh and Ashok Kumar Mallik, Third Edition\ Affiliated East-West Press.

2. Theory of Machine: S.S. Rattan, McGraw Hill Higher Education.

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

2. Theory of Machines and Mechanisms: Joseph Edward Shigley and John Joseph Uicker, Jr. Second Edition McGraw Hill, Inc

ETME 303A	**MACHINE DESIGN-I**	**C** **4**

Overview: The Overview of this course is to provide a brief knowledge about Selection of Materials, Mechanical Joints, Belt rope and Chain Drives & Key Coupling.

Course objectives:

1. Abilities to develop equations about the design of machine elements.
2. Knowledge of different types of joints.
3. Understanding and learning a basic idea about the design process.
4. Knowledge of different materials and their properties for designing the components of machines.

1. Ability to select and design of the different types of joint under various loading conditions.
2. Ability to choose and design the fasteners as per the requirement.
3. Recognize different materials, their properties as well as their applications and select the Standards used in the design of machine elements.
4. Apply the knowledge of Mathematics, Science, and Engineering for designing machine part.
5. Ability to select and design the shaft under various loading conditions.

ETME 303A	MACHINE DESIGN-I	L	T	P	C
		3	1	-	4

Course Objective: the objective of this course is to provide a brief knowledge about Selection of Materials, Mechanical Joints, Belt rope and Chain Drives & Key Coupling.

UNIT I

Design Philosophy: Problem identification- problem statement, specifications, constraints, Feasibility study technical feasibility, economic & financial feasibility, societal & environmental feasibility, Generation of solution field (solution variants), Brain storming, Preliminary design, Selection of best possible solution, Detailed design, Selection of Fits and tolerances and analysis of dimensional chains.

Selection of Materials: Classification of Eng. Materials, Mechanical properties of the commonly used Eng. Materials, hardness, strength parameters with reference to stress-strain diagram, Factor of safety.

UNIT II

Mechanical Joints: ISO Metric Screw Threads, Bolted joints in tension, Eccentrically loaded bolted joints in shear and under combined stresses, Design of power screws, Design of various types of welding joints under different static load conditions.

Riveted Joints, Cotter & Knuckle Joints: Design of various types of riveted joints under different static loading conditions, eccentrically loaded riveted joints, design of cotter and knuckle joints.

UNIT III

Belt rope and chain drives: Design of belt drives, Flat & V-belt drives, Condition for Transmission of max. Power, Selection of belt, design of rope drives, design of chain drives with sprockets.

Keys, Couplings & Flywheel: Design of Keys – Flat, Kennedy Keys, Splines, Couplings design

– Rigid & Flexible coupling, turning Moment diagram, coefficient of fluctuation of energy and speed, design of flywheel – solid disk & rimmed flywheels.

UNIT IV

Clutches: Various types of clutches in use, Design of friction clutches – Disc. Multidisc, Cone & Centrifugal, Torque transmitting capacity.

Brakes: Various types of Brakes, Self-energizing condition of brakes, Design of shoe brakes – Internal & external expanding, band brakes, Thermal Considerations in brake designing.

TEXT BOOKS:

1. Mechanical Engg. Design - First Metric Editions: Joseph Edward Shigley-MGH, New York.
2. Design of Machine Elements – V.B. Bhandari – Tata McGraw Hill, New Delhi.
3. PSG Design Data Book

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.
5. Design of machine elements-C S Sharma, KamleshPurohit, PHI.

ETME 311A	INTERNAL COMBUSTION ENGINES & GAS TURBINES	C 4

Overview:

This course studies the fundamentals of how the design and operation of internal combustion engines affect their performance, efficiency, fuel requirements, and environmental impact. Topics include fluid flow, thermodynamics, combustion, heat transfer and friction phenomena, and fuel properties, with reference to engine power, efficiency, and emissions. Students examine the design features and operating characteristics of different types of internal combustion engines: spark-ignition, diesel, stratified-charge, and mixed-cycle engines.

Course Objective:

The objective of this course is to make students familiar with the design and operating characteristics of modern internal combustion engines. Also to apply analytical techniques to the engineering problems and performance analysis of internal combustion engines, Cooling Systems, Testing/Performance and Air pollution from I.C. Engine and its remedies.

Course Outcome:

Students will be able to…

- Demonstrate the working of different systems and processes of S.I. engines and C.I. engines
- Demonstrate the working of different systems and processes of illustrate the working of lubrication, cooling and supercharging systems.
- Analyze performance and air pollution through the engine
- Illustrate emission norms and emission control
- Comprehend the different technological advances in engines and alternate fuels

ETME 311A	**INTERNAL COMBUSTION ENGINES &**	**L**	**T**	**P**	**C**
	GAS TURBINES	**4**	**-**	**-**	**4**

Course Objective: **T**he objective of this course is to provide a brief knowledge about Internal Combustion Engines, Cooling Systems, Engine Testing and Performance, Air pollution from I.C. Engine and Its remedies.

UNIT I

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

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

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

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; multi stage compression with inter-cooling; multi stage expansion with reheating between stages; exhaust gas heat exchanger, Applications of gas turbines. Problems

TEXT BOOKS:

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:

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

ETEC 308 A	**CONTROL SYSTEMS**	**C**
		4

COURSE OVERVIEW:

This course is designed to provide essential knowledge **t**o give an outline for the analysis of linear control systems. This will provide a student time and frequency domain tools to design and study linear control systems. The various control systems like closed loop and open loop are studied with the help of real time examples. These systems can be represented by the mathematical differential equations advantages to provide the mathematical modelling of physical systems. The transfer function gives the behavior of the output of the system. The various methods of finding the transfer function block diagrams reduction and signal flow graph can be used. The study of AC servo motors, armature controlled and field controlled DC servomotors by deriving their transfer functions has been done in the course. A system can be fully utilized with the proper use of basic control actions- proportional, integral and derivative controllers, with the feedback effect to analyze the transient and steady state response of first and second order systems. A control system designed must be stable and controllable. The stability of the system is the basic necessity for the sustainability of the system, to keep a check on the stability - Routh's Stability criterion, root locus techniques, bode diagram, polar plots and other methods can be used. For studying the output of the system concept of state-state variable and state model with the time invariant and homogeneous state equations are taken for checking the controllability and observability of the system.

COURSE OBJECTIVES:

While the students are involved with a enjoyable lab experience, the educational pedagogy is pinpointed on vital learning objectives. After the effective finish of the course, learners should be able to recognize the basic of control system.

COURSE OUTCOME:

- Identify open and closed loop control system

- Importance of feedback system.
- Formulate mathematical model for physical systems.
- Simplify representation of complex systems using reduction techniques.
- Use standard test signals to identify performance characteristics of first and second-order systems.
- Apply different techniques for stability analysis.

ETEC 308A	CONTROL SYSTEM	L	T	P	C
		3	1	-	4

Course Objective: To give an introduction to the analysis of linear control systems. This will permit an engineer to hands on time domain and frequency domain tools to design and study linear control systems.

UNIT - I

Definitions of Control Systems, Closed Loop and Open Loop Control system, Examples of Control Systems. Mathematical modelling of physical systems, differential equations of physical systems, transfer functions. Armature controlled and field controlled DC servomotors; AC servomotors and deriving their transfer functions; Transfer function from block diagrams and signal flow graphs.

UNIT - II

Basic Control Actions: Proportional, integral and Derivative controllers, effect of feedback on control system; Transient and steady state response of first order system; Second order system, Routh's Stability criterion, relative stability analysis; Static error co-efficient, position, velocity and acceleration error co-efficient.

UNIT – III

Root Locus Techniques Bode Diagram, Minimum and Non-Minimum phase systems; Determination of Transfer from Bode Diagram; Polar Plots; Nyquist Plot; Stability Analysis using; Constant M & N Loci.

UNIT - IV

Introduction to Compensators; lead, lag, lead-lag compensators, Concept of state- state variable and state model, Solution of time invariant, homogeneous state equation, controllability and observability, state transition matrix and its properties.

Text Books:

1. I. J. Nagrath, M. Gopal, “Control System Engineering” New Age International.
2. N. K. Jain, “Automatic Control System Engineering” Dhanpat Rai

Reference Books:

1. Ogata, “Modern Control Engineering” EEE
2. Kuo, “Automatic Control Systems” PHI

ETME 313A	**MANUFACTURING TECHNOLOGY II**	**C**
		4

Overview:

This subject is designed to make the student understand about various machining processes and tools used for machining and their mechanical analysis. It is also useful to explore the various non-conventional machining processes and modern numerical control production processes.

The basic objective to study this subject is to get knowledge of various non-traditional machining processes, Application of these machining methods in various fields and Use of advance technology in various fields.

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

1. Student will be able to choose machining processing to manufacture any component
2. Student will be able to Estimate machining time for milling and drilling process.
3. Student will be able to understand finishing processes
4. Student will be able to calculate forces during orthogonal metal cutting.
5. Student will be able to explain principle and applications of advanced machining processes
6. Student will be able to develop part program for turning.
7. Student will be able to design jig and fixture for given component
8. Student will be able to implement the knowledge of machining processes in manufacturing industries.

ETME 313A	MANUFACTURING TECHNOLOGY II	L	T	P	C
		4	0	0	4

Course Objective: This subject is designed to make the student understand about various machining processes and tools used for machining and their mechanical analysis. It is also useful to explore the various non-conventional machining processes and modern numerical control production processes.

Unit 1

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, factor 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 2

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 3

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 4

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.

Text Books

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

Reference Books

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.

ETME 351A	DYNAMICS OF MACHINE LAB	C
.	.	1

Overview:

Dynamics: is that branch of theory of machines which deals with the forces and their effects, while acting upon the machine parts in motion. Dynamics of Machines is a fundamental subject for Mechanical engineers to understand the working principals of any machine. This course is essential to understand the motion, transmission of the motion and the forces responsible for the motion.

Course Objectives:

1. To perform experiment on Watt and Porter Governors to prepare performance characteristic Curves, and to find stability & sensitivity.
2. To perform experiment on Proell Governor to prepare performance characteristic curves, and to find stability & sensitivity.
3. To perform experiment on Hartnell Governor to prepare performance characteristic Curves, and to find stability & sensitivity.
4. To study gyroscopic effects through models.
5. To determine gyroscopic couple on Motorized Gyroscope.
6. To perform the experiment for static balancing on static balancing machine.
7. To perform the experiment for dynamic balancing on dynamic balancing machine.
8. Determine the moment of inertial of connecting rod by compound pendulum method and tri-flair suspension pendulum.

Course Outcomes: On successful completion of this practical course, student should be able to:

1. To differentiate between the governors
2. To understand the working of governors.
3. To analyze dynamic force analysis of slider crank mechanism and design of flywheel.
4. Understand balancing of reciprocating and rotary masses.

ETME 351A	DYNAMICS OF MACHINES LAB	L	T	P	C
		-	-	2	1

LIST OF EXPERIMENTS

1. To perform experiment on Watt and Porter Governors to prepare performance characteristic Curves, and to find stability & sensitivity.
2. To perform experiment on Proell Governor to prepare performance characteristic curves, and to find stability & sensitivity.
3. To perform experiment on Hartnell Governor to prepare performance characteristic Curves, and to find stability & sensitivity.
4. To study gyroscopic effects through models.
5. To determine gyroscopic couple on Motorized Gyroscope.
6. To perform the experiment for static balancing on static balancing machine.
7. To perform the experiment for dynamic balancing on dynamic balancing machine.
8. Determine the moment of inertial of connecting rod by compound pendulum method and tri-flair suspension pendulum.

ETME 357A	MANUFACTURING TECHNOLOGY LAB	C
		1

Overview:

This lab course is designed to prepare students for employment in the manufacturing industry. Students will learn the basic principles and operative skills to setup, program, and operate

Computer Numerical Control (CNC) machinery. Instruction includes an overview of the machining process, quality control, beginning CNC operations and manual programming skills.

Course Objective:

To understand the concept of manufacturing system and its operating principles, casting, forming, material removal, welding, quality control and advanced manufacturing technologies

.The objective of this course is to provide a brief knowledge about Metal forming Jigs and Fixtures, Unconventional Machining Processes, Numerical Control of Machine Tools.

Course Outcome:

Students will be able to…

- Demonstrate understanding of casting process
- Illustrate principles of forming processes
- Demonstrate applications of various types of welding processes.
- Differentiate chip forming processes such as turning, milling, drilling, etc.
- Illustrate the concept of producing polymer components and ceramic components.
- Distinguish between the conventional and modern machine tools

		L	T	P	C
ETME 357A	**MANUFACTURING TECHNOLOGY LAB**	**-**	**-**	**2**	**1**

LIST OF EXPERIMENTS

1. Study and Practice of Orthogonal & Oblique Cutting on a Lathe.

2. Machining time calculation and comparison with actual machining time while cylindrical turning on a Lathe and finding out cutting efficiency.

3. Study of Tool Life while milling a component on the Milling Machine.

4. Study of Tool Wear of a cutting tool while drilling on a Drilling Machine.

5. Study of Speed, Feed, Tool, Preparatory (Geometric) and miscellaneous functions for N. C part programming.

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

7. Part Programming and Proving on a NC Milling Machine:-

    a. Point to Point Programming

    b. Absolute Programming

    c. Incremental Programming

8. Part Programming and Proving for Milling a Rectangular Slot.

ETME 355A	INTERNAL COMBUSTION ENGINE & GAS TURBINE	C
	LAB	1

Overview:

This lab course studies the fundamentals of how the design and operation of internal combustion engines affect their performance, efficiency, fuel requirements, and environmental impact. Topics include fluid flow, thermodynamics, combustion, heat transfer and friction phenomena, and fuel properties, with reference to engine power, efficiency, and emissions. Students examine the design features and operating characteristics of different types of internal combustion engines: spark-ignition, diesel, stratified-charge, and mixed-cycle engines.

Course Objective:

The main objective of this lab is to develop an idea of fuel properties and their variation with temperature, determination of kinematic viscosity and calorific value of fuels, understanding of basic internal combustion engine performance, Cooling Systems, determination of friction power and volumetric efficiency of I.C. engines and the use of multi-stage compression

Course Outcome:

Students will be able to…

- Understand the complete operation of 2 stroke and 4 stroke I.C engines
- Find the performance of 2-S and 4-S engines and the variation of various performance parameters with load and speed.
- Know how to balance the heat energy available in engine cylinder after the combustion process.
- Understand the working and performance evaluation of mechanical power consuming devices like compressors.

- Analyze the performance of the variable compression ratio engine with computerized set up which enables the understanding of pressure variation with crank angle during a cycle of operation.
- Find the kinematic viscosity of fuels and its variation with temperature.
- Demonstrate the working of different systems and processes of S.I. engines and C.I. engines

ETME 355A	**INTERNAL COMBUSTION ENGINE &**	**L**	**T**	**P**	**C**
	GAS TURBINE LAB	**-**	**-**	**2**	**1**

LIST OF EXPERIMENTS

1. To study the constructional details & working principles of two-stroke/ four stroke petrol engine.
2. To study the constructional detail & working of two-stroke/ four stroke diesel engine.
3. Analysis of exhaust gases from single cylinder/multi cylinder diesel/petrol engine by Orsat Apparatus.
4. To prepare heat balance sheet on multi-cylinder diesel engine/petrol engine.

5. To find the indicated horse power (IHP) on multi-cylinder petrol engine/diesel engine by Morse Test.

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.

7. To find fhp of a multi-cylinder diesel engine/petrol engine by Willian's line method & by motoring method.

8. To perform constant speed performance test on a single cylinder/multi-cylinder diesel engine & draw curves of (i) bhpvs fuel rate, air rate and A/F and (ii) bhpvsmep, mech efficiency &sfc.

9. To measure CO & Hydrocarbons in the exhaust of 2- stroke / 4-stroke petrol engine.

10. To find intensity of smoke from a single cylinder / multi-cylinder diesel engine.

11. To draw the scavenging characteristic curves of single cylinder petrol engine.

12. To study the effects of secondary air flow on bhp, sfc, Mech. Efficiency & emission of a two-stroke petrol engine.

SEMESTER VI

ETME 302A	**HEAT TRANSFER**	**C**
		4

Overview:

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 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.
5. To evaluate the changes in properties of substances in various heat transfer processes.

Course Outcomes:

1. After completing this course, the students will be able to apply energy balance to systems and control volumes, in situations involving heat and work interactions.
2. Students can evaluate changes in thermodynamic properties of substances in various heat transfer processes.
3. The students will be able to evaluate the performance of energy conversion devices.
4. The students will be able to analyze the applicant fields of heat transfer phenomenon.

		L	T	P	C
ETME 302A	**HEAT TRANSFER**	**3**	**1**	**-**	**4**

Course Objective: the objective of this course is to provide a brief knowledge about Steady State Conduction with Heat Generation, Thermal Radiation, Heat Exchangers.

UNIT I

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, Numericals

UNIT II

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

UNIT III

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, Numericals.

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 gray bodies, Radiation shields, Numericals.

UNIT IV

Heat Exchangers: Classification, Performance variables, Analysis of a parallel/counter flow heat exchanger, Heat exchanger effectiveness, Numericals.

Heat Transfer with Change of Phase: Laminar film condensation on a vertical plate, Drop-wise condensation, Boiling regimes, Free convective, Nucleate and film boiling, Numericals.

TEXT BOOKS:

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

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.

5. Heat Transmission – W.M., Mc. Adams , Mc Graw Hill.

ETME 307A	**COMPUTER AIDED DESIGN**	**C**
		4

Overview:

The objective of this course is to provide a brief knowledge about Curves, Automation and Numerical Control; Flexible Manufacturing Systems & Computer aided process planning.

Course Objectives:

5. To impart fundamental knowledge to students in the latest technological topics on Computer Aided Design.
6. To broaden and deepen their capabilities in analytical and experimental research methods, analysis of data, and drawing relevant conclusions for scholarly writing and presentation.
7. To provide guidance to students for their choices in research and professional career outlook and to encourage students to take up research.

1. Ability to create fully constrained solid models that can be quickly modified using standard software tools.

2. ability to use, identify and explain standard features in solid modeling including protrusions, revolutions, cutouts, and patterns.
3. Ability to use standard software tools to create engineering drawings, or other documents, to fully describe the geometries and dimensions of parts, as well as to document assemblies according to standard practice.
4. Ability to use standard software tools to create part assemblies and check for clearances.
5. Ability to create the drawings of farm implements and their analysis.
6. Ability to write the CNC part programming.

ETME 307A	**COMPUTER AIDED DESIGN**	**L**	**T**	**P**	**C**
		4	**-**	**-**	**4**

Course Objective: the objective of this course is to provide a brief knowledge about Curves, Automation and Numerical Control; Flexible Manufacturing Systems & Computer aided process planning

UNIT I

Introduction: Introduction to CAD, Design Process, Introduction to CAM/ CIMS, Importance and Necessity of CAD, Applications of CAD, Hardware and Software requirement of CAD, Basics of geometric and solid modeling, coordinate systems.

Transformations: Introduction, transformation of points and line, 2-D rotation, reflection, scaling and combined transformation, homogeneous coordinates, 3-D scaling, shearing, rotation, reflection and translation, combined transformations.

UNIT II

Curves: Algebraic and geometric forms, tangents and normal, blending functions reparametrization, straight lines, conics, cubic splines, Bezier curves and B-spline curves. Surfaces and Solids: Plane surface, ruled surface, surface of revolution, tabulated cylinder, bi-cubic surface, Bezier surface, B-spline surface, Solid models and representation scheme, boundary representation, constructive solid geometry, sweep representation, cell decomposition.

UNIT III

Automation and Numerical Control: Introduction, fixed, programmable and flexible automation, types of NC systems, MCU and other components, NC manual part programming, coordinate systems, G & M codes, Part program for simple parts, computer assisted part programming.

Group Technology: Part families, part classification and coding, production flow analysis, Machine cell design, Advantages of GT.

UNIT IV

Flexible Manufacturing Systems & Computer aided process planning: Introduction, FMS components, types of FMS, FMS layouts, planning for FMS, advantages and applications Conventional process planning, types of CAPP, Steps in variant process planning, planning for CAPP.

Finite Element Method: Introduction, Procedure, Finite Element Analysis, Finite Element Modeling, Analysis of 1D, 2D structural problems.

TEXT BOOKS:

1. CAD/ CAM by Groover and Zimmer, Prantice Hall.
2. CAD/ CAM Theory and Practice by Zeid, McGraw Hill
3. Numerical Control and Computer Aided Manufacturing by Kundra, Rao&Tiwari, TMH.

REFERENCE BOOKS:

CAD/CAM (Principles, Practice & Manufacturing Management) by ChirsMc Mohan & Jimmie Browne, Published by Addison- Wesley.

ETME 304A	**MACHINE DESIGN II**	**C**
		4

Overview:

Analysis and design of machine elements such as power screws and threaded fasteners; joining components such as rivets and welds; springs; various types of gears such as spur, helical, bevel, and worm; clutches, brakes, belts and chains

Course Objectives:

The objective of this course is to provide a brief knowledge about Shafts, springs, Bearings & Gears and to apply the scientific principles and concepts to the design of basic mechanical components and systems; improving problem solving and decision making abilities; obtaining design solutions to open-ended problems through a systematic design process. The course includes the analysis of the geometry, reference to construction materials, strength analysis, the

analytical calculation, the design and the manufacturing methods of all types of gears. Also makes an introduction to epicycles mechanisms by analyzing the operation and applications especially in vehicle use.

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

1. Describe and identify the main gears, Design and develop the appropriate gear for each application, Analyze the stress-strain state of power transmission train gears loading, Calculate the strength of each case study, Select materials and processing method of non-standard gears, Design and analyze Mechanical multiple-element arrangements, Design and calculate multistage gear reducers, Analyze and make kinematic and dynamic calculations of planetary systems mechanisms.
2. Analyze the stress and strain on mechanical components; and understand, identify and quantify failure modes for mechanical parts
3. Demonstrate knowledge on basic machine elements used in machine design; design machine elements to withstand the loads and deformations for a given application, while considering additional specifications.
4. Be able to approach a design problem successfully, taking decisions when there is not a unique answer.

		L	T	P	C
ETME 304A	**MACHINE DESIGN-II**	**3**	**1**	**-**	**4**

Course Objective: the objective of this course is to provide a brief knowledge about Shafts, springs, Bearings & Gears.

UNIT I

Design for Production; Erogonomic and value engineering considerations in design, Role of processing in design, Design considerations for casting, forging and machining. Variable Loading : Different types of fluctuating/ variable stresses, Fatigue strength considering stress concentration factor, surface factor, size factor, reliability factor etc., Fatigue design for finite and infinite life against combined variable stresses using Goodman and Soderberg's Criterion, Fatigue design using Miner's equation, Problems.

UNIT II

Shafts: Detailed design of shafts for static and dynamic loading, Rigidity and deflection consideration.

Springs: Types of springs, Design for helical springs against tension and their uses, compression and fluctuating loads, Design of leaf springs, Surging phenomenon in springs, Design Problem.

UNIT III

Bearings : design of pivot and collar bearing , Selection of ball and roller bearing based on static and dynamic load carrying capacity using load-life relationship, Selection of Bearings from manufacturer's catalogue, types of lubrication – Boundary, mixed and hydrodynamic lubrication, Design of journal bearings using Raimondi and Boyd's Charts, Lubricants and their properties, Selection of suitable lubricants, Design Problems.

UNIT IV

Gears : Classification, Selection of gears, Terminology of gears, Force analysis, Selection of material for gears, Beam & wear strength of gear tooth, Form or Lewis factor for gear tooth, Dynamic load on gear teeth –Barth equation and Buckingham equation and their comparison, Design of spur, helical, bevel & worm gear including the Consideration for maximum power transmitting capacity, Gear Lubrication, Design Problems.

TEXT BOOKS:

1. Mechanical Engg. Design- Joseph Edward Shigley-Mc Graw Hill Book Co.
2. Design of Machine Elements – V.B. Bhandari – Tata McGraw Hill, New Delhi.

REFERENCE BOOKS:

1. Engineering design – George Dieter, McGraw Hill, New York.
2. Product Design and Manufacturing –: A.K.Chitale and R.C.Gupta, PHI, New Delhi.
3. Machine Design An Integrated Approach: Robert L. Norton, Second Edition –Addison Wisley Longman

4. Machine Design: S.G. Kulkarni, TMH, New Delhi.

ETME 306A	**ROBOTICS & AUTOMATION**	**C**
		4

Overview:

Robotics courses vary widely, from subjective theory courses to technical hands-on courses. In a robotics program, students discover motion planning, kinematics, acceleration and serial chain mechanisms. This course blends multiple disciplines including Electronics, Robotic Controls, Automated Systems and PLCs to give students a well-rounded education in Robotic Technology and Automation.

Course Objective:

The objective of this course is to make students familiar with the design and operating characteristics of modern robotics. Students will understand the techniques and applications of Automation and Robotics Programming in an industrial environment. They will learn to design and implement robotic systems and apply what they learned to a career in the Automation and Robotics field.

Course Outcome:

Students will be able to…

- How to troubleshoot robotic systems
- See how programmable controllers control automation
- Learn how electronics, circuits and sensors effect automation controls
- Learn why hydraulics and pneumatics move industrial robots

- Align, fit and assemble robot component parts
- test robotic assembles
- Develop robotic path motions

ETME 306A	ROBOTICS & AUTOMATION	L	T	P	C
		4	-	-	4

Course Objective: the objective of this course is to provide a brief knowledge about Robot kinematics, Robot dynamics, Configuration of a robot controller, Applications for manufacturing.

UNIT I

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

Robot kinematics: Matrix representation. Homogeneous transformations. Forward and inverse kinematics.

Robot dynamics: Differential motions of a frame. Jacobian, static force analysis.

UNIT III

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

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.

ETME 312A	**NON-CONVENTIONAL ENERGY RESOURCES**	**C** **4**

Overview:

The purpose of this course is to provide a brief knowledge about non-conventional energy resources or renewable energy resources such as Geothermal Energy, Fuel Cells, Thermo-electrical and thermionic Conversions, Wind Energy, Bio-mass & Ocean Thermal Energy Conversion (OTEC).

Course Objectives:

1. To encourage the preferential use of renewable energy.
2. To debate the best technical and sustainable options for increasing renewable energy and energy efficiency.
3. Facilitate Research and Development in renewable energy and energy efficiency
4. Disseminate information on renewable energy and energy efficiency.

1. Understand the different non-conventional sources and the power generation techniques to generate electrical.
2. Design a prescribed engineering sub-system.
3. Recognize the need and ability to engage in lifelong learning for further developments in this field.

ETME 312A	**NON-CONVENTIONAL ENERGY RESOURCES**	**L**	**T**	**P**	**C**
		4	**-**	**-**	**4**

Course Objective: the objective of this course is to provide a brief knowledge about. Geothermal Energy, Fuel Cells, Thermo-electrical and thermionic Conversions, Wind Energy, Bio-mass & Ocean Thermal Energy Conversion (OTEC).

UNIT I

Introduction: Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits.

Solar Cells: Theory of solar cells. solar cell materials, solar cell power plant, limitations.

Solar Thermal Energy: Solar radiation flat plate collectors and their materials, applications and performance, focussing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.

UNIT II

Geothermal Energy: Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations.
Magneto-hydrodynamics (MHD): Principle of working of MHD Power plant, performance and limitations.

UNIT III

Fuel Cells: Principle of working of various types of fuel cells and their working, performance and limitations.

Thermo-electrical and thermionic Conversions: Principle of working, performance and limitations.

Wind Energy: Wnd power and its sources, site selection, criterion, momentum theory,classification of rotors, concentrations and augments, wind characteristics.performance and limitations of energy conversion systems.

UNIT IV

Bio-mass: Availability of bio-mass and its conversion theory.

Ocean Thermal Energy Conversion (OTEC): Availability, theory and working principle, performance and limitations.

Wave and Tidal Wave: Principle of working, performance and limitations. Waste Recycling Plants.

REFERENCES BOOKS:

1. Andra Gabdel, "A Handbook for Engineers and Economists".

2. A. Mani , "Handbook of Solar radiation Data for India".

3. Peter Auer, "Advances in Energy System and Technology". Vol. 1 & II Edited by Academic Press.

4. F.R. the MITTRE, "Wind Machines" by Energy Resources and Environmental Series.

C

ETME 320A AUTOMOBILE ENGINEERING

4

Overview: The overview of this course is to provide a brief knowledge about Power Transmission, Suspension Systems, Automotive Brakes, Tyres & Wheels.

Course Objectives:

The purpose of this course is to impart adequate knowledge in both practically and theoretically, covering the various types of systems of Automobile vehicles and to familiarize the students with the fundamentals of vehicle, Chassis and suspension system, braking and transmission system, and cooling system. The students are acquainted with the operation, maintenance and repairs of all components of the various transportation vehicles.

Course Outcomes:

After taking this course the students should be able to

1. List different types of Engine and their classifications.

2. Judge firing order for multi-cylinder engines for igniting of fuels.

3. Develop concept and define working of Automobile Engine cooling and lubrication system.

4. Describe functioning of Transmission train, conventional and non-conventional drives, Clutches, Gear boxes, Synchromesh device, Propeller shaft, Differential axle, braking system and Suspension systems.

5. Describe functioning of steering system, steering geometry wheel alignment and wheel angles for modern Automobile.

7. Explain the need of Catalytic converter and their functioning.

		L	T	P	C
ETME 320A	**AUTOMOBILE ENGINEERING**	**4**	**-**	**-**	**4**

Course Objective: the objective of this course is to provide a brief knowledge about Power Transmission, Suspension Systems, Automotive Brakes, Tyres & Wheels.

UNIT I

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

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 load coming on Rear Axles, Full Floating, Three quarter Floating and Semi Floating Rear Axles.

UNIT III

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, Toein/ 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

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.

TEXT BOOKS:

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.

ETME 352A	**HEAT TRANSFER LAB**	**C**
		1

Overview: 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.

Course Objectives:

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 cross-flow heat exchanger.

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

1. Evaluate heat transfer through lagged pipe, Insulating powder and Drop and Film wise condensation.

2. Experiment the Thermal conductivity of a given metal Rod.
3. 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.

4. Test Emissivity, Stefan Boltzmann Constant and Critical Heat flux.

		L	T	P	C
ETME 352A	**HEAT TRANSFER LAB**	**-**	**-**	**2**	**1**

LIST OF EXPERIMENTS

1. To determine the thermal conductivity of a metallic rod.

2. To determine the thermal conductivity of an insulating power.

3. To determine the thermal conductivity of a solid by the guarded hot plate method.

4. To find the effectiveness of a pin fin in a rectangular duct natural convective condition and plot temperature distribution along its length.

5. To find the effectiveness of a pin fin in a rectangular duct under forced convective and plot temperature distribution along its length.

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.

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.

8. To measure the emmisivity of the gray body (plate) at different temperature and plot the variation of emmisivity with surface temperature.

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.

10. To verify the Stefen-Boltzmann constant for thermal radiation.

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.

12. To study the two phases heat transfer unit.

13. To determine the water side overall heat transfer coefficient on a cross-flow heat exchanger.

14. Design of Heat exchanger using CAD and verification using thermal analysis package eg. I-Deas etc.

ETME 353A	**COMPUTER AIDED DESIGN LAB**	**C** **1**

Overview

Course emphasis is on introducing the use of computer aided design tools in the engineering problem solving process. Assigned design projects require the use of both wire frame and solid modeling tools. Lecture and lab activities are used to support project requirements and to provide more in-depth understanding of computer aided engineering design and drawing.

1. To present an overview of CAD and describe its applications in different fields.
2. To describe common terms associated with CADD hardware and software.
3. To outline the basic principles associated with CAD and to demonstrate common drafting techniques and shortcuts used by professionals.
4. To introduce the advanced capabilities of CAD and how they can be used to increase productivity.
5. To provide information about the CADD industry resources.

1. Interpret 2D part drawings of the parts.
2. Understand fundamental concepts of solid modeling such as geographical constraints, the creation and use of reference geometry, and the creation of and modification of sketches and features.
3. Create basic 2D drawings of parts and assemblies.

ETME 353A	COMPUTER AIDED DESIGN LAB	L	T	P	C
		-	-	2	1

LIST OF EXPERIMENTS

1. Setting up of drawing environment by setting drawing limits, drawing units, naming the drawing, naming layers, setting line types for different layers using various type of lines in engineering drawing, saving the file with .dwg extension.

2. Layout drawing of a building using different layer and line colors indicating all Building details. Name the details using text commands, Make a title Block.

3. To Draw Orthographic projection Drawings (Front, Top and side) of boiler safety valve giving name the various components of the valve.

4. Make an Isometric dimensioned drawing of a connecting Rod using isometric grid and snap.

5. Draw quarter sectional isometric view of a cotter joint.

6. Draw different types of bolts and nuts with internal and external threading in Acme and square threading standards. Save the bolts and nuts as blocks suitable for insertion.

7. Draw 3D models by extruding simple 2D objects, dimension and name the objects.

8. Draw a spiral by extruding a circle.

ETME 354A	**ROBOTICS & AUTOMATION LAB**	**C**
		1

Overview:

The Robotics & Automation Lab is an arrangement of numerous robotic arms and industrial devices such as conveyor belts and sensors. The lab environment simulates small manufacturing lines by requiring the use of multiple electromechanical inputs to invoke a controlled sequence of outputs. 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.

Course Objective:

The objective of this course is to make students familiar with interfacing robotic systems with computers and programming them with specific, controlled motions. Also, familiarize students with managing the control flow of inputs from various sensors to guide the automated movement of robotic systems and other industrial devices to produce a certain sequence of mechanical events. Through this students will learn to design and implement robotic systems and apply what they learned to a career in the Automation and Robotics field.

Course Outcome:

Students will be able to…

- Describe and explain 3D translation and orientation representation & illustrate the robot arm kinematics and use of Robot Operating System usage.
- Design / Simulate a robot which meets kinematic requirements
- Apply localization and mapping aspects of mobile robotics.
- Demonstrate self-learning capability.

- Select & identify suitable automation hardware for the given application.
- Describe & explain potential areas of automation
- Differentiate various control aspects of automation
- Demonstrate the self-learning capability of Industrial Automation.

		L	T	P	C
ETME 354A	**ROBOTICS & AUTOMATION LAB**	**-**	**-**	**2**	**1**

LIST OF EXPERIMENTS

1. Demonstration of Cartesian/ cylindrical/ spherical robot.

2. Demonstration of Articulated/ SCARA robot.

3. Virtual modeling for kinematic and dynamic verification any one robotic structure using suitable software.
4. Design, modeling and analysis of two different types of grippers.

5. Study of sensor integration.

6. Two program for linear and non-linear path.

7. Study of robotic system design.

8. Setting robot for any one industrial application after industrial visit.

ETME 356A	**AUTOMOBILE ENGINEERING LAB**	**C**
		1

Course Objectives: To enable the students to understand the basic principles of steering, fluid coupling, Torque convertor, different types of clutch through theoretical and experimental means.

Course Outcomes:

After taking this course the students should be able to

1. Understand the working of Different types of clutches.
2. Understand the working different types of steering system.
3. Distinguish between the working of different type's clutch and gear transmissions.
4. Understand the working of Different types of Brakes in automobile Engineering.

ETME 356A	**AUTOMOBILE ENGINEERING LAB**	**L**	**T**	**P**	**C**
		-	**-**	**2**	**1**

LIST OF EXPERIMENTS

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. To study and prepare report on the constructional details, working principles and operation of the following Fuels supply systems:

    a. Carburetors

    b. Diesel Fuel Injection Systems

    c. Gasoline Fuel Injection Systems.

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.

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.

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.

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.

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.

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.

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.

10. To study and prepare report on the constructional details, working principles and operation of Automotive Emission / Pollution control systems.

11. Modeling of any two automotive systems on 3D CAD using educational softwares (eg. 3D modeling package/Pro Engineering/I-Deas/ Solid edge etc.)

12. Crash worthiness of the designed frame using Hypermesh and LS-Dyna solver or other software.

SEMESTER VII

ETME 401A	**REFRIGERATION & AIR-CONDITIONING**	**C**
		4

Overview:

The overview of this course is to provide a brief knowledge about Vapor Compression (VC) Refrigeration Systems, Other Refrigeration Systems, Psychometry of Air & Air Conditioning Processes, & Air Conditioning Systems with Controls & Accessories.

Course objectives:

1. To understand the properties of refrigerants.
2. To understand the fundamentals of refrigeration and air conditioning.
3. To calculate the COP of the refrigerator.
4. To calculate the cooling/heating load for different applications.
5. To study the appropriate equipment for various RAC applications.

Course outcomes:

After taking this course students should be able to

1. Illustrate the basic concepts of refrigeration system and analyze the vapour compression cycle.
2. Understand VARS, aircraft refrigeration system and select proper refrigerant.

3. Use psychrometric principles for air-conditioning systems.

4. Design various components of air-conditioning systems.

ETME 401A	**REFRIGERATION & AIR-CONDITIONING**	**L**	**T**	**P**	**C**
		3	**1**	**-**	**4**

Course Objective: the objective of this course is to provide a brief knowledge about Vapour Compression (VC) Refrigeration Systems, Other Refrigeration Systems, Psychrometry of Air & Air Conditioning Processes, & Air Conditioning Systems with Controls & Accessories.

UNIT I

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

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

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

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 Equipments: 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.

TEXT BOOKS:

1. Refrigeration & Air conditioning –R.C. Jordan and G.B. Priester, Prentice Hall of India.
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.

ETME 405A	**POWER PLANT ENGINEERING**	**C**
		4

Overview:

The aim of the course is to establish a balanced understanding of the global energy domain, enhancing student contextual understanding of material contained in Power Plant Engineering. World energy outlook, Integrated Energy Plan, Types of power generation plant, Environmental impact and sustainability, Renewable energy resources, Nuclear power generation, Energy industry. Economics of power generation

Course Objective:

The objective of this course is to make students familiar with different aspects of power plant engineering with principles of safety and environmental issues. To understand the working of power plants based on different fuels.

Course Outcome:

Students will be able to…

- Understand basic knowledge of Different types of Power Plants, site selection criteria of each one of them and understanding of Power Plant Economics,
- Energy Storage including compressed air energy and pumped hydro etc.
- Select the suitability of site for a power plant
- Explain the basic principles of thermal-fission and fast-breeder nuclear power plants, such as pressurized-water, boiling-water, and heavy-water reactors.
- Propose ash handling, coal handling method in the thermal power plant.
- Understand the working of Hydroelectric and Nuclear power plant
- Understand the working of Diesel & Gas Turbine Power plant
- Understand Nonconventional Energy sources.
- Design the Power Plant Instrumentation and understand Environmental Impact

ETME 405A	**POWER PLANT ENGINEERING**	**L**	**T**	**P**	**C**
		4	**-**	**-**	**4**

Course Objective: The objective of this course is to provide a brief knowledge about Steam Power Plants, Combined Cycles, Nuclear Power Plants, Hydro Electric Power Plants, Other Power Plant, Control and Economics.

UNIT I

Introduction: Energy resources and their availability, types of power plants, selection of the plants, review of basic thermodynamic cycles used in power plants.

Steam Generator: Fuel handling systems, Indian coals, combustion of coal in furnaces, Elementary boilers- Cochran, Babcock & Wilcox. High pressure heavy duty boilers, Super critical and once through boilers layout of evaporator, super heater, re-heater and economizer; dust collectors; ash disposal, fans and draft systems, fluidized bed combustion;

UNIT II

Steam Power Plants: Flow sheet and working of modern-thermal power plants, super critical pressure steam stations, site selection, coal storage, preparation, coal handling systems, feeding and burning of pulverized fuel, ash handling systems, dust collection-mechanical dust collector and electrostatic precipitator.

Combined Cycles: Constant pressure gas turbine power plants, Arrangements of combined plants (steam & gas turbine power plants), re-powering systems with gas production from coal, using PFBC systems, with organic fluids, parameters affecting thermodynamic efficiency of combined cycles. Problems.

UNIT III

Hydro Electric Power Plants : Rainfall and run-off measurements and plotting of various curves for estimating stream flow and size of reservoir, power plants design, construction and operation of different components of hydro-electric power plants, site selection, comparison with other types of power plants.

Nuclear Power Plants: Principles of nuclear energy, basic nuclear reactions, nuclear reactors-PWR, BWR, CANDU, Sodium graphite, fast breeder, homogeneous; gas cooled. Advantages and limitations, nuclear power station, handling of nuclear waste and safety measures, peak load power generation method.

Other Power Plant: General layout of I.C. Engines and turbine power plants, types, gas turbine plants, fields of application, Nuclear power plants, power reactors and nuclear steam turbines;

UNIT IV

Control: Important instruments on steam generator and turbine; drum water level control, combustion control and super heat temperature control; testing of power plants and heat balance. **Economics**: Planning for power generation in India, super thermal power plants, estimation of cost of power generation; choice of plant site.

TEXT BOOKS:

1. Power station Engineering and Economy by Bernhardt G.A. skrotzki and William A. Vopat – Tata Mc Graw Hill Publishing Campany Ltd., New Delhi
2. Power Plant Engineering: P.K. Nag Tata McGraw Hill second Edition.
3. Arora & Domkundwar, “A course in Power Plant Engineering”, Dhanpat Rai & Sons T2]

4. P.L.Balaney “Thermal Engineering”, Khanna Publishers.

REFERENCE BOOKS:

1. Power Plant Engg. : M.M. El-Wakil McGraw Hill.
2. R.K.Rajput “Thermal Engineering”, Laxmi Publications (P) Ltd.
3. A.S Sarao “Thermal Engineering”, Satya Prakshan.
4. Shamsher Gautam “Power Plant Engineering” Vikas Publishing House

ETME 409A	**MEASUREMENT & METROLOGY**	**C**
		3

Overview:

The objective of this course is to provide a brief knowledge about Comparators, Angular Measurement, Straightness and flatness, Gear Measurement & Machine Tool Alignment.

Course 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.

6. Machine tool testing to evaluate machine tool quality.

Course Outcomes:

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

1. To design tolerances and fits for selected product quality.
2. Choose appropriate method and instruments for inspection of various gear elements and thread elements.
3. Understand the standards of length, angles, they can understand the evaluation of surface finish and measure the parts with various comparators. The quality of the machine tool with alignment test can also be evaluated by them.

ETME 409A	**MEASUREMENTS & METROLOGY**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**

Course Objective: the objective of this course is to provide a brief knowledge about Comparators, Angular Measurement, Straightness and flatness, Gear Measurement & Machine Tool Alignment.

UNIT I

Principles of measurement: Definition of Metrology, difference between precision and accuracy. Sources of errors: Controllable and Random Errors, Effects of Environment and Temperature, Effects of support, alignment errors, application of Least Square principles, errors in measurement of a quality which is function of other variables.

Length Standards: Line standards, end standards and wavelength standards, transfer from line standards to end standards. Numerical based on line standards. Slip gauges – its use and care, methods of building different heights using different sets of slip gauges.

Limits, fits and tolerances: Various definitions, IS919-1963, different types of fits and methods to provide these fits. Numerical to calculate the limits, fits and tolerances as per IS 919-1963. ISO system of limits and fits; Gauges and its types, limit gauges – plug and ring gauges. Gauge Design – Taylor's Principle, wear allowance on gauges. Different methods of giving tolerances on gauges, Numerical

UNIT II

Comparators: Mechanical Comparators: Johanson Mikrokator and Signma Mechanical Comparator. Mechanical - optical comparator. Principles of Electrical and electronic comparators. Pneumatic comparators – advantages, systems of Penumatic gauging:- Flow type and back pressure type, Principle of working of back pressure gauges, different type of sensitivities and overall magnification, Solex Penumatic gauges and differential comparators. Numericals based on pneumatic comparators.

Angular Measurement: Sine Bar – different types of sine bars, use of sine bars in conjuction with slip gauges, precautions and calibration of sine bars. Use of angle gauges, spirit level, errors in use of sine bars. Numericals. Principle and working of Micro-optic autocollimator. Circular Division: dividing head and circular tables, circular division by precision Polygons. Caliper Principle, Calibration of polygons. Numerical based on circular division

UNIT III

Straightness and flatness: Definition of Straightness and Flatness error. Numerical based on determination of straightness error of straight edge with the help of spirit level and auto collimator.

Numerical based on determination of flatness error of a surface plate with the help of spirit level or auto collimator.

Screw Thread Measurement: Errors in threads, Measurement of elements of screw threads – major dia, minor dia, pitch, flank angle and effective diameter (Two and three wire methods). Effect of errors in pitch and flank angles and its mathematical derivation, Numerical

Gear Measurement: Measurement of tooth thickness – Gear tooth vernier caliper, Constant chord method, base tangent method and derivation of mathematical formulae for each method. Test plug method for checking pitch diameter and tooth spacing. Measurement of Gear Pitch, Parkinson Gear Tester, Numericals.

UNIT IV

Machine Tool Alignment: Machine tool tests and alignment tests on lathe. Alignment tests on milling machine. Alignment tests on a radial drilling machine.

Interferometry: Principle of measurement, Interferometry applied to flatness testing, surface contour tests, optical flats, testing of parallelism of a surface with the help of optical flat. Quantitative estimate of error in parallelism, Flatness Interferometer NPL-Gauge length interferometer for checking the error in slip gauges. Numericals based on Interferometry.

Surface texture: Introduction, different types of irregularities, standard measures for assessment and measurement of surface finish.

TEXT BOOKS:

1. R.K. Jain, "Engineering Metrology", Khanna Publishers, Delhi
2. I.C. Gupta, "Engineering Metrology", Dhanpat Rai Publications, Delhi

REFERENCE BOOKS:

1. F.W. Galyer & C.R. Shotbolt, "Metrology for Engineers", ELBS edition.

ETME 417A	**SOLAR ENERGY**	**C**

		4

Course Objective: The course is to provide a brief knowledge about solar system, Solar Collectors, Solar Electric Conversion Systems.

Course Outcome: Student will able to understand the various forms of conventional energy resources. Analyze the environmental aspects of renewable energy resources, historical and latest developments as well as designing of Solar Electric Conversion Systems.

Applications: Solar energy is used for the various components used in the energy production with respect to applications like - heating, cooling, desalination, power generation, Solar Drying of Agricultural and Animal Products, Solar Electric Power Generation, Solar Thermal Power Production & cooking.

ETME 417 A	**SOLAR ENERGY**	**L**	**T**	**P**	**C**
		4	**-**	**-**	**4**

Course Objective: the objective of this course is to provide a brief knowledge about solar system, Solar Collectors, Solar Electric Conversion Systems.

UNIT I

Solar Radiation: Introduction, solar system – sun, earth and earth-sun angles, time, derived solar angles,estimation of solar radiation (direct and diffuse), measurement systems – phyrheliometers and other devices.Effect of Solar radiation upon structures: Steady state heat transmission, solar radiation properties of surfaces,shading of surfaces, periodic heat transfer through walls and roofs.

UNIT II

Solar Collectors: Flat plate and concentrating – comparative study, design and materials,

efficiency, selective coatings, heliostats. Heating Applications of Solar Energy: Air and Water

heating systems, thermal storages, solar bonds, solar pumps, solar lighting systems, solar cookers, solar drying of grains.

UNIT III

Cooling Applications of Solar Systems: Continuous and intermittent vapour absorption systems for cooling applications, absorbent – refrigerant combination, passive cooling systems.

UNIT IV

Solar Electric Conversion Systems: Photovoltaics, solar cells, satellite solar power systems.

Effects on Environment, economic scenario, ozone layer depletion, greenhouse effect, global

Warming, Remedial measures by international bodies

Text Books:

1. Solar Energy – S P Sukhatme, Tata McGraw Hill

2. Solar Energy Process – Duffie and Bechman, John Wiley

Reference Books:

1. Applied Solar Energy – Maniel and Maniel, Addison Wiley

2. Solar Energy: Fundamentals and Applications – R P Garg and Jai Prakash, TMH

C

ETME 451A REFRIGERATION & AIR-CONDITIONING LAB

1

Overview: The Overview of this course is to provide a brief knowledge about Selection of refrigerant, working of components related refrigeration and air-conditioning.

Course Objectives:

1. To familiarize with the terminology associated with refrigeration systems and air conditioning

2. To understand basic refrigeration processes.

3. To understand the basics of psychometry and practice of applied psychometrics.

4. To acquire the skills required to model, analyse and design different refrigeration as well as air conditioning processes and components.

Course Outcomes:

A student who has done this course will have a good understanding of the working principles of refrigeration and air-conditioning systems, Vapour Absorption refrigeration system, Mechanical Heat pump and chiller plant.

ETME 451A	**REFRIGERATION & AIR-CONDITIONING**	**L**	**T**	**P**	**C**
	LAB	**-**	**-**	**2**	**1**

LIST OF EXPERIMENT

1. To study the vapour compression Refrigeration System and determine its C.O.P. and draw P-H and T-S diagrams.

2. To Study the Mechanical heat pump and find its C.O.P.

3. To study the Air and Water heat pump and find its C.O.P.

4. To study the cut- sectional models of Reciprocating and Rotary Refrigerant compressor.

5. To study the various controls used in Refrigerating & Air Conditioning systems.

6. To study the Ice- plant, its working cycle and determine its C.O.P and capacity.

7. To study the humidification, heating, cooling and dehumidification processes and plot them on Psychrometric charts.

8. To determine the By-pass factor of Heating & Cooling coils and plot them on Psychrometric charts on different inlet conditions.

9. To determine sensible heat factor of Air on re-circulated air-conditioning set up.

10. To study the chilling plant and its working cycle.

		C
ETME 453A	**MEASUREMENT & METROLOGY LAB**	**1**

Overview:

The objective of this lab course is to provide a brief knowledge about Comparators, Angular Measurement, Straightness and flatness, Gear Measurement & Machine Tool Alignment with the help experiments and real life exposure.

Course Objectives:

1. To understand the use of Comparators (Mechanical, Opto-Mechanical & Electrical (LVDT)), Projectors (Profile & Tool Maker's Microscope), Angular Measurements using Combination Set, Bevel Protactor & Sine Bar, Linear Measurements using Vernier Caliper (Depth Caliper, Height Gauge) and Micrometers (Outside, Inside Rod type, Inside Jaw type & Point / all Micrometer), Radius Measurement using Radius Gauge & Profile Projector, Inside Diameter Measurement using Bore Gauge, Measurement of Pitch Diameter of External Threads, Use of Plug & Ring Gauges, Snap Gauge (Fixed & Adjustable both), Working Principle of a Pneumatic Air Gauge
2. To use of Slip Gauges of various types and their Setup,
3. Gauge Repeatability & Reproducibility Study using the $\overline{X} - R$ Method,
4. Measurement of Surface Roughness parameters such as R_a, R_t and R_{tm}.

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

1. To design and measure the tolerances and fits for selected product quality.
2. Choose appropriate method and instruments for inspection of various gear elements and thread elements.
3. Understand the standards of length, angles, they can understand the evaluation of surface finish and measure the parts with various comparators. The quality of the machine tool with alignment test can also be evaluated by them.

ETME 453A	MEASUREMENT & METROLOGY LAB	L	T	P	C
		-	-	2	1

LIST OF EXPERIMENTS

1. Use of Comparators (Mechanical, Opto-Mechanical & Electrical (LVDT)),
2. Projectors (Profile & Tool Maker's Microscope),
3. Angular Measurements using Combination Set,
4. Bevel Protactor & Sine Bar,
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,
6. Inside Diameter Measurement using Bore Gauge,
7. Measurement of Pitch Diameter of External Threads,
8. Use of Plug & Ring Gauges, Snap Gauge (Fixed & Adjustable both),
9. Working Principle of a Pneumatic Air Gauge,
10. Use of Slip Gauges of various types and their Setup,
11. Gauge Repeatability & Reproducibility Study using the $\overline{X} - R$ Method,
12. Measurement of Surface Roughness parameters such as R_a, R_t and R_{tm}.

SEMESTER VIII

ETME 402A	**MECHANICAL VIBRATIONS**	**C**
		4

Overview: The overview of this course is to provide a brief knowledge about Harmonically Excited Vibrations, Two Degrees of Freedom Systems & Normal Mode Vibration of Continuous System.

Course Objectives:

1. Understanding of vibration concepts for design of machine parts that operate under vibratory conditions.
2. To be able to obtain the linear vibratory models of dynamic systems with changing complexities.
3. Ability to derive the differential equations of motion of vibratory systems.
4. Capability to carry out vibration analysis using efficient solution methodologies.

Course Outcomes:

1. Understanding of basic concepts and capability to model physical systems that operate in vibratory conditions.
2. Application of principal of Mechanics and mathematics to obtain governing equations
3. Capability to obtain the solution of Governing equations and interpretation of results using efficient methodologies.
4. Ability to model and analyze continuous systems and to obtain approximate solution of vibratory systems.

ETME 402A	MECHANICAL VIBRATIONS	L	T	P	C
		3	1	-	4

Course Objective: the objective of this course is to provide a brief knowledge about Harmonically Excited Vibrations, Two Degrees of Freedom Systems & Normal Mode Vibration of Continuous System.

UNIT I

Fundamentals : Importance of Study of Vibrations, Classifications of Vibrations, Free and Forced, Undamped and Damped, Linear and Non-linear, Deterministic and Random, Harmonic Motion, Vector and Complex Number Representations, Definitions and Terminology, Periodic Functions, Harmonic Analysis, Fourier Series Expansion.

Free and Damped Vibrations : Single Degree of Freedom system, D'Alemberts Principal, Energy Methods, Rayleighs Method, Application of these Methods, Damped Free Vibrations, Logarithmic Decrement, Under Damping, Critical and Over Damping, Coulomb Damping.

UNIT II

Harmonically Excited Vibrations : Forced Damped Harmonic Vibration of Single Degree of Freedom Systems, Rotating Unbalance, Rotor Unbalance, Critical Speeds and Whirling of

Rotating Shafts, Support Motion, Vibration Isolation, Energy Dissipated by Damping, Equivalent, Viscous Camping, Structural Damping Sharpness of Resonance, Vibration Measuring Instruments.

UNIT III

Transient Vibrations: Impulse Excitation, Arbitrary Excitation, Response to Step Excitions, Base Excitation Solution by Laplace Transforms, Response Spectrum, Runge-Kutta Method. **Two Degrees of Freedom Systems :** Introduction to Multi-Degree of Freedom Systems, Normal Mode Vibrations, Coordinate Coupling, Principal Coordinates, Free Vibrations in Terms of Initial Conditions, Forced Harmonic Vibrations, Vibration Absorber, Centrifugal Vibration Absorber, Vibration Damper.

UNIT IV

Multi degrees of Freedom Systems and Numerical Methods Introduction, Influence Coefficients, Stiffness Matrix, Flexibility Matrix, Natural Frequencies and Normal Modes, Orthogonality of Normal Modes, Dunkerley's Equation, Method of Matrix Iteration, The Holzer Type Problem, Geared and Branched Systems, Beams.

Normal Mode Vibration of Continuous System: Vibrating String, Longitudinal Vibrations of Rod, Torsional Vibrations of Rod, Lateral Vibrations of Beam.

TEXT BOOKS:

1. Theory of Vibrations with Applications W.T. Thomson, Prentice Hall of India.

2. Mechanical Vibrations: G.K. Grover and S.P. Nigam, Nem Chand and Sons

REFERENCE BOOKS:

1. Theory and Practice of Mechanical Vibrations J.S. Rao and K. Gupta, Wiley Eastern Ltd.

2. Mechanical Vibrations S.S. Rao, Addison – Wesely Publishing Company

ETME 404A	ADDITIVE MANUFACTURING	C
		4

Overview:

Additive Manufacturing (AM) is an economically viable alternative to conventional manufacturing technologies for producing highly complex parts. The main objective of this course is to acquaint students with the concept of AM, various AM technologies, selection of materials for AM, modeling of AM processes, and their applications in various fields. The course will also cover AM process plan including building strategies and post-processing.

Course 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.

1. Understand the reverse engineering.
2. Familiar with the materials of Additive Manufacturing.
3. Select the technologies for Additive Manufacturing.
4. Solve problems on mathematical models for AM.

ETME 404A	ADDITIVE MANUFACTURING	L	T	P	C
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Course Objective: Additive Manufacturing (AM) is an economically viable alternative to conventional manufacturing technologies for producing highly complex parts. The main objective of this course is to acquaint students with the concept of AM, various AM technologies, selection of materials for AM, modeling of AM processes, and their applications in various fields. The course will also cover AM process plan including building strategies and post-processing.

UNIT I

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

Materials science for AM - multifunctional and graded materials in AM, Role of solidification rate, Evolution of non-equilibrium structure, microstructural studies, Structure property relationship,

UNIT III

AM technologies - Powder-based, droplet based, extrusion based, object stereolithography, Micro- and Nano-additive processes.

UNIT IV

Mathematical models for AM, Selection of AM technologies using decision methods, AM process plan, Monitoring and control of defects, transformation.

TEXT BOOKS:

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:

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.

B.TECH (ME) **K.R Mangalam University, Gurugram** **Scheme of Studies 2020**

ETME 412A	**INDUSTRIAL ENGINEERING**	**C** **3**

Overview:

The objective of this course is to provide a brief knowledge about Manufacturing Cost Analysis, Materials Management, Quality Management, and Production Planning & Control (PPC).

1. Assume professional, technical managerial, or leadership roles within industrial organizations and/or pursue graduate level education
2. Apply knowledge through discovery, synthesis, and integration for the betterment of their organization or society at large.

1. Function on multidisciplinary teams.
2. Identify, formulate, and solve engineering problems.
3. Understand professional and ethical responsibility.
4. Communicate effectively.
5. Understand the impact of engineering solutions in a global, economic, environmental, and societal context.
6. Know contemporary issues.
7. Use the techniques, skills, and modern engineering tools necessary for engineering practice.

ETME 412A	INDUSTRIAL ENGINEERING	L	T	P	C
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Course Objective: the objective of this course is to provide a brief knowledge about Manufacturing Cost Analysis, Materials Management, Quality Management, Production Planning & Control (PPC).

UNIT I

Definition of Industrial Engineering: Objectives, Method study, Principle of motion economy, Techniques of method study - Various charts, THERBLIGS, Work measurement -

various methods, time study PMTS, determining time, Work sampling, Numericals. Productivity & Workforce Management :Productivity - Definition, Various methods of measurement, Factors effecting productivity, Strategies for improving productivity, Various methods of Job evaluation

& merit rating, Various incentive payment schemes, Behavioural aspects, Financial incentives.

UNIT II

Manufacturing Cost Analysis: Fixed & variable costs, Direct, indirect & overhead costs, & Job costing, Recovery of overheads, Standard costing, Cost control, Cost variance Analysis - Labour, material, overhead in volume, rate & efficiency, Break even Analysis, Marginal costing & contribution, Numericals.

Materials Management : Strategic importance of materials in manufacturing industries, Relevant costs, Inventory control models - Economic order quantity (EOQ), Economic batch quantity (EBQ) with & without shortage, Purchase discounts, Sensitivity analysis, Inventory control systems - P,Q,Ss Systems, Service level, Stock out risk, determination of order point & safety stock, Selective inventory control - ABC, FSN, SDE, VED and three dimensional, Numericals.

UNIT III

Quality Management: Definition of quality, Various approaches, Concept of quality assurance systems, Costs of quality, Statistical quality Control (SQC), Variables & Attributes, X, R, P & C

- charts, Acceptance sampling, OC - curve, Concept of AOQL, Sampling plan - Single, Double & sequential, Introduction to TQM & ISO - 9000.

Production Planning & Control (PPC) : Introduction to Forecasting - Simple & Weighted moving average methods, Objectives & variables of PPC, Aggregate planning - Basic Concept, its relations with other decision areas, Decision options - Basic & mixed strategies, Master production schedule (MPS), Scheduling Operations Various methods for line & intermittent production systems, Gantt chart, Sequencing – Johnson algorithm for n-Jobs-2 machines, n-Jobs-3 machines, 2 Jobs n-machines, n-Jobs m-machines Various means of measuring effectiveness of PPC, Introduction to JIT, Numericals.

UNIT IV

Management Information Systems (MIS) : What is MIS Importance of MIS, Organizational & information system structure, Role of MIS in decision making, Data flow diagram, Introduction to systems analysis & design, organizing information systems.

Product Design and Development: Various Approaches, Product life cycle, Role 3S's –

Standardization, Simplification, Specialization, Introduction to value engineering and analysis, Role of Ergonomics in Product Design.

TEXT BOOKS:

1. Production & Operations Management - Chary, TMH, New Delhi.
2. Management Information Systems - Sadagopan, PHI New Delhi.
3. Modern Production Management – S.S. Buffa, Pub.- John Wiley.

REFRENCE BOOKS:

1. Operations Management - Schroeder, McGraw Hill ISE.
2. Operation Management - Monks, McGraw Hill ISE.
3. Production & Operations Management - Martinich, John Wiely SE.
4. Industrial & Systems Engineering - Turner, MIZE, CHASE, Prentice Hall Pub.