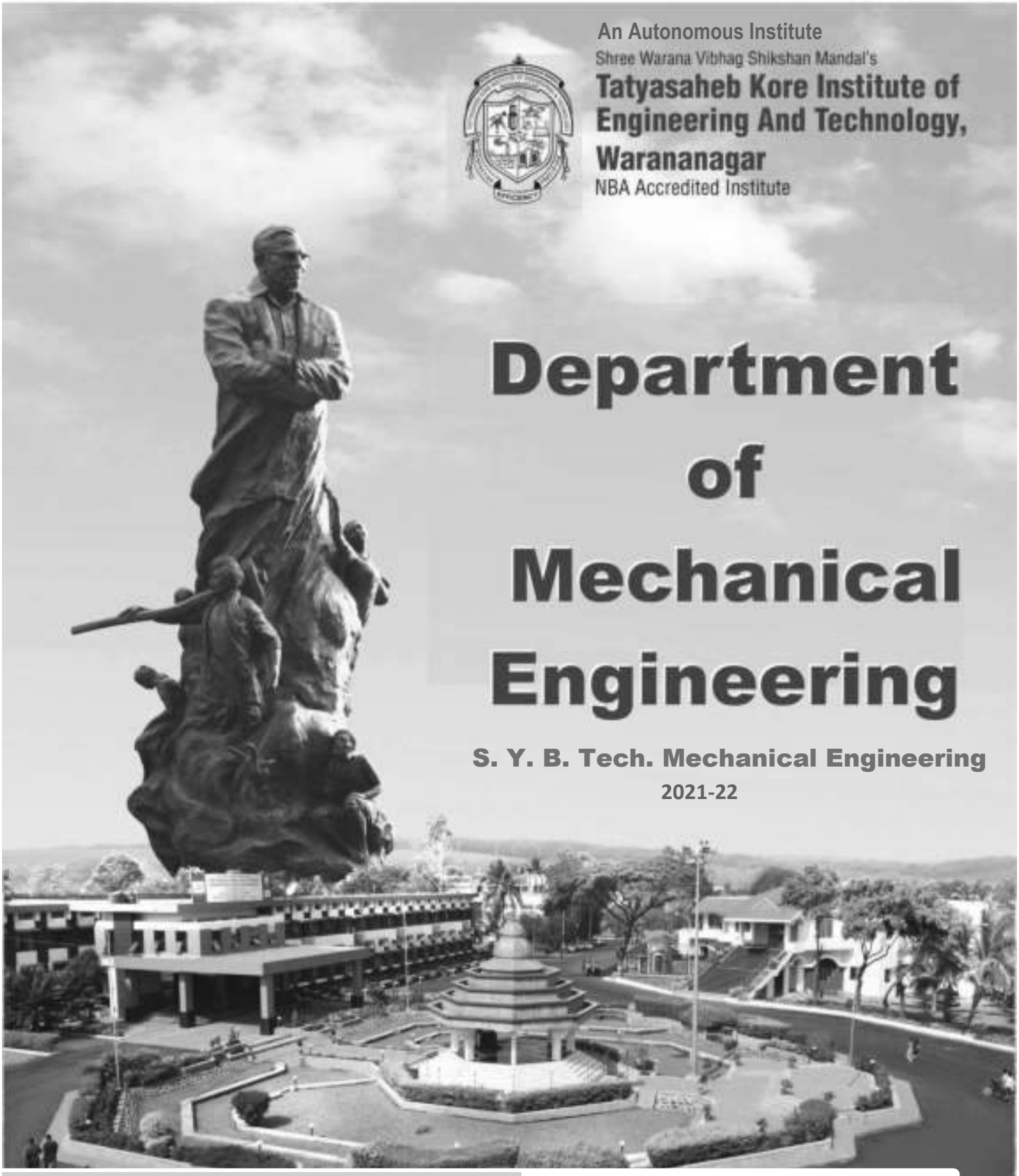


An Autonomous Institute

Shree Warana Vibhag Shikshan Mandal's

Tatyasaheb Kore Institute of Engineering And Technology, Warananagar

NBA Accredited Institute

Department of Mechanical Engineering

S. Y. B. Tech. Mechanical Engineering

2021-22

B. Tech. In Mechanical Engineering

Syllabus Structure and Curriculum under Autonomy

Tatyasaheb Kore Institute of engineering and Technology, Warananagar
An Autonomous Institute

Department of Mechanical Engineering

❖ Vision

To become an academy of excellence in technical education and human resource development.

❖ Mission

- To develop engineering graduates of high repute with professional ethics.
- To excel in academics and research through innovative techniques.
- To facilitate the employability, entrepreneurship along with social responsibility.
- To collaborate with industries and institutes of national recognition.
- To inculcate lifelong learning and respect for the environment.

❖ Quality Policy

To promote excellence in academic and training activities by inspiring students for becoming competent professionals to cater industrial and social needs.

Tatyasaheb Kore Institute of engineering and Technology, Warananagar
An Autonomous Institute
Department of Mechanical Engineering

PROGRAM EDUCATIONAL OBJECTIVES

Graduates will be able to,

[1] Make successful careers in Indian and multinational companies
[2] Be competent with strong technological background to solve industrial and societal problems
[3] Succeed in a post graduate as well as research programs.
[4] Be sensitive towards professional ethics and environmental issues.
[5] Lead teams for executing multidisciplinary projects

PROGRAM OUTCOMES

After completion of the Program, graduates will have,

[1] An ability to apply knowledge of mathematics, science and engineering fundamentals to solve complex Mechanical engineering problems
[2] An ability to analyze the mechanical problem, interpret data through synthesis and evaluate to make conclusion
[3] Capability to solve complex engineering problems and design system components or processes as per specified requirements addressing public health, safety, cultural, societal and environmental issues
[4] An ability to identify the problems and apply the research methodology to formulate, investigate and validate the outcomes.
[5] An ability to make use of advanced techniques and tools necessary in engineering practices
[6] An ability to understand societal, health, safety, legal and cultural issues while providing solutions for mechanical engineering problems
[7] An ability to develop sustainable solutions and identify with their effects on society and environment
[8] An apply ethical principles and commit to professional ethics and responsibilities of the engineering practice
[9] An ability to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
[10] An ability to comprehend technical ideas, communicate through effective design documentation and oral presentation.
[11] An ability to lead and manage multidisciplinary teams by applying engineering and management principles.
[12] An ability to engage in independent and life - long learning in the broadest context of advancement in technology.

PROGRAM SPECIFIC OUTCOMES

[1] Graduates will be able to model and analyze the machine design problems.
[2] Graduates will be able to demonstrate the working of energy conversion devices.
[3] Graduates will be able to manufacture the products using different machine tools.

SWVSM'S

Tatyasaheb Kore Institute of Engineering andTechnology, Warananagar

An Autonomous Institute

Abbreviations

Sr. No.	Acronym	Definition
1	ISE	In-Semester Examination
2	ISE-I	In-Semester Examination-I
3	ISE-II	In-Semester Examination-II
4	ESE	End Semester Examination
5	ISA	In-Semester Assessment (Term Work)
6	L	Lecture
7	T	Tutorial
8	P	Practical
9	CH	Contact Hours
10	C	Credit

Course/ Subject Categories

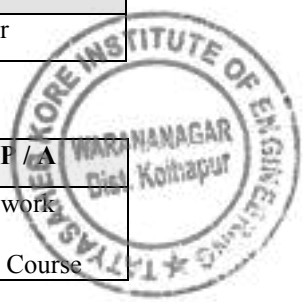
Sr. No.	Acronym	Definition
1	BSC	Basic Science Course
2	HSC	Humanity Science Course
3	ESC	Engineering Science Course
4	PCC	Professional Core Course
5	OEC	Open Elective Course
6	MC	Mandatory Course
7	PEC	Professional Elective Course
8	PW	Project Work (Mini and Major Project)
9	II	Industrial Internship

Course/ Subject Code

M	E	3	0	1
Branch Code		Semester	Course Number	

Course Term work and POE Code

M	E	3	0	1	T / P / A
Branch Code		Semester	Course Number		T- Term work P- POE A- Audit Course



Second Year B. Tech. In Mechanical Engineering

Syllabus Structure under Autonomous Status of TKIET, Warananagar

2021-22

Tatyasaheb Kore Institute of Engineering and Technology, Warananagar

Second Year B. Tech. (Mechanical Engineering)

Semester-III

(To be implemented from 2021 - 22)

Credit Scheme

Course Code	Category	Course Title	Teaching and Credit Scheme					Examination & Evaluation Scheme			
			L	T	P	CH	C	Component	Marks	Min for Passing	
ME301	BSC	Engineering Mathematics - III	3	--	--	3	3	ESE	60	24	40
								ISE	40	16	
ME302	PCC	Applied Thermodynamics	3	--	--	3	3	ESE	60	24	40
								ISE	40	16	
ME303	PCC	Material Science and Metallurgy	3	--	--	3	3	ESE	60	24	40
								ISE	40	16	
ME304	ESC	Fluid Mechanics	3	--	--	3	3	ESE	60	24	40
								ISE	40	16	
ME305	ESC	Electrical Technology	2	--	--	2	2	ESE	60	24	40
								ISE	40	16	
ME301T	BSC	Engineering Mathematics – III Tutorial		1	--	1	1	ISA	25	10	10
ME302T	PCC	Applied Thermodynamics Lab		--	2	2	1	ISA	25	10	10
ME305T	ESC	Electrical Technology Lab		--	2	2	1	ISA	25	10	10
ME303P	PCC	Material Science and Metallurgy Lab	--	--	2	2	1	ISA	25	10	10
								POE	25	10	10
ME304P	ESC	Fluid Mechanics Lab	--	--	2	2	1	ISA	25	10	10
								POE	25	10	10
ME306	PCC	Industrial Drawing	--	--	2	2	1	ISA	25	10	10
ME307	ESC	Programming in C++	--	--	2	2	1	ISA	50	20	20
ME308	PCC	Manufacturing Skill Development Lab -I	--	--	2	2	1	ISA	50	20	20
ME309A	--	Audit Course - III	--	--	--	--	--	--	--	--	--
			14	1	14	29	22	--	800	--	--

Note: In theory examination, there will be separate passing of ESE and ISE.

Tatyasaheb Kore Institute of Engineering and Technology, Warananagar

Second Year B. Tech. (Mechanical Engineering)

Semester- IV

(To be implemented from 2021-22)

Credit Scheme

Course Code	Category	Course Title	Teaching Scheme					Examination & Evaluation Scheme			
			L	T	P	CH	C	Component	Marks	Min for Passing	
ME401	ESC	Computational Techniques and Programming	2	--	--	2	2	ESE	60	24	40
								ISE	40	16	
ME402	PCC	Analysis of Mechanical Elements	3	--	--	3	3	ESE	60	24	40
								ISE	40	16	
ME403	PCC	Fluid and Turbo Machinery	3	--	--	3	3	ESE	60	24	40
								ISE	40	16	
ME404	PCC	Theory of Machines –I	3	--	--	3	3	ESE	60	24	40
								ISE	40	16	
ME405	PCC	Manufacturing Processes and Machine Tools	3	--	--	3	3	ESE	60	24	40
								ISE	40	16	
ME401T	ESC	Computational Techniques and Programming Lab	--	--	2	2	1	ISA	25	10	10
ME402T	PCC	Analysis of Mechanical Elements Lab	--	--	2	2	1	ISA	25	10	10
ME403T	PCC	Fluid and Turbo Machinery Lab	--	--	2	2	1	ISA	25	10	10
ME406	ESC	Programming in Python	--	--	2	2	1	ISA	50	20	20
ME404P	PCC	Theory of Machines –I Lab	--	--	2	2	1	ISA	25	10	10
								POE	25	10	10
ME407P	PCC	Manufacturing Skill Development Lab -II	--	--	2	2	1	ISA	25	10	10
								POE	50	20	20
ME408P	PCC	Computer Aided Drafting	--	--	2	2	1	ISA	25	10	10
								POE	25	10	10
ME409A	--	Audit Course – IV	--	--	--	--	--	--	--	--	--
			14	0	14	28	21		800	--	--

Note: In theory examination, there will be separate passing of ESE and ISE.

Second Year B. Tech. (Mechanical Engineering)

First Semester Detailed Syllabus

ME301- ENGINEERING MATHEMATICS - III

Lectures	**:** 3 Hrs/Week	**Evaluation Scheme**	
Credit	**:** 3	**ISE**	**:** 40 Marks
Tutorials	**:** 1 Hr/Week	**ESE**	**:** 60 Marks

Course Objectives: The objective of the course is to

1. Deliver the basics of Differential equation, Laplace transforms, Fourier series, and Statistics
2. Provide the knowledge to identify and solve different problems of Mechanical engineering

Course Outcomes:

COs	At the end of successful completion of the course, the student will beable to	Blooms Taxonomy
CO1	Solve Linear Differential Equation of higher order	Knowledge Understand
CO2	Identify and solve Partial differential equations	Understand
CO3	Compute Laplace transform and apply them to solve Ordinary differential equations	Apply
CO4	Expand functions in terms of sine and cosine	Understand
CO5	Calculate divergence, curl, gradient and directional derivative of a vector and scalar point function	Apply Evaluate
CO6	Use Binomial, Poisson and Normal distributions to calculate probabilities	Apply

Description:

Engineering Mathematics-III course is offered as the basic science course. This course contains Mathematical methods and techniques that are used to solve complex Mechanical engineering problems. This course has six units namely i) Linear Differential equation, ii) Partial Differential Equations iii) Vector Differentiation, iv) Laplace Transformation, v) Fourier Series and vi) Correlation, Regression and curve fitting.

Prerequisites:	1:	Trigonometric identities and Logarithmic identities
	2:	Differentiation and integration formulae
	3:	Partial Differentiation.

Section – I

Unit 1	**Linear Differential Equations**	
	Linear Differential Equation with constant coefficients-Definition, Complementary and particular integrals (without method of variation of parameter), Homogeneous linear differential equations.	**7 Hrs**
Unit 2	**Partial Differential Equations**	
	Introduction; formation of partial differential equations; Linear equations of first order, Non-linear equations of first order (four Standard forms).	**6 Hrs**

Unit 3	**Laplace Transformation**	
	Definition and Laplace transforms of elementary functions, properties of Laplace transforms, Transforms of derivatives and integrals, Multiplication by tn, division by t, Evaluation of integrals by Laplace transforms, Inverse Laplace transform using method of partial fraction and convolution theorem (without proof), Solution of Ordinary differential equation by transform method.	**7 Hrs**
Section – II		
Unit 4	**Fourier Series**	
	Introduction of Dirchlet's conditions, Euler's formulae. Fourier Series of functions of period 2L, even and odd functions, half range sine and cosine series.	**7 Hrs**
Unit 5	**Vector Differentiation**	
	Differentiation of vectors, Velocity and acceleration, Gradient of scalar point function and Directional derivative, Divergence of vector point function, Curl of a vector point function, Solenoidal and Irrotational vector fields	**6 Hrs**
Unit 6	**Probability Distributions**	
	Random variable, Mathematical Expectation, Standard Deviation, Binomial, Poisson and Normal distributions.	**7 Hrs**

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	2	1	--	--	--	--	--	---	--	--	--	--	--	--	--
CO2	2	2	--	--	--	--	--	--	--	--	--	--	--	--	--
CO3	2	1	--	--	--	--	--	--	--	--	--	--	--	--	--
CO4	2	1	--	--	--	--	--	--	--	--	--	--	--	--	--
CO5	2	1	--	--	--	--	--	--	--	--	--	--	--	--	--
CO6	2	1	1	--	--	--	--	--	--	--	--	--	--	--	--

References:

Text Books	
1	Higher Engineering Mathematics, Dr. B. S. Grewal, S. Chand and Company, 40th Edition.
2	Advanced Engineering Mathematics, H. K. Das, S. Chand Publication, 8th Edition.
Reference Books	
1	Higher Engineering Mathematics, B. V. Ramana, Tata Mc Graw Hill, New Delhi
2	A Text Book of Applied Mathematics, Vol. I and II, P. N.Wartikar and J. N. Wartikar, Vidyarthi Griha Prakashan, Pune.

3	A textbook of Engineering Mathematics, N. P. Bali, Iyengar, Laxmi Publications (P) Ltd, New Delhi
4	Advanced Engineering Mathematics,Erwin Kreyszig, Wiley India Pvt. Ltd

Web Links/ Video Lectures

Lectures

1. **https://nptel.ac.in/courses/111/107/111107098/**
2. **https://nptel.ac.in/courses/111/101/111101153/**
3. **https://nptel.ac.in/courses/111/105/111105123/**
4. **https://nptel.ac.in/courses/111/106/111106111/**
5. **https://nptel.ac.in/courses/111/105/111105122/**

ME302 - APPLIED THERMODYNAMICS

Lectures: 3 hrs/week
Credits: 3
Tutorials: __

Evaluation Scheme:
ESE: 60 Marks
ISE: 40 Marks

Course Objectives: The objective of the course is to

1. Provide knowledge of basic concept of energy, energy transfer and different laws of thermodynamics.
2. Study of applications of first and second laws of thermodynamics on various thermodynamic devices like steam generator, condenser, nozzle and turbine.
3. Make understand about construction and working of different types of steam turbines and performance analysis of these devices using velocity diagrams.

Course Outcomes:

COs	At the end of successful completion of the course, the student will beable to	Blooms Taxonomy
CO1	Define and state thermodynamics concepts, fundamental laws, basic principles	Knowledge
CO2	Summarize the construction and working of steam power plant, steam boilers, steam condensers ,steam nozzles, steam turbines	Understand
CO3	Apply theory of thermodynamics to calculate different performance parameters for steam boiler, steam condenser, steam nozzle and steam turbine	Apply
CO4	Compare the device such as steam condensers, steam nozzles, steam turbines used in steam power plant for better performance.	Analyze
CO5	Estimate the design parameters calculations of Steam nozzles and steam turbine for given operating conditions	Evaluate
CO6	Plot the velocity diagrams for impulse and reaction steam turbines	Create

Description:

Thermodynamics is a course that explores the concepts of heat and how it can be converted to Work/ power or vice versa, covers all the aspects of energy and energy transfer. Power generation and Refrigeration are two focal aspects of applied thermodynamics which are outcomes of second law of thermodynamics.

This Course covers only power generation aspect of thermodynamics specifically steams power. Hence it is essential for Mechanical engineering students to understand thermodynamics principles, fundamentals things that are useful to the engineering applications The student will learn thermodynamics basic concepts, definitions, laws, thermodynamics cycle, work, heat and energy; enthalpy and entropy, state equation etc. By applying these concepts for the main components of steam power plant (Boiler, Steam nozzles, Steam turbines, steam condensers),students are able to understand and analyze the performance of it.

	1:	Basic Mechanical Engineering

Prerequisites:	2:	Applied Physics
	3:	Basic Engineering Mathematics

Section - I		
Unit 1	**Review of Laws of Thermodynamics:**	
	Zeroth law, first law and Second law of thermodynamics, Statement of third law of thermodynamics. Corollaries of Second Law, Equivalence of Second law Simple Numerical treatment second law of Thermodynamics (Heat engine, Refrigerator and Heat Pump), Entropy, Clausius theorem, Clausius inequality, Entropy as a property of system, Entropy change in a reversible and irreversible processes, Increase of entropy principle, Calculation of entropy changes of gases,(numerical treatment should be based on single Thermodynamic process),	**08Hrs**
Unit 2	**Properties of Pure Substances and Vapour Power Cycles**	
	Properties of steam, Use of steam table and Mollier chart, Temperature Entropy Diagram Carnot cycle using steam, Limitations of Carnot cycle Rankine cycle, Representation on P-v, Ts and h-s planes, Thermal efficiency, Specific steam consumption. Work ratio, Effect of steam supply pressure and temperature, Condenser pressure on the performance. (Numerical Treatment)	**06Hrs**
Unit 3	**Steam Condensers**	
	Steam Condenser, Functions, Elements of condensing plant, Types of steam condensers, surface and jet condensers, Comparison, Vacuum efficiency, Condenser efficiency, Sources of air leakages, Methods of leak detection Estimation of cooling water required (Numerical Treatment on Steam Condensers)	**06Hrs**
Section - II		
Unit 4	**Steam Nozzles**	
	Functions, Shapes, Critical pressure ratio, Maximum discharge condition, Effect of faction, Design of throat and exit areas, Nozzle efficiency, Velocity coefficient, Coefficient of discharge, Supersaturated flow, Degree of under-cooling and degree of super saturation, Effects of super saturation(Numerical Treatment on nozzle without friction)	**06Hrs**
Unit 5	**Impulse Turbines**	
	Principles of operation, Classification, Impulse and reaction steam turbine, compounding of steam turbines. Flow through impulse turbine blades, Velocity diagrams, Work done, Efficiencies, End thrust, Blade friction, condition curve and reheat factors.(Numerical Treatment on Single stage impulse turbine)	**07Hrs**
Unit 6	**Reaction Turbines**	
	Comparison between impulse and reaction, Flow through impulse reaction blades, turbine Velocity diagram, and degree of reaction, Parson's reaction turbine, Governing of steam turbines. Losses in steam turbines, Performance of steam turbines. Function of diaphragm, Glands, Turbine troubles like Erosion, Corrosion, Vibration, Fouling etc. (Numerical Treatment on Single stage impulse reaction turbine)	**07Hrs**

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	3	--	--	--	--	--	--	--	--	--	--	--	--	3	--
CO2	3	1	--	--	--	--	--	--	--	--	--	--	--	3	--
CO3	2	3	2	1	--	--	--	--	--	--	--	--	1	2	--
CO4	2	3	2	1	--	--	--	--	--	--	--	--	1	2	--
CO5	2	3	2	1	--	--	--	--	--	--	--	--	1	2	--
CO6	2	1	2	2	--	--	--	--	--	--	--	--	1	1	--

References:

Text Books	
1	"Thermal Engineering", Kumar and Vasandani, D. S . Publisher Metropolitan Book Co, Delhi, 3rd Edition.
2.	"Thermal Engineering", Ballaney P.L, Khanna Publishers, New Delhi, 27th Edition.
3.	"Engineering Thermodynamics", P.K. Nag., Tata McGraw Hill, New Delhi, 4th Edition.
4.	"Thermal Engineering", R. K. Rajput, Laxmi Publications, 3rd Edition.
5.	"Steam and Gas Turbines", R. Yadav, CPH Allahabad, 2nd Edition , 2005.
Reference Books	
1	"Fundamentals of Thermodynamics", Claus Borgnakke, Sonntag R. E., John Wiley and
2	"Thermodynamics: an Engineering Approach", Cengel and Boles, Tata McGraw-Hill, New Delhi, 3rdEdition,.

Video Lectures

Lectures 1 to 40. https://nptel.ac.in/courses/112/105/112105123/

ME303 - MATERIAL SCIENCE AND METALLURGY

Lectures: 3 hrs / week
Credits: 3

Evaluation Scheme:
ESE: 60 marks
ISE: 40 Marks

Course Objectives: The objective of the course is to

1) Provide students an understanding of basic structure, crystal arrangement of materials and the phase diagrams
2) Study the different methods of heat treatment processes and advantages of heat treatment for different steel components
3) Introduce the fundamental theory of powder metallurgy processes

Course Outcomes:

Cos	At the end of successful completion of the course, the student will be able to	Blooms Taxonomy
CO1	State and Describe various crystal structures and phases of metals and alloys	Knowledge
CO2	Explain and plot equilibrium diagrams of ferrous and non ferrous metals	Understand
CO3	Discuss the various stages of techniques used in manufacturing of Powder Metallurgy components	Understand
CO4	Compare the heat treatment processes used in mechanical components	Apply
CO5	Explain various destructive and nondestructive testing techniques	Knowledge Apply
CO6	Select the appropriate material and heat treatment process for the given mechanical components	Analyze

Description:

Life of the Mechanical Components is greatly influenced by the material properties and heat treatment provided for it. Hence Material selection is the important task in manufacturing process. To select the appropriate material, One should know about required properties for specified task. This course deals with different engineering material and their properties. It also includes knowledge of heat treatment to change the properties as per the requirement.

Prerequisites:	1:	Basic Mechanical Engineering
	2:	Engineering Physics
	3:	Engineering Chemistry

Section - I		
Unit 1	**Introduction to Metals and alloy systems**	
	Introduction to Metallic and Non-metallic materials and its classification (metals/alloys, polymers and composites) a) Imperfections in crystals , Defects-Point, Line, Planar, Volume- Slip planes and slip systems b) Alloy formation by crystallization, Nucleation and growth, Cooling curves, Dendritic structure and coring. c) Solid solutions and intermediate phases d) Phases and Gibbs phase rule e) Construction of equilibrium diagrams from cooling curves, Isomorphous system(Solid Solution), Eutectic, Partial solubility Peritectic and Intermetallic Compounds Lever arm principles, Long and short-range freezing	**07Hrs**
Unit 2	**Study of Phase Diagrams**	
	(With respect to typical compositions, Properties and Applications for the following alloys.) a)Fe- Fe3C equilibrium diagram - Ferrous alloys (Plain carbon steels, cast iron) Alloy steels- Free cutting steels, HSLA high carbon low alloy steels, maraging steels. creep resisting steels, Stainless steels- different types. Tool steels- types, Selection of materials and Specifications based on -IS, BS, SAE, AISI, Copper based alloys brasses Cu- Zn, Bronzes Cu- Sn, , Cu- Be, Cu-Ni. Aluminum based alloys Al- Cu(Duralumin) - Al-Si (Modification), Pb- Sn (Solders and fusible alloys)	**11 Hrs**
Unit 3	**Principles of Mechanical Testing:**	
	Destructive Testing methods: Tensile, Compressive, Impact, Fatigue, Creep, Hardness (Rockwell, Brinell and Vickers) Non- Destructive Testing: Dye Penetrant, Magnetic, Ultrasonic, Radiography, Eddy Current testing.	**04 Hrs**
Section - II		
Unit 4	**Principles of Heat Treatment & heat treatment of Ferrous Alloys**	
	Transformation of Pearlite into austenite upon heating, Transformation of austenite into Pearlite, Bainite and Martensite on cooling. TTT –Diagram and CCT - Diagrams - significance, Effect of alloying elements on TTT diagram and its significance. Heat treatment furnaces and equipments, controlled atmosphere	**06 Hrs**
Unit 5	**Heat Treatment Processes:**	
	a) Heat Treatment of Steels **Annealing –** Types-Full, Partial and Sub critical annealing (Various types) and purposes **Normalising-** Purposes **Hardening** (Hardening types), Purposes, Austempering and Martempering,	**08 Hrs**

	Mechanism of quenching and Quenching media, Hardenability- Concept and methods of determination of hardenability- Grossmans critical diameter method and Jominy end quench test. **Tempering** Types, Structural transformations during tempering, purposes sub zero treatment **Surface hardening** - Flame and Induction **Chemical heat treatments for case hardening** - Carburising, Nitriding, Cyniding, Carbonitriding **Annealing**- Stress relief, Recrystallization and Process annealing **Precipitation hardening** - Basic requirements, Stages, Common alloys, Variables,theories Heat treatment defects and remedies	
Unit 6	**Powder Metallurgy:**	
	Advantages, Limitations and Applications of Powder Metallurgy Powder manufacturing types- Mechanical, Physical, Chemical and Electro-Chemical Mixing/ Blending. Compaction- types- Conventional, Isostatic, HERF, Powder rolling and extrussion Sintering- Types liquid stage and solid stage sintering Finishing operations: Sizing, Machining, Infiltration and Impregnation Flowcharts for – Self-lubricating bearings.	**04 Hrs**

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	3	--	--	--	--	--	1	--	--	--	--	--	--	--	--
CO2	2	2	2	--	--	--	1	--	--	--	--	--	--	--	--
CO3	2	--	--	2	--	--	--	--	--	--	--	--	--	--	3
CO4	2	2	3	1	--	--	--	--	--	--	--	--	--	--	2
CO5	2	2	1	--	--	--	--	--	--	--	--	--	--	--	1
CO6	1	--	3	2	--	--	--	--	--	--	--	--	--	--	3

References:

Text Books	
1	S.H. Avner, "Introduction to physical metallurgy", Mcgraw Hill Book Company Inc, Edition, 2nd, 1974.
2	Vijendrasingh, "Physical metallurgy", Standard Publishers Delhi
3	W. D Callister, "Material science and engineering", Wiley India Pvt. Ltd., 5th Edition.

4	. V.D. Kodgire, “Material science and metallurgy for engineers”, Everest Publishers Pune,12th Edition
5	T.V. Rajan / C.P. Sharma, “Heat Treatments Principles and Practices”, Prentice Hall of India Pvt Ltd, New Delhi
6	V Raghwan, “Material Science and Engineering”, Prentice Hall of India Pvt. Ltd., New Delhi ,3rd Edition, 1995.
Reference Books	
1	V. Raghvan, “Materials Science & Engineering”, PHI 5th Edition, Prentice-Hall of India (P) Ltd.
2	W. Callister, “Materials Science & Engineering”, John Wiley & sons
3	R.A. Higgins, “Engineering Metallurgy”, Viva Books Pvt. Ltd., New Delhi, 1 st Edition

Video Lectures: -----

ME304 - FLUID MECHANICS

Lectures: 3 hrs / week
Credits: 3

Evaluation Scheme:
ESE: 60 Marks
ISE: 40 marks

Course Objectives: The objective of this course is to

1) Introduce fundamental aspects of fluid properties, fluid flow behavior and develop energy balance equation for fluid flow systems.
2) Apply the fundamental equations on fluid flow such as Continuity equation, Bernoulli's equation and Momentum equation to analyze its characteristics
3) Understand the fluid flow in pipe and determine the different head losses in pipe.
4) Study the concept of boundary layer developed in fluid flow over the surface

Course Outcomes:

COs	At the end of successful completion of the course the student will be able to	Blooms Taxonomy
CO1	State and define the different properties of the fluid and fluid flow	Knowledge
CO2	Describe the principles of continuity, momentum and energy as applied to fluid motions.	Understand
CO3	Derive and apply the governing equations of Fluid Dynamics	Apply
CO4	Determine different head losses in flow through pipe and apply this on practical problems associated with fluid systems.	Apply Analyze
CO5	Understand the boundary layer theory of fluid flow as well as estimate the lift and drag coefficient of the fluid flow.	Understand Apply
CO6	Derive and analyze the mathematical expressions related to fluid statics, kinematics, dynamics, pipe flow systems and boundary layer theory	Analyze

Description:

Fluid Mechanics is offered as the engineering science course. This course contains basic principles and applications in Mechanical Engineering. In this course students will learn about fundamentals, properties, principles and governing equations of fluid behavior in statics and in motion. Students will get new problem solving approaches like control volume concept, streamline patterns and fluid flow analysis. This course has six units namely i) Fluid Statics ii) Fluid Kinematics iii) Fluid Dynamics iv) Momentum Equation and Laminar Flow v) Flow through pipes vi) Boundary Layer Theory

Prerequisites:	1:	Engineering Mathematics
	2:	Applied Mechanics
	3:	Engineering Physics
	4:	Basic Mechanical Engineering

Section - I		
Unit 1	**Fluid Properties and Fluid Statics:** **A) Fluid Properties :**Definition of fluid, Properties of fluid Mass Density, Weight Density, Specific Volume, Specific Gravity, Dynamic Viscosity, Kinematic Viscosity, Surface Tension, Capillarity and Compressibility, Types of fluid.	
	B) Fluid Statics: Statement of Pascal's law, Hydrostatic law of pressure, Definition of Total Pressure, Centre of Pressure, Buoyancy, Meta-center, Condition of Equilibrium of floating and submerged bodies (No Numerical Treatment on fluid Statics).	**7 Hrs.**
Unit 2	**Fluid Kinematics:** Eulerian and Langragian approach of fluid flow, Flow visualization, Types of flow, Streamlines, Pathlines, streaklines, Stream tube, Continuity Equation in Cartesian coordinates in three dimensional flows.	
	Velocity and Acceleration of fluid particles, Stream function and velocity potential function.	**6 Hrs.**
Unit 3	**Fluid Dynamics:** Euler's Equation of motion, Integration of Euler's equation as energy equation. Kinetic Energy correction factor, Applications of Bernoulli's equation Venturimeter, orifice meter	
	Definition of Notch, Classification and it Applications, Derivation of Flow over triangular and rectangular notches only Definition of Orifice, classification and it Applications, Hydraulic Coefficients Cd, Cc and Cv and Cr	**7 Hrs.**
Section - II		
Unit 4	**Momentum Equation and Laminar Flow:** **A) Momentum Equation:** Derivation of momentum equation, Applications of momentum equation, momentum correction factor, Analysis of fluid flow through pipe bends.	
	B) Laminar Flow: Laminar flow through circular pipes and derivation of Hagen Poiseuille's equation. Laminar flow through parallel plates, Introduction of CFD and its applications.	**7 Hrs.**
Unit 5	**Fluid Flow through Pipes:** Different energy losses in flow through pipe, Losses due to friction: Darcy's Weisbach equation and Chezy's equation, Minor Losses due to expansion, contraction, pipe fittings, at entrance, at exit, due to obstruction etc.	
	Flow through Series pipe, Parallel pipe, Siphon pipes, Branching pipes and equivalent pipes	**7 Hrs**.
Unit 6	**Boundary Layer Theory and Forces on Immersed Body: A) Boundary Layer Theory:** Boundary layer thickness, its characteristics, laminar and turbulent boundary layers, Displacement thickness, Momentum thickness, Energy thickness, separation, boundary layer control.	
	B) Forces on Immersed Bodies: Lift and Drag, Drag on a flat plate and on aerofoil, Types of drags, Development of lift. (Magnus effect) stalling condition of aerofoil.	**6 Hrs.**

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	1	-	-	-	-	-	-	1	-
CO2	3	3	2	1	-	-	2	-	-	-	-	-	-	2	-
CO3	3	2	2	1	-	-	2	-	-	-	-	-	-	3	-
CO4	2	2	3	1	-	-	2	-	-	-	-	-	-	3	-
CO5	2	2	2	1	-	-	2	-	-	-	-	-	-	3	-
CO6	1	3	2	1	-	-	1	-	-	-	-	-	-	2	-

References:

Text Books	
1	Fluid Mechanics, R.K.Bansal, Laxmi publications. New Delhi, 1998.
2	Fluid mechanics and Hydraulic Machinery, R.K. Rajput, Laxmi publishers
3	Introduction to Fluid Mechanics and Fluid Machines, S.K.Som, Gautam Biswas, Suman Chakraborty, Tata McGraw- Hill Publication. 3rd Edition 2012.
4	Hydraulics and Fluid Mechanics including Hydraulic Machines, Dr. P. N. Modi and Dr. S. M. Seth, Standard Book House .
Reference Books	
1	Fluid Mechanics –Fundamentals and Application, Y. A. Cengel, J. M. Cimbala, TMI,
2	Fluid Mechanics, K.L.Kumar, S. Chand Publication. New Delhi, 2nd Edition, 2000.
3	Fluid Mechanics, V.L. Streeter and E.B. Wylie, Tata McGraw Hill Pvt Ltd., New Delhi, 2ndEdition 1997.

Video Lectures

Lectures 1. https://nptel.ac.in/courses/112/105/112105269/

2. https://nptel.ac.in/courses/112/104/112104118/

3. https://nptel.ac.in/courses/112/105/112105218/

4. https://www.youtube.com/watch?v=fa0zHI6nLUo

ME305 - ELECTRICAL TECHNOLOGY

Lectures: 2 hrs / week
Credits: 2

Evaluation Scheme:
ESE: 60 Marks
ISE: 40 Marks

Course Objectives: The objectives of the course is to

1) To Provide the Basic knowledge of Electrical concepts and Motors used in mechanical applications
2) To select suitable drives for different mechanical systems by considering its speed Torque characteristics.
3) To study the various concept of electrical heating and Welding.

Course Outcomes:

Cos	At the end of successful completion of the course, the student will be able to	Blooms Taxonomy
CO1	Define and Deals the basic principles of Electromagnetic Induction.	Knowledge
CO2	Describe the construction, working and characteristics of various Electric motors.	Understand
CO3	Describe and Identify the suitable Electric heating and welding methods for different Mechanical Applications.	Knowledge Understand
CO4	Apply Various speed control techniques for DC and AC motors in various mechanical systems.	Apply Analysis
CO5	Analyze and select suitable types of motors for different mechanical systems by considering different speed torque characteristics.	Apply Analysis
CO6	Determine the Efficiency of 3 Phase Induction motor by using various input and output parameters.	Evaluate

Description:

Number of Mechanical systems requires Prime movers to get the required mechanical motion. Electrical motors are widely used for this purpose. Hence It is essential to study the concept of AC and DC motor under Mechanical Engineering Stream. Electrical Heating and welding is also integral part of Mechanical Industry, Therefore Every Mechanical Engineer should aware about this. Electrical Technology course is offered as the Fundamental science to achieve above these aspects This course contains study of various Electric motors construction, working, characteristics, speed control Techniques and applications. This course has six units namely i) DC Motor, ii) Three Phase Induction motor, iii) Fractional Horse power Motor, iv) Electric Drives, v) Electric Heating and vi). Electric Welding

Prerequisites:	1:	Basic Electrical Engineering
	2:	Few basic electrical components identification

Section -I		
Unit 1	**DC motors**	
	Construction, Working, Types, Back EMF, Speed equation, Torque equation, Speed torque characteristics, and Power losses in DC. Motors. Speed control of DC Shunt and series motor.	**04Hrs**
Unit 2	**Three Phase Induction Motor**	
	Construction, Types, Working, Speed equation, Torque equation, Torque speed characteristics, Power stages in motor, Advantages of 3- Phase Induction motor. (Numerical treatment on power stages)	**05 Hrs**
Unit 3	**Fractional Horse Power Motors**	
	Construction, Working, characteristics and Applications of Single phase permanent capacitor type Induction motor, AC servo motor, DC servo motor, Stepper motor (VR type and PM type).	**05 Hrs**
Section – II		
Unit 4	**Electrical Drives**	
	Advantages of electrical drives, Types – Individual & Group drive, Criteria for selection of motors for applications like lathe, Traction, pumps, Conveyors, Lift, etc.	**05 Hrs**
Unit 5	**Electric Heating**	
	Construction and Working of - Direct & Indirect resistance Heating, Direct arc furnace, Indirect arc furnace, Horizontal Core type induction furnace,(Numerical treatment on Electrical to Heat energy conversion)	**05 Hrs**
Unit 6	**Electric Welding**	
	Principle, Advantages and types of Resistance Welding. Formation and Characteristics of Electric Arc. - Effect of Arc Length.	**04 Hrs**

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CO2	3	2	--	1	--	--	--	--	--	--	--	--	--	--	--
CO3	3	1	1	--	2	--	--	--	--	--	--	--	--	--	--
CO4	3	2	--	1	2	--	--	--	--	--	--	--	--	--	--
CO5	--	2	--	1	2	--	--	--	--	--	--	--	--	--	--
CO6	--	2	--	1	2	--	--	--	--	--	--	--	--	--	--

References:

Text Books	
1	A Text book of Electrical Technology, Vol-II ,B. L. Theraja, S. Chand publication, 1st Edition.
2	Principles of Electrical Machines by V.K.Mhta,& Rohit Mehta. S. Chand Publishing, 2008
Reference Books	
1	A Text book of "Electrical Power system "by S. L. Uppal, DBS Publications
2	Utilization of Electric Power, R. K. Rajput, Laxmi publication (p) Ltd., 4th Edition, 2007.
3	Electrical Technology, by U. A. Bakshi , Technical Publication Pune,4th Edition , 2009.

Web Links/ Video Lectures

Lectures https://nptel.ac.in/courses/108/108/108108076/#
https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-ee65/
https://nptel.ac.in/courses/112/107/112107090/

ME301T- ENGINEERING MATHEMATICS – III TUTORIAL

Tutorial : 1 Hr/Week
Credit : 1

Evaluation Scheme
ISA : 25 Marks
POE : NA

Course Objectives: The objective of the course is to
1. Solve Differential equation, 2. Find Laplace transforms and apply to solve differential equations 3. Expand given function as Fourier series expansion 4. Calculate standard deviation, variance and probabilities

Course Outcomes:

COs	At the end of successful completion of the course, the student will be able to	Blooms Taxonomy
CO1	Identify and solve differential Equation	Knowledge Understand
CO2	Compute Laplace transforms and apply to solve differential equations	Apply
CO3	Express functions in terms of sine and cosine	Understand
CO4	Calculate the probabilities using distribution functions	Apply

Description:

Engineering Mathematics-III tutorial is dedicated to solve more problems in each unit. In this section, more problems will be practiced so that students can use mathematical methods and techniques to solve complex mechanical engineering problems.

Prerequisites:	1:	Trigonometric identities and Logarithmic identities
	2:	Differentiation and integration formulae
	3:	Partial Differentiation.

Tutorials

Number	Practical/ Experiment/Tutorial Topic	Hrs.	Bloom's Taxonomy
1	Linear differential equation-I	1 Hr	Understand
2	Linear differential equation-II	1 Hr	Knowledge
3	Partial differential equation (Linear)	1 Hr	Knowledge
4	Non-linear partial differential equation	1 Hr	Knowledge
5	Laplace Transformation	1 Hr	Understand
6	Inverse Laplace transformation and applications	1 Hr	Apply

7	Fourier series expansion of functions	1 Hr	Understand
8	Velocity and acceleration, gradient and directional derivative	1 Hr	Knowledge
9	Divergence and curl of vector point function	1 Hr	Knowledge
10	Probability distribution	1 Hr	Apply

Mapping of POs & COs:

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

References:

Text Books	
1	Higher Engineering Mathematics, Dr. B. S. Grewal, S. Chand and Company, 40th Edition.
2	Advanced Engineering Mathematics, H. K. Das, S. Chand Publication, 8th Edition.
Reference Books	
1	Higher Engineering Mathematics, B. V. Ramana, Tata Mc Graw Hill, New Delhi
2	A Text Book of Applied Mathematics, Vol. I and II, P. N.Wartikar and J. N. Wartikar, Vidyarthi Griha Prakashan, Pune.

ME302T - APPLIED THERMODYNAMICS LAB

Practicals: 2 hrs/ week
Credits: 1

Examination Scheme
ISA: 25 Marks
POE: NA

Course Objectives: The objective of the course is to
1. Learn about various energy conversion devices such as steam boilers, steam condensers, cooling towers. 2. Identify and make different types of steam boilers, condensers and cooling towers 3. Recommend particular steam boiler, steam condensers as per the specified applications

Course Outcomes:

Cos	**At the end of successful completion of the course, the student will beable to**	**Blooms Taxonomy**
CO1	Understand classification, construction, working of different types of steam boilers, steam condensers and cooling towers used in steam power plants	Knowledge
CO2	Recognize the different safety devices(mountings)and accessories are used in steam boiler	Understand
CO3	Identify the particular type of steam boiler for specific application	Apply
CO4	Know the functions of different boiler mountings and accessories in operation of boiler	Understand
CO5	Estimate and determine heat balance sheet of steam boiler	Evaluate Create

Description:

The Applied thermodynamics laboratory consists of a number of models of steam boiler, steam condenser, steam turbines, and various boiler accessories. Students are able to enhance their basic and fundamental knowledge of applied thermodynamics by effective using of these demo models.

Prerequisites:	1:	Basic Mechanical Engineering
	2:	Applied Physics
	3:	Basic Engineering Mathematics

Practicals:

Sr. No.	Practical Topic	Hrs.	Bloom's Taxonomy
1	Study and Demonstration of water tube and fire tube boilers.	2	Understand Apply
2	Study and Demonstration of boiler mountings.	2	Understand
3	Study and Demonstration of boiler accessories.	2	Understand
4	Study and demonstration of steam condensers	2	Understand
5	Study of cooling towers used in steam power plants	2	Knowledge Understand
6	Heat balance sheet of steam boiler	2	Analysis Evaluate

Mapping of POs & COs:

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

References:

Text Books	
1	"Thermal Engineering", Kumar and Vasandani, D. S . Publisher Metropolitan Book Co, Delhi, 3rd Edition.
2.	"Thermal Engineering", Ballaney P.L, Khanna Publishers, New Delhi, 27th Edition.
3.	"Engineering Thermodynamics", P. K. Nag., Tata McGraw Hill, New Delhi, 4th Edition.
4.	"Thermal Engineering", R. K. Rajput, Laxmi Publications, 3rd Edition.
5.	"Steam and Gas Turbines", R. Yadav, CPH Allahabad, 2nd Edition, 2005.
6.	"Principles of Engineering Thermodynamics", Moran, Shapiro, Boetnner, Wiley, 8th Edition.
Reference Books	
1	"Fundamentals of Thermodynamics", Claus Borgnakke, Sonntag R. E., John Wiley and

2	"Thermodynamics: an Engineering Approach", Cengel and Boles, Tata McGraw-Hill, New Delhi ,3rd Edition,.

Video Lectures / Practicals

Practicals 1 to 6. https://nptel.ac.in/courses/112/107/112107216/

ME305T - ELECTRICAL TECHNOLOGY LAB

Practicals: 2 hrs / week
Credits: 1

Examination Scheme:
ISA: 25 Marks
P**OE:** NA

Course Objectives: The objective of the course is to

1) Provide the Basic knowledge of Electrical connections for different Electrical Setups.
2) Analyze speed control techniques and estimate efficiency at different load conditions for DC and AC Motor
3) Perform calculations to estimate the suitable motor for given application

Course Outcomes:

COs	At the end of successful completion of the course, the student will be able to	Blooms Taxonomy
CO1	Deals how to make Electrical wiring connection for a different Setups as per the circuit diagram	Knowledge
CO2	Define and describe the construction and working details of Various starters for both AC and DC Motor	Knowledge Understand
CO3	Apply Various speed control techniques for DC and AC to analyze its Speed Torque characteristics	Apply Analyze
CO4	Select the suitable Motor for different Mechanical applications with required speed, Torque and power calculations.	Evaluate

Practicals:

Minimum Ten (10) experiments should be performed.

Sr. No	Practical/ Experiment/Tutorial Topic	Hrs.	Bloom's Taxonomy
1	Speed control of DC shunt motor by flux control method.	**2**	Analysis
2	Speed control of DC shunt motor by armature voltage control.	**2**	Knowledge Analyze
3	Reversal of rotation of DC motor.	**2**	Knowledge Analyze
4	Load test on DC shunt motor.	**2**	Analyze
5	Study of DC motor starters.	**2**	Knowledge Understand
6	Study of Electric Braking for DC Motor	**2**	Understand
7	Load test on 3 phase induction motor.	**2**	Analyze
8	Reversal of rotation of 3 phase induction motor	**2**	Knowledge Analyze
9	Study of 3 phase induction motor starter	**2**	Understand

10	Load test on Single phase Induction motor	**2**	Knowledge Analyze
11	Study of Selection Criteria of Motor	**2**	Analyze
12	Study Motor selection for Electric Vehicle	**2**	Knowledge Analyze

Mapping of POs & COs:

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

References:

Text Books
A Text book of Electrical Technology", Vol-II ,B. L. Theraja, S. Chand publication, 1st Edition.
Principles of Electrical Machines by V. K. Mhta,& Rohit Mehta. S. Chand Publishing, 2008

Links of V-Labs provided for Experiments

https://ems-iitr.vlabs.ac.in/List%20of%20experiments.html

http://vem-iitg.vlabs.ac.in/

ME303P - MATERIAL SCIENCE AND METALLURGY LAB

Practicals: 2 hrs / week
Credits: 1

Examination Scheme:
ISA: 25 Marks
P**OE:** 25 Marks

Course Objectives: The objective of the course is to
1) To familiarize the students with the use equipments to determine mechanical properties of materials to acquire the knowledge in Destructive Material Testing. 2) To familiarize the students with various heat treatment processes.

Course Outcomes:

COs	**At the end of successful completion of the course the student will be able to**	**Blooms Taxonomy**
CO1	Determine different properties like strength, elongation, toughness, hardness by doing tests like Tensile test, Impact test, Hardness test.	Knowledge, Apply
CO2	Choose different NDT techniques for determining surface and sub surface cracks	Analyze
CO3	Explain various heat treatment processes and their micro structural changes	Analyze
CO4	Explain the concept of hardenability and estimate the hardnability	Understand Analyze

Practicals:

Sr. No.	**Practical/ Experiment/Tutorial Topic**	**Hrs.**	**Bloom's Taxonomy**
1	Tensile testing of M.S.	2	Apply
2	Hardness testing (Rockwell and Brinell)	2	Knowledge Apply
3	Impact testing (Izod and Charpy) of M.S.	2	Apply
4	Non Destructive testing-Dye penetrant and magnetic particle testing.	2	Knowledge, Analyze
5	Macroscopic Examinations -Spark Test.	2	Knowledge
6	Preparation of specimen for microstructure analysis	2	Analyze
7	Study of microstructure of steels and Cast Irons.	2	Analyze
8	Study of microstructure of Non-ferrous alloys (Brass, Duralimin, Babbit)	2	Evaluate
9	Heat treatment of steels (Annealing, Normalizing, Hardening on medium / high carbon steel).	2	Analyze

10	Jominy end quench test for hardenability.	2	Knowledge, Apply
11	Industrial visit should be conducted to observe industrial heat treatment practices.	2	Understand Apply

Mapping of POs & COs:

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

References:

Text Books	
1	S.H. Avner, "Introduction to physical metallurgy", Mcgraw Hill Book Company Inc, Edition, 2nd, 1974.
2	Vijendrasingh, "Physical metallurgy", Standard Publishers Delhi
3	V.D. Kodgire, "Material science and metallurgy for engineers", Everest Publishers Pune,12th Edition
Reference Books	
1	V. Raghvan, "Materials Science & Engineering", PHI 5th Edition, Prentice-Hall of India (P) Ltd
2	W. Callister, "Materials Science & Engineering", John Wiley & sons
3	R.A. Higgins, "Engineering Metallurgy", Viva Books Pvt. Ltd., New Delhi, 1st Edition

ME304P - FLUID MECHANICS LAB

Practicals: 2 hrs / week
Credits: 1

Examination Scheme:
ISA: 25 Marks
P**OE:** 25 Marks

Course Outcomes:		
COs	**At the end of successful completion of the course, the student will beable to**	**Blooms Taxonomy**
CO1	Identify and use different pressure measuring device used fluid system	Knowledge Understand
CO2	Understand different types of fluid flow and determine laminar or turbulent fluid flow	Understand
CO3	Calibrate the different discharge measuring devices to determine coefficient of discharge	Apply Analyze
CO4	Determine the major and minor losses n pipe system	Apply

Practicals:
List of Assignments and Experiments:

Number	**Practical/ Experiment/Tutorial Topic**	**Hrs.**	**Blooms Taxonomy**
1	Assignment on Study and demonstration of Pressure Measuring Devices (Compulsory)	2	Knowledge
2	Theoretical Assignment on Dimensional analysis which may include procedure and Numerical on Rayleigh's method and Buckingham π theorem. (Compulsory)	2	Knowledge Understand
3	Flow visualization by plotting of streamlines (Heleshaw's apparatus).	2	Knowledge
4	Reynold's experiment.	2	Apply Analyze
5	Verification of Bernoulli's equation.	2	Analyze
6	Calibration of Venturimeter	2	Analyze
7	Calibration of notches	2	Analyze
8	Calibration of orifice under steady and unsteady flow condition.	2	Application Analyze
9	Determination of minor losses in pips-fittings.	2	Analyze
10	Determination of coefficient of friction in pipes of different materials.	2	Analyze

Mapping of POs & COs:

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

References:

Text Books	
1	Fluid Mechanics, R. K. Bansal, Laxmi publications. New Delhi, 1998.
2	Fluid mechanics and Hydraulic Machinery, R.K. Rajput, Laxmi publishers
3	Experiments in Fluid Mechanics, Sarbjit Singh, PHI Learning, New Delhi
4	Hydraulics and Fluid Mechanics including Hydraulic Machines, Dr. P. N. Modi and Dr. S. M. Seth, Standard Book House .

Links of V-Labs

Practical

1. https://fm-nitk.vlabs.ac.in/#

2. https://eerc03-iiith.vlabs.ac.in/List%20of%20experiments.html

3. http://vlabs.iitb.ac.in/vlabs-dev/labs/mit_bootcamp/fluid_mechanics/experimentlist.html

ME306 – INDUSTRIAL DRAWING

Practicals: 2 hrs / week
Credits: 1

Examination Scheme:
ISA: 25 Marks
POE: NA

Course Objectives: The objective of the course is to
1. To study and identify BIS conventions used in machine drawing. 2. To understand the line and curve of intersection in interpenetrations of solids. 3. To study and identify function of Standard machine components. 4. To study limits fits and geometrical tolerances on components. 5. To study and drawing of assembly to details and details to assembly drawings.

Course Outcomes:

Cos	**At the end of successful completion of the course the student will be able to**	**Blooms Taxonomy**
CO1	Draw BIS conventions and Standard machine components	Knowledge, Application
CO2	Analyze and interpret production Drawing	Analysis
CO3	Understand the use of limit fits and tolerances on production drawing.	Knowledge, Application
CO4	Develop the skills for drawing assembly from details and details from assembly drawing.	Knowledge, Analysis

Description:

This course has six units namely i) Introduction to CAD, ii) Use of layers, iii) Geometric Dimensioning and Tolerancing, iv) Detail and Assembly Drawings, v) Production Drawing, vi) Introduction of 3D.

Prerequisites:	1:	Fundamentals of Engineering Graphics

Unit 1	**Study of B.I.S. (Bureau of Indian Standards) Conventions**	
	Importance of BIS Conventions, Drawings sheet sizes, BIS Conventional representation of engineering materials, BIS conventions for sectioning, Types of threads profiles, Internal and external threads, Types of springs, Types of gears BIS Conventional representation of Splined shaft, Serrated shaft, Knurling, Bearings, BIS Conventional representation of welds.	**04 Hrs**
Unit 2	**Sketching of Machine Component**	
	Importance of sketching, proportionate dimensioning on following sketches, Sketches of nut, Bolts square and Hexagonal Flanged nuts, Lock nuts, Dome nut, Capstan nut, Wing nut, Castle nut, Split pin, Square headed bolt, Cup headed bolt, T-headed bolt, Types of foundation bolts, Stud, Washer, Set screws, Cap screws.	**04 Hrs**

	Various types of rivets and riveted joints, Various types of keys, Socket and spigot (Cotter joint) , Knuckle (pin) joint, Muff coupling, Protected and unprotected Flanged, Coupling, Universal coupling, solid and bush bearing. Plummer block (pedestal bearing), Foot step bearing. Flat and V-belt pulleys, Fast and loose pulleys, speed cone pulleys, Pipe joint for C.I. Flanged, socket and spigot type pipe joint	
Unit 3	**Interpenetration of Solids**	
	Introduction to Interpenetration of Solids, interpenetration of Prism with Prism, Prism with cylinder, Prism with cone, prism with pyramid, Cylinder with Cylinder, Cone with Cylinder.	**04 Hrs**
Unit 4	**Limits, Fits and Tolerances**	
	Significance of limits and fits and tolerances, Definitions, Types, Recommendations and selections in relation with limits fits and tolerance system, Tolerances of form and position, surface finish symbols as per BIS conventions, Selection and entering of all these symbols with reference to details and assembly drawings, Tolerancing an individual dimensions of details drawing.	**04 Hrs**
Unit 5	**Auxiliary Projection**	
	Importance of Auxiliary Projection, Projection on auxiliary vertical and horizontal plane, Auxiliary projection of simple machine components.	**04 Hrs**
Unit 6	**Industrial Drawing (Production Drawing)**	
	Importance of Details and Assembly Drawing. To prepare detail drawings from given assembly drawing. To prepare assembly drawing from given details drawing. Preparation of detail and assembly drawing from the following examples such as Machine tool parts: Tool post, Tailstock, Machine vice, Chucks etc. Engine parts: Stuffing box, Crosshead assembly, Piston and connecting rod, etc. Miscellaneous parts: Valve assembly, Screw jack, Jigs and fixtures, Pipe vice etc.	**04 Hrs**

Practicals:

Number	Practical/ Experiment/Tutorial Topic	Hrs	Cognitive levels of attainment asper Bloom's
1	Sheet on BIS conventions.	4	Knowledge
2	Sheet on Free hand sketches of Machine Component	4	Knowledge, Application
3	Sheet on Interpenetration of Solids	4	Knowledge, Application
4	Sheet on Limits, Fits and Tolerances.	4	Knowledge, Application
5	Sheet on Auxiliary Projection	4	Knowledge, Application
6	Sheet on Details and Assembly Drawing	4	Knowledge, Application

Mapping of POs & COs:

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

References:

Text Books	
1	N. D. Bhatt, Machine Drawing. Charotor Publication House, Bombay, 42th Edition, 2007
2	P.S. Gill, Machine Drawing. S. K. Kataria and Sons, Delhi, 7th Edition, 2008
3	"Production Drawing", Narayana, Kannaiah and Venkata Reddy, New Age International. 2nd Edition, 2002.
Reference Books	
1	IS: SP46-Engineering Drawing Practice for Schools and Colleges, B.I.S. Publications.
2	IS: 696-Code of Practice for General Engineering Drawings B.I.S. Publications.
3	IS: 2709-Guide for Selection of Fits, B.I.S. Publications.
4	IS: 919-Recommendation for Limits and Fits for Engineering, B.I.S. Publications

ME307 - PROGRAMMING IN C++

Practicals: 2 hrs / week
Credits: 1

Examination Scheme:
ISA: 50 Marks
POE: NA

Course Objectives : The objectives of the course is to

1. To understand how C++ improves C with object-oriented features.
2. To introduce an object oriented programming language.
3. After the students have successfully completed the course, they shall have sufficient knowledge of the basic computer operations and various programming techniques
4. To develop and enhance the programming skills amongst the students in general as well as application of it in the field of Mechanical Engineering.

Course Outcomes:

COs	At the end of successful completion of the course, the student will be able to	Blooms Taxonomy
CO1	Develop logic for solving problems using object oriented language	Knowledge, Understand,
CO2	Plot algorithms and flowcharts for programs involving decision control statements, loop control statements and case Control structures.	Understand Create
CO3	Compile and debug programs in C++ language	Application
CO4	Apply their knowledge and programming skills to solve various computing problems in the field of Mechanical Engineering.	Apply Create

Description/ Applications:

Today's era is computer era. All sectors of engineering are modified with the aid of computer. Therefore it is essential to know the very fundamental computer language i.e. C++. It has tremendous applications. Real-World Applications Of C++ are Games, GUI Based Applications, Database Software, Operating systems, Various Browsers, Advanced Computation And Graphics, Banking Applications. Through this course, C++ will be introduced to mechanical students.

Prerequisites:	1.	Fundamentals of computer programming.
	2.	Fundamentals of c programming and Object oriented programming.

Unit 1	**Evolution of Programming Methodologies**	
	Introduction to OOP and its basic features, Basic components of a C++, Program and program structure, Compiling and Executing C++ Program. Selection control statements in C++.	**04 Hrs**
Unit 2	**Data Types, Expression and Control Statements Iteration**	
	statements in C++, Introduction to Arrays, Multidimensional Arrays, Strings and String related Library Functions..	**04Hrs**
Unit 3	**Functions**	
	Passing Data to Functions, Scope and Visibility of variables in Functions	**04Hrs**
Unit 4	**Creating Classes and Abstraction**	
	Classes objects, data members, member functions, this Pointer, Friends, Friend Functions, Friend Classes, Friend Scope, and Static Functions. Structures in C++. **Constructors and Destructors,** Static variables and Functions in class.	**06Hrs**
Unit 5	**Operator Overloading**	
	Overloading Unary Operators, Overloading binary operators.	**02 Hrs**
Unit 6	**Inheritance in C++**	
	Types of Inheritance, Pointers, Objects and Pointers, Multiple Inheritances. Virtual Functions, Polymorphism, Abstract classes.	**04Hrs**

Practicals:

Sr. No.	Practical/Experiment/Tutorial Topic	Hrs	Blooms Taxonomy
1	One assignment based on Object-Oriented programming: Introduction, Basic concepts, Benefits,	**4**	Understand
2	Minimum 2 program on Data types, Expression and control statements Iteration statements in C++	**4**	Understand
3	Minimum 2 program on Functions, Passing Data	**6**	Apply Synthesis
4	Minimum 2 program on Creating classes and Abstraction: Classes objects, static Functions.	**2**	Apply, Evaluate Create
5	Minimum 2 program on Operator Overloading in C++,	**4**	Understand Apply

6	.Minimum 2 program on Inheritance in C++	**4**	Understand

Mapping of POs & COs:

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

References:

Text Books	
1	Object Oriented Programming, E. Balguruswami, Tata McGraw Hill Publication.
2	Let us C++ ,YashwantKanitkar , BPB Publication, New Delhi
3	C++ Programming, AlstevanswielyIndia,7th Edition.
4	Object oriented Programming with C++, SouravSahay, Oxford University Press.
5	Object-Oriented Programming in C++, Rajesh K Shukla, Wiley India
Reference Books	
1	The C++ Programming Language, Brian W. Kernighan, Dennis M. Ritchie, Prentice Hall
2	C++: The Complete Reference, Schildt H., Tata Mcgraw Hill.

Link of VLAB
http://vlabs.iitb.ac.in/vlabs-dev/labs/oops/labs/index.php

ME308 - MANUFACTURING SKILL DEVELOPMENT LAB-I

Practicals: 2 hrs / week
Credits: 1

Examination Scheme:
ISA: 50 Marks
POE: NA

Course Objectives: The objective of the course is

1. To study Patterns, Core boxes, Preparation of Pattern for solid casting.
2. To conduct Sand testing, Size analysis, Moisture percentage, Permeability Test.
3. Impart Knowledge of welding Processes and classification.

Course Outcomes:

COs	At the end of successful completion of the course, the student will be able to:	Bloom's Taxonomy
CO1	To describe importance of casting processes in manufacturing.	Understand
CO2	To design and develop the pattern.	Apply Create
CO3	To demonstrate the various sand tests.	Apply
CO4	To create mechanical component using welding technology	Create

Description:

Most of mechanical manufacturing industries are dealing with casting processes and welding processes. Student should have hands on experience related to this technology to make them skilled with industrial environment. To emphasis this objective, manufacturing skill development lab-I is introduced to the mechanical engineering course which contains basic knowledge of casting process, sand testing and welding process.

Prerequisites:	1:	Basic Mechanical Engineering

Sr. No	Practical/Experiment/Tutorial Topic	Hrs.	Bloom's Taxonomy
1	Study of Patterns–Types, Materials used, Pattern Allowances, Construction and color code and preparation of pattern for solid casting.	8hrs	Knowledge Apply
2	Study of Core boxes: Types, Allowances	2hrs	Knowledge
3	**Sand testing for green sand and core sand (Any four)** Preparation of standard specimen Preparation of greensand mould Size analysis. Grain fineness Number Moisture percentage Permeability Test	8hrs	Knowledge Apply

	Green Compressive strength Clay content Mould hardness		
4	Preparation of one job by using welding process like Tungsten Inert Gas(TIG)/Metal Inert Gas(MIG)	4hrs	Apply Create
5	Foundry visit to study pattern shops and making moulding	2hrs	Knowledge Apply

Mapping of POs & COs:

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

References:

Text Books	
1	Manufacturing Technology - Foundry, Forming and Welding, Vol. I, P. N. Rao, Tata Mc Graw-Hill, New Delhi, 3rd edition, 2009.
2	A Text book of Production Technology (Manufacturing Processes) ,P. C. Sharma,S. Chandand Company Pvt. Ltd, New Delhi. 7th Edition, 2010.
6	Production technology, R. K. Jain, Khanna Publishers, Delhi,15th Edition, 2000.
Reference Books	
1	Principles of metal casting, Haine and Rosenthal, TataMcGraw-Hill Book, Company. New Delhi.
2	Workshop Technology, W. A. J. Chapman , CBS Publishing and Distributors, New Delhi Vol.I

ME309A - AUDIT COURSE-III [ENVIRONMENTAL STUDIES]

Practicals: 2 hrs / week
Credits: Non-Credit

Examination Scheme:
ISE : 50
Audit Point : 2

Course Objectives: The objective of the course is

The syllabus of Environmental Studies provides an integrated, quantitative and interdisciplinary approach to the study of environmental systems. The students of Engineering undergoing this course would develop a better understanding of human relationships, perceptions and policies towards the environment and focus on design and technology for improving environmental quality. Their exposure to subjects like understanding of earth processes, evaluating alternative energy systems, pollution control and mitigation, natural resource management and the effects of global climate change, shall help the students to bring a systems approach to the analysis of environmental problems.

Course Outcomes:

COs	At the end of successful completion of the course, the student will be able to:	Bloom's Taxonomy
CO1	Relate the interdependency of environmental components.	Understand / Apply
CO2	Identify the environmental problems and prevent environmental pollution	Apply
CO3	Interpret impacts of waste on environmental components.	Analysis
CO4	Analyze environmental change and its social impacts	Analysis

Description:

The Study of Environment is playing important and crucial role for sustainable development of society, particularly to address industrial pollution, living standards and claimant change issues. This course covers essential theory of environment processes and infrastructure for the supply of water, the disposal of waste, and the control of pollution of all kinds.

Prerequisites:	1:	Understanding of Environment Education course.

Sr. No	Practical/Experiment/Tutorial Topic	Hrs.
1	**Ecology:** Ecosystem, Ecological Pyramids, Food chain, food web, Ecological succession, Natural Resources and Associated Problems. Forest resources, Water resources, Mineral resources, Food resources, Energy resources, Land resources Role of individuals in conservation of natural resources.	4 Hrs

2	**Pollution** Water pollution: causes, effects, control, drinking water quality standards, Arsenic, lead, cadmium, chromium, fluoride contamination & its effects, water treatment, wastewater treatment**.** Air pollution: Causes, effects, control, Air pollution controlling equipments, Air quality standards, National air quality index, vehicular emission, alternative fuels, indoor air pollution, Thermal inversions, Photochemical Smog and Acid Precipitation Noise pollution: Causes, effects, control, noise standards recommended by CPCB, Environmental Protection Act , Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act and International and National efforts for Environmental Protection.	10 Hrs
3	**Waste management:** Solid waste management, biomedical waste management, E waste, plastic waste management, Hazardous waste management, carbon footprint, Recycling of waste, Role of Central Pollution Control Board (CPCB),State Pollution Control Board, Role of NGO‘s	4 Hrs
4	**Social Issues and Environment:** Global Warming, Ozone layer depletion, urban problems related to energy, Alternative energy sources, Evolution of Sustainable development: timeline, Evolution of green movements in India, Disaster management: Flood, Earthquakes, Cyclones, Landslides, Draught, Tsunami etc., Swachh Bharat Mission, Role of Information technology in Environment and human health.	6 Hrs
5	**Project Work:** Visit to Local Polluted site – Urban/Rural/Industrial/Agricultural Or Study of simple Ecosystems –Ponds, River, Hill slopes Or Preparation of small models or device to resolve the environment problem/issue Project work shall be based on programme	---

Mapping of POs & COs:

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

References:

Text Books	
1	Agarwal K.C. ,2001 "Environmental Biology", Nidi publication ltd., Bikaner
2	D.K.Asthana, Meera Asthana, A Textbook of Environmental Studies, S. Chand Publication Revised edition, 2006.
3	S. Deswal & A. Deswal, Basic course in environmental Studies, Dhanpat Rai & Co ltd., Delhi, Second revised edition, 2009.
Reference Books	
1	Eldon D Enger, Bradley F. Smith, Environmental science – a study of inter- relationships Wm C Brown Publishers 1989
2	Francois Ramade Ecology of Natural resources, John wiley & Sons, 2009
3	Robert Leo Smith, Ecology and field biology, Harper Collins Publishers, 1998
4	Gilbert M. Masters, Introduction to Environmental Engineering & Science, Prentice Hall International Inc. Second Edition

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Seal of Institute

Second Year B. Tech. (Mechanical Engineering)
Second Semester Detailed Syllabus

ME401-COMPUTATIONAL TECHNIQUES AND PROGRAMMING

Lectures : 2 hrs. /week
Credits : 2
Tutorials : NA

Evaluation Scheme:
ESE : 60 Marks
ISE : 40 Marks

Course Objective: The objective of the course is to

1. Provide the knowledge of Numerical methods used and solve various types of problems in Mechanical Engineering
2. Identify specific method to solve a specific engineering problem
3. Enable students to write computer program in C++/ Python for aforementioned numerical methods.

Course Outcomes:

COs	At the end of successful completion of the course the student will be able to	Bloom's Taxonomy
CO1	Differentiate between direct methods and numerical methods with their significance	Knowledge
CO2	State different numerical methods used to solve engineering problems	Knowledge
CO3	Describe mathematical process of above methods to solve problems	Comprehension
CO4	Relate a specific method to solve an engineering specific problem with greater emphasis on mechanical Engineering.	Analysis
CO5	Develop the logic behind a method for its coding through flowcharts.	Synthesis
CO6	Prepare computer program for these numerical methods using C++/ Python	Synthesis/ Create

Description:

The course, Computational Techniques and Programming is offered as the Engineering Science course. There are some situations in engineering, where the direct methods fail or do not provide correct solution to mathematical problems. These situations may be critical and need some solutions. Engineer should have knowledge of Numerical methods to cope up with the situations. This course contains Numerical Methods to solve various Engineering Problems which has six units namely,
i) Roots of Equations ii) Linear Algebraic Equations iii) Curve Fitting & Interpolation iv) Numerical Differentiation & Integration v) Ordinary Differential Equations and vi) Ordinary Differential Equations.

Prerequisites:	1:	Basics in Algebra: Roots of equations, Simultaneous equations.
	2:	Basics of Matrices and determinants
	3:	Basic knowledge of derivative and integration

	4.	Basic Knowledge of C++ Programming / Python	
Section-I			
Unit 1	**Roots of Equations**		
	Bracketing Methods: Bisection method & Regula falsi method Open Methods: Muller method, Newton Raphson method for single root & for Non-linear equations. **A C++/Python Program on Regula falsi method**		**06 Hrs**
Unit 2	**Linear Algebraic Equations**		
	Direct Methods: Gauss elimination method, LU Decomposition method Iterative Methods: Gauss-Siedel method. **A C++/Python Program on Gauss elimination method**		**04 Hrs**
Unit 3	**Curve Fitting & Interpolation**		
	Curve Fitting: Straight line fit, Parabolic fit Interpolation: Newton's Divided difference method **A C++/Python Program on Straight Line fit**		**04 Hrs**
Section-II			
Unit 4	**Numerical Differentiation & Integration**		
	Num. Differentiation: Newton's Forward, Backward and Central Difference method, Newton's Divided difference method for unequal intervals Num. Integration: Trapezoidal method, Simpson's methods, Gauss quadrature methods **A C++/Python Program on Simpson's 3/8th rule**		**07 Hrs**
Unit 5	**Ordinary Differential Equations**		
	Taylor's series method, Modified Euler's method, Finite Difference method **A C++/Python Program on Modified Euler's method**		**04 Hrs**
Unit 6	**Partial Differential Equations**		
	Liebmann's method for Laplace equation, Crank-Nicholson method (Descriptive treatment only)		**03 Hrs**

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	1	2	-	-	-	-	-	-	-	-	-		
CO4	2	3	1	2	-	-	-	-	-	-	-	-	2	2	2
CO5	2	3	1	2	2	-	-	-	-	-	-	-	-	-	-
CO6	2	2	2	2	3	-	-	-	-	-	1	-	2	2	2

References:

Text books	
1	Dr. P. Kandasamy, Dr. K. Thilagavathy, Dr. K. Gunavathi, Numerical Methods, S. Chand Publications
2	S. Arumugam, A. Thangapandi Isaac, A. Somasundaram, Numerical Methods, Scitech Publications
3	E. Balagurusamy, Numerical Methods, McGraw Hill Education
Reference Books	
1	Steven Chapra, Applied Numerical Methods with MATLAB for Engineers &Scientists, McGraw Hill Publication
2	S. R. Otto, J. P. Denier, An introduction to Programming & Numerical Methods in MATLAB.
3	Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford University Press

Link for Video Lectures:

https://nptel.ac.in/courses/111/107/111107105/

https://nptel.ac.in/courses/106/106/106106212/

Link of VLAB for Experiments:

http://vlabs.iitb.ac.in/vlabs-dev/labs/numerical_lab/labs/explist.php

ME402- ANALYSIS OF MECHANICAL ELEMENTS

Lectures : 3 hrs. /week
Credits : 3
Tutorials : NA

Evaluation Scheme:
ESE : 60 Marks
ISE : 40 Marks

Course Objectives : The objective of the course is

1. To develop understanding of the basic concepts related to tensile, compressive and shear stresses in engineering components and basic knowledge of principal stresses and strains.
2. To discuss the basic principles of torsion in shafts, shear force and bending moment in beams, deflection in beams, buckling in mechanical elements.
3. To enable the students to calculate distribution of bending stresses and shear stresses in mechanical components of various cross sections.

Course Outcomes:

Cos	At the end of successful completion of the course the student will be able to	Blooms Taxonomy
CO1	Define different types of stresses and strains induced in any machine component due to various loading conditions.	Remember
CO2	Interpret the nature of internal stresses that will develop within the mechanical components for different types of loading.	Understand
CO3	Utilize mathematics and basic engineering principle to evaluate stress, strain, torque, buckling load, slope and deflection.	Apply
CO4	Examine the effect of different loading conditions in various machine elements such as simple machine components, beams, shafts, columns.	Analyze
CO5	Determine the mechanical design parameters of structural member under different loadings.	Evaluate
CO6	Apply and Construct graphical solutions for given loading conditions of structure.	Apply Create

Description:

Analysis of Mechanical Elements is a fundamental subject needed primarily for the students of Mechanical sciences. The course provides an introductory study on stresses and strains on deformable solids. It focuses on the analysis of members subjected to axial, bending, and torsional loads. The course discusses in detail, the shear force and bending moments on beams. It introduces the concept of principal stresses in the analysis of structural members. In a nutshell, the course aims at developing the skill to solve design problems on Analysis of Mechanical Elements which is basic need of mechanical engineering.

Prerequisites:	1:	Knowledge of Basic Mechanical Engineering
	2:	Knowledge of applied mechanics

Section - I		
Unit 1	**Stresses and Strains**	
	Concept of Stress and Strain, (Linear, Lateral, Shear and Volumetric), Hooke's Law, Poisson's ratio, Stress-strain diagram for ductile and brittle material, Factor of safety, Elastic constants and Inter-relationship between elastic constants, Stresses, stains and deformation in composite bars, Complementary shear stresses, Thermal Stresses.	**06 Hrs**
Unit 2	**Torsion**	
	Introduction to Torsion, Basic assumptions, Torsion equation, Stresses in hollow and solid circular shafts, power transmitted by shaft.	**09 Hrs**
	Shear Force and Bending Moment Diagram	
	Concept and definition of shear force and bending moment in determinate beams (Simply supported, cantilever and overhanging) due to concentrated load, UDL, UVL and Couple.	
Unit 3	**Bending Stresses in Beams**	
	Symmetric pure bending of beams, Derivation of flexure formula, moment of resistance of cross-sections, Design of rectangular, circular(solid and hollow) sections, I and T sections	**06 Hrs**
	Shear Stresses in Beams	
	Distribution of shear stresses in beams of various commonly used sections such as rectangular, circular, I and T.(Only numerical)	
Section - II		
Unit 4	**Principal Stresses and Strains**	
	Normal and shear stresses on any oblique planes, Concept of Principal planes, Derivation of expression for Principal stresses and maximum shear stress, Positions of principal planes and planes of maximum shear, Graphical solutions using Mohr's circle of stresses.	**08 Hrs**
Unit 5	**Slope and Deflection of Beams**	
	Slope and deflection of beam using double integration method and area moment method for simply supported beam and cantilever beam due to concentrated load and UDL.	**06 Hrs**
Unit 6	**Columns**	
	Euler's formula for different end connections, Concept of equivalent length, limitations of Euler's formula, Rankine formula.	**05 Hrs**

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Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	3	2	--	1	1	--	--	--	--	--	--	--	1	--	--
CO2	2	3	--	--	--	--	--	--	--	--	--	--	1	--	--
CO3	3	2	--	2	1	--	--	--	--	--	--	--	1	--	--
CO4	1	3	2	2	--	--	--	--	--	--	--	--	2	--	--
CO5	1	2	1	3	--	--	--	--	--	--	--	--	1	--	--
CO6	1	1	2	1	--	--	2	--	--	--	--	--	1	--	--

COs vary with course code

References:

Text Books	
1	"Strength of Materials", S. Ramamruthum, DhanpatRai and Sons, New Delhi.
2	"Strength of Materials", R. K. Bansal, Laxmi Publication, 4th Edition.
3	"Strength of Materials", Khurmi Gupta, S. Chand Publication.
4	"Strength of Materials", R.K. Rajput, S. Chad Publication.
5	"Mechanics of structure", S.BJunnerkar,Charotar Publication House.
6	"Strength of Materials", S. S. Bhavikatti, Vikas Publication House.
Reference Books	
1	"Strength of Materials", Beer and Johnson, CBS Publication.
2	"Strength of Materials", G.H. Rider,Mac Millan India Ltd.
3	"Strength of Materials", Nag and Chanda, Willey India Publication.
4	"Advanced Mechanics of Materials", Boresi, Willey India Publication.
5	"Strength of Materials", Den Hartong, McGraw Hill Publication.

Web Links/ Video Lectures :

1. https://nptel.ac.in/courses/112/107/112107146/

2.https://nptel.ac.in/courses/112/106/112106141/

ME403-FLUID AND TURBO MACHINERY

Lectures : 3 hrs. /week
Credits : 3
Tutorials : NA

Evaluation Scheme:
ESE : 60 Marks
ISE : 40 Marks

Course Objectives: The objective of the course is to

1. Make students understand the construction, working principles, model testing & performance characteristics of hydraulic devices such as water turbines &centrifugal pump.
2. Discuss theory of various types of compressors, its applications and performance evaluation.
3. Impart the information and explain the construction and working of gas turbine using thermodynamic cycle.

Course Outcomes:

Cos	At the end of successful completion of the course the student will be able to	Blooms Taxonomy
CO1	Define and state the applications of pump, compressor, water turbine and gas turbine.	Knowledge
CO2	Explain working principle and classifications of turbo machines.	Understand
CO3	Apply the Euler's theory to estimate the work done by plotting velocity triangles for various turbo machines.	Apply
CO4	Analyze the performance parameters such as work done, power and efficiency of turbo machines.	Analyze
CO5	Compare various turbo machines and recommend suitable device for required application.	Evaluate
CO6	Design turbo machines for specified conditions	Create

Description:

The course deals with rotodynamic machines like water turbines, centrifugal pump, reciprocating compressor, centrifugal compressor and gas turbine etc. The knowledge of these rotodynamic machines is necessary for students to understand the working and design of power generation plants. It covers the different aspects such as fundamental theory, construction, working, design and efficiency calculations etc of these machines.

Prerequisites:	1:	Basic Mechanical Engineering
	2:	Basic knowledge of fluid mechanics
	3:	Thermodynamic laws & processes

Section - I		
Unit 1	**Impulse Water Turbines**	
	Euler's equation for work done in rotodynamic machine, definition of hydraulic turbine, classification of water turbines, **Impulse turbine**: Pelton wheel turbine - construction and working of pelton wheel turbine , application of impulse water turbine, velocity triangles, calculations of work done, different efficiencies, power, discharge etc , specific speed, pelton wheel design Governing of pelton wheel.	**06 Hrs**
Unit 2	**Reaction Water Turbines**	
	Reaction turbine: Construction and working of francis and kaplan turbine, application of reaction water turbine, comparison between impulse and reaction water turbine, velocity triangles, degree of reaction, calculation of work done, various efficiencies, power, discharge, specific speed etc. Introduction of draft tube, cavitation in reaction turbine, governing of reaction turbine.	**07 Hrs**
Unit 3	**Centrifugal Pump**	
	Centrifugal pump: classification of pumps, principle, construction and working of centrifugal pump, applications, different heads& efficiencies, velocity triangles, calculations of work done, power, efficiencies, specific speed etc. Minimum starting speed, multistaging of centrifugal pump, priming of pump, NPSH(Net Positive Suction Head), cavitation of centrifugal pump.	**07 Hrs**
Section - II		
Unit 4	**Reciprocating Air Compressor**	
	Compressor, applications of air compressors, classification of compressors, air compressor terminology, construction and working, calculation of work done, power and different efficiencies in polytropic, isothermal & isentropic compression for single stage reciprocating air compressor. Effect of clearance volume and expression for volumetric efficiency, Introduction of multistage compressor.	**07 Hrs**
Unit 5	**Rotary Air Compressor**	
	Construction and working of centrifugal compressor, velocity triangle, calculations of work done, power and efficiency etc. Difference between centrifugal and axial flow compressor, difference between reciprocating and rotary compressor. Introduction of roots blower, vane blower and axial flow compressor.	**07 Hrs**
Unit 6	**Gas turbines**	
	Classification of gas turbine, applications, Standard Brayton's cycle, actual Brayton's cycle, calculation of work done, power & thermal efficiency etc. Construction and working of gas turbine with reheating, regeneration and inter cooling,	**06 Hrs**

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	3	2	--	--	--	--	2	--	--	--	--	--	--	1	--
CO2	3	1	--	--	--	--	2	--	--	--	--	--	--	1	--
CO3	1	2	3	--	--	--	--	--	--	--	--	--	--	2	--
CO4	1	3	3	1	--	--	--	--	--	--	--	--	1	3	--
CO5	2	2	2	--	--	--	--	--	--	--	--	--	--	2	--
CO6	1	1	2	3	--	--	--	--	--	--	--	--	2	2	--

References:

Text Books	
1	A text book of Fluid Mechanics and Hydraulic Machines by R.K.Bansal, Laxmi Publicaton
2	A text book of Thermal Engineering by R. S. Khurmi, S Chands Publicatuon
3	Hydraulics and Fluid Mechanics including Hydraulic Machine by Dr. P. N. Modi and Dr. S. M. Seth, Standard Book House .
4	Fluid mechanics and Hydraulic Machinery by R.K. Rajput, LaxmiPublicaton
Reference Books	
1	Turbo machines by S. M. Yahya
2	Steam and Gas Turbines by R. Yadav
3	Turbines, compressors, fans by S.M.Yahya
4	Thermodynamics – An Engineering Approach by Cengel& Boles

Web Links/ Video Lectures:-

1. **https://nptel.ac.in/courses/112/104/112104305/**
2. **https://nptel.ac.in/courses/112/106/112106303/**
3. **https://nptel.ac.in/courses/112/106/112106061/**
4. **https://nptel.ac.in/courses/101/101/101101058/**
5. **https://nptel.ac.in/courses/112/106/112106200/**

ME404- THEORY OF MACHINE - I

Lectures : **3** hrs. /week
Credits : 3
Tutorials : NA

Evaluation Scheme:
ESE : 60 Marks
ISE : 40 Marks

Course Objectives: The objective of the course is to

1. Provide the students with basic knowledge of mechanism and its application in mechanical engineering including power transmitting devices.
2. Explain types of Cam with followers and select according to their applications.
3. Introduce working principle and construction of governors as well as comparing different types of governing mechanisms.
4. Study the fundamental theory of friction and its analysis in different Mechanisms and machines

Course Outcomes:

Cos	At the end of successful completion of the course, the student will be able to	Blooms Taxonomy
CO1	List different types of mechanisms and their applications in mechanical engineering	Knowledge
CO2	Describe and apply kinematic theories of mechanism to plot velocity and acceleration diagrams	Understand Apply
CO3	Apply knowledge of cam to draw the Cam Profile with follower for different applications	Apply
CO4	Compare power transmitting elements used in different machines and select the appropriate as per requirement	Analysis
CO5	Evaluate suitability of given governing mechanisms based on speed control parameter analysis	Evaluate
CO6	Select and design an appropriate mechanism for given proposed machine	Create

Description:

The effectiveness of mechanical machines depends upon mechanism used for transmission of motion in different components. Engineer can deal with these machines only if he has fundamental knowledge of mechanisms. Theory of Machine subject is introduced in syllabus to get the students acquainted with mechanism which is used in machine to transmit power from a source to its various parts as well as to transform motion from one form in to another form. It includes kinematics and kinetics of mechanism, design of cam and follower , theory of governor etc.

Prerequisites:	1:	Applied mechanics
	2:	Basic Mathematics

	3:	Basic Mechanical Engineering

Section - I		
Unit 1	**Basic Concept of Mechanisms**	
	Links, kinematic pair (lower and higher), Kinematic chain, Mechanism, inversion, Types of constraints, Grubblers criterion, Inversions of slider crank chain, Double slider crank chain, Four bar, Steering gear mechanisms, Hooke's joint (only theoretical treatment).	**05 Hrs**
Unit 2	**Velocity and Acceleration in Mechanisms**	
	Graphical analysis of Velocity and acceleration for different mechanisms using relative velocity and acceleration method, Klein's construction for slider crank mechanism, Velocity analysis by Instantaneous center method.	**10 Hrs**
Unit 3	**Friction**	
	Introduction to friction, Friction in pivot bearings, Inclined plane theory, Friction in screws	**05 Hrs**
Section - II		
Unit 4	**Cams**	
	Types of cams and followers, Profiles of cams for specified motion of different followers, Spring load on the follower, Jumping of follower.	**08 Hrs**
Unit 5	**Belts and Dynamometers**	
	Types of belt drives, Calculation of power transmitted, Belt tension ratio, Actual tension in a running belt, Centrifugal and initial tension in belt, Slip and creep of belt.	**06 Hrs**
Unit 6	**Governors**	
	Types of governors, Porter and Hartnell governor, Controlling force and stability of governor, Hunting, Sensitivity, Isochronisms, Governor effort and power, Insensitiveness of governors.	**06 Hrs**

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	3	1	--	--	--	--	1	--	--	--	--	--	--	--	--
CO2	3	2	2	1	--	--	--	--	--	--	--	--	1	--	--
CO3	2	2	1	2	--	--	--	--	--	--	--	--	2	--	--
CO4	2	2	3	1	--	--	--	--	--	--	--	--	2	--	--
CO5	1	3	1	2	--	--	--	--	--	--	--	--	3	--	--
CO6	1	2	3	3	--	--	--	--	--	--	--	--	3	--	--

References:

Text Books	
1	"Theory of Machines", Ratan S.S, Tata McGraw Hill New Delhi, 2nd Edition..
2	"Theory of Machines", P.L.Ballany, Khanna Publication, New Delhi, 2nd Edition.
3	"Theory of Machines", V.P. Singh, DhanpatRai and Sons.
Reference Books	
1	"Theory of Machines and Mechanism", Shigley, McGraw Hill, New York
2	"Theory of Machines", Abdullah Shariff, McGraw Hill, New Delhi.
3	"Theory of Machines", Thomas Bevan, CBS Publisher

Web Links/ Video Lectures:

1. **http://nptel.ac.in/courses/**

2. http://ocw.mit.edu

ME405- MANUFACTURING PROCESSES AND MACHINE TOOLS

Lectures : 3 hrs. / Week
Credits : 3
Tutorials : NA

Evaluation Scheme:
ESE : 60 Marks
ISE : 40 Marks

Course Objectives: The objective of the course is

1. To understand different methods of Molding and Casting.
2. To study different types of forming processes
3. To learn various plastic shaping processes and welding processes.
4. To understand theories of lathe, drilling and boring machine and metal removal rate, shaping, milling and gear manufacturing process & Non conventional Machining.

Course Outcomes:

COs	At the end of successful completion of the course, the student will be able to:	Bloom's Taxonomy
CO1	Explain the construction & working of various machine tools used in Manufacturing processes.	Understand
CO2	Describe various metal casting, metal cutting, metal forming & metal joining processes.	Understand,
CO3	Discuss various plastic processing and tools includes thermoforming, extrusion etc.	Understand
CO4	Apply the fundamental theory of machining processes to calculate Machining time and Metal removal rate.	Apply, Analysis
CO5	Summarize various Gear manufacturing processes and select the appropriate process as per the requirement.	Evaluation
CO6	Illustrate the principles and applications of Non- traditional machining (NTM) processes	Understand, Apply

Description:

Manufacturing processes used in industry for converting raw materials into finished products. This course contains basic knowledge of different types of manufacturing process and its advantages, applications. Machining and machine tools is an important subject with application in several industries. Traditional machining is the broad term used to describe removal of material from a work piece. This course has six units namely i) casting process ii) Metal forming process iii) plastic shaping process and welding process iv) metal cutting processes-I v) Metal cutting processes-II and vi)Non Traditional Machining

Prerequisites:	1:	Basic Mechanical Engineering
	2:	Metallurgy and Material science

Section - I		
Unit 1	**Casting Processes:**	
	Importance of casting as manufacturing process, advantages and limitations of casting processes, foundry layouts and mechanization, Moulding types such as Green sand moulding, Shell moulding, CO_2moulding, investment casting, Components of gating system. Introduction to permanent mould casting process such as continuous casting, Gravity die casting, pressure die casting, Melting practices and Metallurgical control in Cupola furnace, Induction and Arc Furnace, casting defects, metal pouring equipment's, Cleaning-fettling and inspection of casting. **Numerical Treatment.**	**09 Hrs**
Unit 2	**Forming Processes:**	
	a) Rolling: Introduction, Hot and cold rolling, Rolling Mill Classification, Defects in rolling. **b) Forging:** Introduction, Forging Machines (board Hammer, Air and Steam, Hydraulic Hammer), Open and Closed die Forging, Defects in forging. **c) Extrusion:** Introduction, Direct, Indirect, Tube, Impact and Hydraulic Extrusion, Defects in extrusion.	**07 Hrs**
Unit 3	**Plastic Shaping and welding process**	
	a) Thermosetting and thermoplastic materials, their properties and applications, Introduction to blow moulding, injection moulding, extrusion, calendaring and thermo forming. b) Definition of welding ,classification of welding, construction and working of Metal inert gas(MIG),Tungsten inert gas(TIG)	**04 Hrs**
Section - II		
Unit 4	**Machine Tools for Metal Cutting I:**	
	a) Lathe: Introduction, Working principle, types, specifications, principle parts, accessories, attachments, and various lathe operations. **b) Drilling Machines:** Classification of drilling machines, Construction and working of radial drilling machine, various accessories and various operations and **Numerical Treatment**. **C) Boring Machines:** Introduction to boring machines, Types of boring machine, different operations.	**09 Hrs**
Unit 5	**Machine Tools for Metal Cutting II:**	
	a)Shaping & Planning Machine: Construction & working of shaper and Planer machine, Comparison between planer and shaper machine and **Numerical Treatment.** **b) Milling Machine:** Types- Horizontal, Vertical milling machines, Milling cutters, construction and working of column and knee type, milling operations, simple and	**07 Hrs**

	compound indexing. **c) Gear Manufacturing processes:** Study of various processes like gear shaping, gear hobbing, Gear finishing processes –Gear shaving, Gear burnishing and gear rolling.	
Unit 6	**Nonconventional Machining:** Fundamental principle, machining unit, tool material, advantages, limitations and applications of Abrasive Jet Machining, Electrical Discharge machining, Electro-Chemical machining, Laser beam machining, Ultrasonic machining, Water jet machining.	**04 Hrs**

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	2	2	--	--	2	--	--	--	--	--	--	--	--	--	
CO2	2	2	--	--	3	--	--	--	--	--	--	--	--	--	2
CO3	2	2	--	--	3	--	--	--	--	--	--	--	--	--	2
CO4	3	2	--	--	--	--	--	--	--	--	--	--	--	--	3
CO5	3	3	--	--	2	--	--	--	--	--	--	--	--	--	2
CO6	3	2	1	--	3	1	1	--	--	--	1	--	--	--	2

References:

Text Books	
1	"Manufacturing Technology- Foundry, Forming and Welding, Vol. I", P. N. Rao, Tata McGraw-Hill, New Delhi,3rd edition, 2009.
2	"A Textbook of Production Technology (Manufacturing Processes)", P.C. Sharma, S. Chand and Company Pvt.Ltd, New Delhi.7th Edition,2010.
3	"Workshop Technology vol. II", B.S. Raghuvanshi, Dhanapat Rai Publications Pvt.Ltd, New Delhi.10th Edition, 2000.
4	"Workshop Technology vol. II", B.S. Raghuvanshi, Dhanapat Rai Publications Pvt.Ltd Viva Books Pvt.Ltd,NewDelhi,1st Edition,2001.
5	"Elements of Workshop Technology vol. II", S.K.Hajra Choudhury and A.K. Hajra Choudhury , Media promoters and Publishers Pvt.Ltd,NewDelhi,13th Edition,2012.
6	"Production technology", R. K. Jain, Khanna Publishers, Delhi, 15th Edition,2000.

Reference Books	
1	"Principles of metal casting", Haineand Rosenthal, Tata McGraw-Hill Book, Company. New Delhi.
2	"Workshop Technology", W.A.J.Chapman, CBS Publishing and Distributors, N.DelhiVol.I [ISBN-13:9788123904016]2001, Vol.II [9788123904115] 2007 andVol.III [9788123904122] 1995.
3	"Machine Tools and Manufacturing Technology", Steve F. Krar, Mario Rapisarda, Albert F. Check.

Web Links/ Video Lectures:

1. http://msvs-dei.vlabs.ac.in/
2. https://nptel.ac.in/courses/112/107/112107083/
3. https://nptel.ac.in/courses/112/107/112107250/

ME401T- COMPUTATIONAL TECHNIQUES AND PROGRAMMING LAB

Practicals : 2 hrs. /week
Credits : 1

Evaluation Scheme:
ISA : 25 Marks
POE : NA

Course Objectives: The objective of the course is to

1. Develop the logic of the Numerical method for Programming.
2. To prepare an algorithm & flowchart for a program for specific method.
3. Write computer program in C++/ Python for numerical methods.
4. To impart Programming skills to the students.

Course Outcomes:

COs	At the end of successful completion of the course the student will be able to	Bloom's Taxonomy
CO1	Solve a specific problem using an appropriate Numerical method.	Application
CO2	Develop a logic required to prepare a Computer program for Numerical method.	Application
CO3	Prepare an algorithm and Flowchart for a C++ or Python program for a Numerical method.	Application, Synthesis
CO4	Create a program on Numerical method using C++ or Python.	Application, Create

Description:

The course, Computational Techniques and Programming Lab is offered as the Engineering Science course. In Engineering, most of the time the problem involves complex mathematical logic & repetitive and tedious calculations. There is always a limitation to carry out these complex and repetitive calculations manually. It becomes mandatory to have knowledge of computer program in order to deal with this practical situation. This course contains Programming exercises on Numerical Methods to solve various Engineering Problems which has six units namely, i) Roots of Equations ii) Linear Algebraic Equations iii) Curve Fitting & Interpolation iv) Numerical Differentiation & Integration v) Ordinary Differential Equations and vi) Ordinary Differential Equations.

Prerequisites:	1:	Basics in Algebra: Roots of equations, Simultaneous equations.
	2:	Basics of Matrices and determinants
	3:	Basic knowledge of derivative and integration
	4.	Basic Knowledge of C++ Programming / Python

Practicals:

Number	Practical/Experiment/Tutorial/Topic	Hrs.	Attainment of Cognitive level as per Bloom
1 to 6	ONE assignment EACH on every Unit containing: 1. At least ONE problem on all the methods in each unit 2. Flowchart & a C++/Python program on at least ONE method in each unit mentioned in syllabus	2 each	Application Analysis Synthesis Create

Mapping of POs & COs:

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

References:

Text books	
1	Dr. P. Kandasamy, Dr. K. Thilagavathy, Dr. K. Gunavathi, Numerical Methods, S. Chand Publications
2	S. Arumugam, A. Thangapandi Isaac, A. Somasundaram, Numerical Methods, Scitech Publications
3	E. Balagurusamy, Numerical Methods, McGraw Hill Education
Reference Books	
1	Steven Chapra, Applied Numerical Methods with MATLAB for Engineers &Scientists, McGraw Hill Publication
2	S. R. Otto, J. P. Denier, An introduction to Programming & Numerical Methods in MATLAB.
3	Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford University Press

Link for Video Lectures:

https://nptel.ac.in/courses/111/107/111107105/

https://nptel.ac.in/courses/106/106/106106212/

Link of VLAB for Experiments:

http://vlabs.iitb.ac.in/vlabs-dev/labs/numerical_lab/labs/explist.php

ME402T- ANALYSIS OF MECHANICAL ELEMENTS LAB

Practicals : 2 hrs. /week
Credits : 1

Evaluation Scheme:
ISA : 25 Marks
POE : NA

Course Objectives: The objective of the course is to
1. apply the basic concepts related to tensile, compressive and shear stresses in engineering components and evaluate the stress- strain 2. Calculate force and bending moment in beams, deflection in beams, buckling in columns using fundamental equations. 3. Estimate distribution of bending stresses and shear stresses

Course Outcomes:

Cos	At the end of successful completion of the course the student will be able to	Blooms Taxonomy
CO1	Understand the concept of stresses and strains.	Understand
CO2	Draw shear force and bending moment diagram under different loading conditions.	Create
CO3	Determine bending stresses, shear stresses and principle stresses in beams.	Evaluate
CO4	Evaluate deflection in beams and buckling load in column due to application of different loading.	Evaluate

Description:

Analysis of Mechanical Elements is a fundamental subject needed primarily for the students of Mechanical sciences. As the engineering design of different components, structures etc. used in practice are done using different kinds of materials, it is essential to understand the basic behavior of such materials. Analysis of Mechanical Elements, also known as mechanics of materials, is focused on analyzing stresses and deflections in materials under load.

Prerequisites:	1:	Knowledge of Basic Mechanical Engineering
	2:	Knowledge of applied mechanics

Practicals : For this course numerical based assignments are offered during practical hours.

Number	Tutorial Topic	Hrs.
1	Assignment on stresses and strains.	2
2	Assignment on torsion (Problems based on industrial applications)shear force diagram & bending moment diagram.	2
3	Assignment on bending stresses and shear stresses in beams.	2
4	Assignment on principal stresses (both analytical and graphical).	2
5	Assignment on deflection of beams.	2
6	Assignment on Column	2

Mapping of POs & COs:

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

References:

Text Books	
1	"Strength of Materials", S. Ramamruthum, Dhanpat Rai and Sons, New Delhi.
2	"Strength of Materials", R. K. Bansal, Laxmi Publication, 4th Edition.
3	"Strength of Materials", Khurmi Gupta, S. Chand Publication.
4	"Strength of Materials", R.K. Rajput, S. Chad Publication.
5	"Mechanics of structure", S.BJunnerkar, Charotar Publication House.
6	"Strength of Materials", S. S. Bhavikatti, Vikas Publication House.
7	"Strength of Materials", Timoshenko and Young, CBS Publication.
8	"Mechanics of Materials", S. S. Ratan, Tata McGraw Hill Publication, 2009.

Reference Books	
1	“Strength of Materials”, Beer and Johnson, CBS Publication.
2	“Strength of Materials”, G.H. Rider, Mac Millan India Ltd.
3	“Strength of Materials”, Nag and Chanda, Willey India Publication.
4	“Advanced Mechanics of Materials”, Boresi, Willey India Publication.
5	“Strength of Materials”, Den Hartong, McGraw Hill Publication.
6	“Mechanical analysis and design”, H. Burr and John Cheatam, PHI, New Delhi.

Web Links/ Video Lectures:

1. https://nptel.ac.in/courses/112/107/112107146/

2.https://nptel.ac.in/courses/112/106/112106141/

ME403T-FLUID AND TURBO MACHINERY LAB

Practicals : 2 hrs. /week
Credits : 1

Evaluation Scheme:
ISA : 25 Marks
POE : NA

Course Outcomes:		
COs	**Attheendofsuccessfulcompletionofthecourse,-thestudentwillbeableto**	**Blooms Taxonomy**
CO1	Analyze the performance of hydraulic machines by obtaining work done, power, efficiencies etc.	Analyze
CO2	Plot performance characteristics curves with their theoretical nature of different hydro machinery	Apply
CO3	Select turbo machine for specified condition	Apply Evaluate
CO4	Evaluate performance of reciprocating compressor.	Evaluate

Practicals: List of Experiments

Number	Name of Experiment	Hrs.	Cognitive levels of attainment as per Bloom's
1	Study of model testing and unit quantities of water turbines & pump	2	Understand
2	Trial on pelton wheel and to plot characteristics curve	2	Apply, Analyze
3	Trial on francis turbine and to plot characteristics curve	2	Apply, Analyze
4	Trial on centrifugal pump and to plot characteristics curve	2	Apply, Analyze
5	Trial on reciprocating compressor	2	Apply, Analyze
6	Selection criteria for different types of pumps (Case Study)	2	Apply, Evaluate
7	Selection criteria for different types of compressor / blower (Case Study)	2	Apply, Evaluate
8	Industrial visit to pump/turbine manufacturing industry or hydro power plant.	2	Understand

Mapping of POs & COs:

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

References:

Text Books	
1	A text book of Fluid Mechanics and Hydraulic Machines by R.K.Bansal, LaxmiPublicaton
3	Thermal Engineering by R. K. Rajput, Laxmi Publications

Links of V-Labs :

1. https://fmc-nitk.vlabs.ac.in/exp/pelton-turbine/

2.https://fmc-nitk.vlabs.ac.in/exp/francis-turbine/

3. https://fmc-nitk.vlabs.ac.in/List%20of%20experiments.html

ME406- PROGRAMMING IN PYTHON LAB

Practicals : 2 hrs. /week
Credits : 1

Evaluation Scheme:
ISA : 50 Marks
POE : NA

Course Objectives: The objective of the course is to

1. Introduce to Python Programming Language (free open source) which is world widely used
2. Apply the principles of python programming so that students are able to write computer program in Python
3. Provide knowledge of user define Functions and Modules in Python
4. Study of classes used in Python.

Course Outcomes:

COs	At the end of successful completion of the course the student will be able to	Bloom's Taxonomy
CO1	State and use different Input/output functions, Standard data types, Strings, basic operators in python programming	Knowledge
CO2	Implement Python programs with conditionals and loops	Understand Application
CO3	Utilize the Python strings and Python list concept in programming	Understand Application
CO4	Develop code for user defined function in python and implement it in simple programs	Application Create

Description:

Computer programming skills are now becoming part of basic education as these skills are increasingly of vital importance for future job and career prospects. The Python programming language which is one of the most popular programming languages worldwide. The course shows you how to use the free open-source Python to write basic programs and high level applications using concepts such as Class, BIF of Python, functions, variables, If Else statements, For loops, While loops, iterative and recursive programs and algorithms such as the Insertion Sort algorithm.
This course will be of great interest to all learners who would like to gain a thorough knowledge and understanding of the basic components of computer programming using the Python language

Prerequisites:	1:	Basics of C and C++ Programming
	2:	Knowledge of fundamentals of Computer Software and Hardware

Lab Work		
Unit 1	**Introduction to Python Programming Language.**	
	▪ Why Python Script or Program, Application of Python ▪ Python identifiers and reserved words ▪ Lines and indentation, multi-line statements ▪ Comments ▪ Input/output with print and input functions, ▪ Command line arguments and processing command line ▪ arguments ▪ Standard data types - basic, none, Boolean (true & False), ▪ numbers ▪ Data type conversion ▪ Python basic operators (Arithmetic, comparison, ▪ assignment, bitwise logical) ▪ Operator precedence	**04 Hrs**
Unit 2	**Control Statements and Python loops**	
	▪ Control Statements ▪ Python loops ▪ Iterating by subsequence index ▪ Loop control statements (break, continue, pass) ▪ Mathematical functions and constants (import math) ▪ Random number functions	**04 Hrs**
Unit 3	**Python strings**	
	▪ Concept, escape characters ▪ String special operations ▪ String formatting operator ▪ Single quotes, Double quotes, Triple quotes ▪ Raw String, Unicode strings, Built-in String methods. ▪ Python Lists - concept, creating and accessing elements, ▪ Updating & deleting lists, basic list operations, reverse ▪ Indexing, slicing and Matrices ▪ Built-in List functions	**04 Hrs**
Section-II		
Unit 4	**Python tuples and sets**	
	▪ Creating & deleting tuples ▪ Accessing values in a tuple ▪ Updating tuples, delete tuple elements ▪ Basic tuple operations ▪ Indexing, slicing and Matrices, built- in tuple functions.	**04 Hrs**
Unit 5	**Functions**	
	▪ Defining a function (def) ▪ Calling a function ▪ Function arguments - Pass by value, Keyword Arguments, ▪ default arguments ▪ Scope of variable - basic rules ▪ Documentation Strings ▪ Variable Number of Arguments ▪ Call by Reference ▪ Order of arguments (positional, extra & keyword)	**04 Hrs**

	▪ Anonymous functions ▪ Recursion ▪ Treatment of Input and Output Arguments	
Unit 6	**Classes**	
	▪ Defining Classes and Creating objects ▪ Class method and self argument ▪ Class variables and object variables ▪ Public and private data members ▪ Calling a class method from another class method ▪ Built in functions and class attributes	**04 Hrs**

Practicals :

Number	Practical/Experiment/Tutorial Topic	Hrs.	Cognitive levels of attainment as per Bloom
1 to 6	Minimum Two Python program on each unit mentioned in syllabus	2 each	Knowledge Application Analysis Synthesis Create

Mapping of POs & COs:

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

References:

Text books	
1	Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford University Press
2	Let Us Python: Python Is Future, Yashavant Kanetkar, Aditya Kanetkar, BPB Publication, New Delhi,
3	Introduction to Python Programming, Gowrishankar S, Veena A ·, CRC Press, Taylor and Francs Group, New York, 2018

Link for Video Lectures:

1. **https://nptel.ac.in/courses/111/107/111107105/**
2. **https://nptel.ac.in/courses/106/106/106106212/**

ME404P- THEORY OF MACHINE-I LAB

Practicals : 2 hrs. /week
Credits : 1

Evaluation Scheme:
ISA : 25 Marks
POE : 25 Marks

Course Objectives: The objective of the course is to
1. Provide the students with basic knowledge of mechanism and its application in mechanical engineering through the experiments 2. get known the significance of velocity and acceleration diagram in application of mechanism 3. Introduce the role of power transmission device (belt drive) in mechanism 4. Study the fundamental theory of friction and its analysis in different Mechanisms and machines

Number	Practical/ Experiment/Tutorial Topic	Hrs.	Cognitive levels of attainment as per Bloom's
1	Study of basic mechanisms. (Demonstration of models, Actual mechanisms, etc.)	2	Evaluation
2	One A3 size sheet of Velocity problems by relative velocity method. (Minimum 4 problems)	2	Evaluation
3	One A3 size sheet of Acceleration problems (including Coriolis component) by relative acceleration method. (Minimum 4 problems)	2	Evaluation
4	One A3 size sheet of Velocity problems by Klien's construction and Instantaneous center method. (Minimum 4 problems)	2	Evaluation
5	Verification of ratio of angular velocities of shafts connected by Hooks joint.	2	Evaluation
6	One A3 size sheet of Problems on cam profile. (Minimum 4 problems)	2	Analysis
7	Experiment on Governor characteristics for Porter or Hartnell governor.	2	Analysis
8	Experiment on Cam Profile	2	Evaluation
9	Experiment on belt drives.	2	Analysis
10	Experiment on Dynamometer	2	Application

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	3	1	--	--	--	--	1	--	--	--	--	--	--	--	--
CO2	3	2	2	1	--	--	--	--	--	--	--	--	1	--	--
CO3	2	2	1	2	--	--	--	--	--	--	--	--	2	--	--
CO4	2	2	3	1	--	--	--	--	--	--	--	--	2	--	--
CO5	1	3	1	2	--	--	--	--	--	--	--	--	3	--	--
CO6	1	2	3	3	--	--	--	--	--	--	--	--	3	--	--

References:

Text Books	
1	"Theory of Machines", Ratan S.S, Tata McGraw Hill New Delhi, 2nd Edition..
2	"Theory of Machines", P.L.Ballany, Khanna Publication, New Delhi, 2nd Edition.
3	"Theory of Machines", V.P. Singh, DhanpatRai and Sons.
Reference Books	
1	"Theory of Machines and Mechanism", Shigley, McGraw Hill, New York
2	"Theory of Machines", Abdullah Shariff, McGraw Hill, New Delhi.
3	"Theory of Machines", Thomas Bevan, CBS Publisher

Web Links/ Video Lectures:

1. **http://nptel.ac.in/courses/**

2. http://ocw.mit.edu

ME407P- MANUFACTURING SKILL DEVELOPMENT LAB- II

Practicals : 2 hrs. /week
Credits : 1

Evaluation Scheme:
ISA : 25 Marks
POE : 50 Marks

Course Objectives: The objectives of the course is to

1. To study Machine layout, installation of Machine Tools, selection of Tools.
2. To study Lathe Machine, Drilling Machine, Milling Machine.
3. To study and perform the various machining operations.
4. To Implement principles of metrology.

Course Outcomes:

Cos	At the end of successful completion of the course the student will be able to	Blooms Taxonomy
CO1	Understand Machine layout, method of Machine Tool installation, selection of Tools for various machining operation.	Understand
CO2	Selection of Machine tools such as Lathe Machine, Drilling Machine and Milling Machine for specific component operations	Analysis
CO3	Perform various machining operations to prepare Job using plain turning, taper turning, external threading, knurling, slotting, Keyway and Tapping etc.	Application Create
CO4	Apply quality inspection techniques on a component using principles of metrology.	Application

Description:

To get the hands on experience on Machine tools used in industries, Manufacturing Skill Development Lab-II course is designed. It contains basic knowledge and different operations on lathe machine, drilling machine, milling machine, shaping and drilling machine. The major focus is given on actual manufacturing of mechanical components as per provided drawing using these machine tools.

Prerequisites:	1:	Engineering Graphics, Basic Mechanical Engineering.
	2:	Composition of materials.

Practicals:

Number	Practical/ Experiment/Tutorial Topic	Hrs.	Cognitive levels of attainment as per Bloom's
1	Machine layout, existing machine specifications, Installation procedure of Machine Tools	2	Understand
2	Study the Mechanism and Application of Lathe Machine, Drilling Machine, Milling Machine.	2	Knowledge
3	Study the Mechanism and Application of Shaping, Slotting, Grinding, Tapping, Die threading.	2	Understand
4	Performing operations on job of MS material having facing, countering, parting, plain turning, taper turning, threading knurling etc.	2	Knowledge, Application
5	Performing operations on job of MS material having facing, countering, parting, plain turning, taper turning, threading knurling etc.	2	Knowledge, Application
6	Performing operations on job of MS material having facing, countering, parting, plain turning, taper turning, threading knurling etc.	2	Knowledge, Application
7	Performing one job of MS material on milling machine includes slotting / keyways.	2	Knowledge, Application
8	Performing one job of MS material on milling machine includes slotting / keyways.	2	Knowledge, Application
9	Performing one job of MS material on shaping machine.	2	Knowledge, Application
10	Performing operations on one job of MS material on grinding machine.	2	Knowledge, Application
11	Operations to be performed which includes tapping, die threading, boring.	2	Knowledge, Application
12	To carry out assembly of all components.	2	Application
13	Apply inspection techniques of Metrology	2	Analysis

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	2	3	1	2	--	--	--	--	--	--	--	--	--	--	--
CO2	2	3	1	2	2	--	--	--	--	--	--	--	--	--	--
CO3	2	3	1	2	2	--	--	--	--	--	--	--	2	2	2
CO4	2	2	2	2	3	--	--	--	--	--	4	--	2	2	2

References:

Text Books	
1	"Workshop Technology Vol. II", Raghuvanshi
2	"Workshop Technology Vol. II", Hajara Choudhary, Media Promoters and Publishers, Mumbai
3	"Workshop Technology Vol. I", Hajara Choudhary
Reference Books	
1	"Production Technology", P. C. Sharma, S. Chand Publication ,11th Edition.
2	"Production Technology", HMT handbook
3	"Workshop Practice Manual",V. Venkata Reddy, 6th edition

ME408P - COMPUTER AIDED DRAFTING

Practicals : 2 hrs. /week
Credits : 1

Evaluation Scheme:
ISA : 25 Marks
POE : 25 Marks

Course Objectives : The objectives of the course is to
1. To understand importance of CAD tool. 2. To develop an ability to create 2-D drawings. 3. To create 3-D models of machine components. 4. To create assembly of simple machine components with industrial approach.

Course Outcomes:

COs	At the end of successful completion of the course the student will be able to	Blooms Taxonomy
CO1	Draw 2D drawings and 3D models of simple components.	Application
CO2	Analyze and interpret production Drawing	Analysis
CO3	Use modern engineering techniques, tools and skills for engineering practice.	Analysis
CO4	Develop the skills for drafting using CAD software and get the knowledge to enhance the CAD utilities.	Knowledge, Analysis

Description:

This course has six units namely i) Introduction to CAD, ii) Use of layers, iii) Geometric Dimensioning and Tolerance, iv) Detail and Assembly Drawings, v) Production Drawing, vi) Introduction to 3D.

Prerequisites:	1.	Fundamentals of Engineering Graphics.
	2.	Fundamentals of Machine Drawing and Engineering Drawing.

Unit 1	**Introduction to CAD**	
	Limits command, Units command, **DRAW** commands like, Point (Format,Divide & Measure), Lines, Polyline, Circle, Ellipse, Polygon, Rectangle andBlock. **MODIFY** commands like, Erase, Move, Copy, Array, Scale, Lengthen,Fillet, Chamfer, Explode, Mirror, Offset, Trim, Extend, and Break. Viewing commands like Zoom, Pan, 3D Orbit. Auxiliary commands: INQUIRY Toolbar (Distance, Area and Mass), OSNAP& its settings, ORTHO, OTRACK **TEXT** Commands: Text, Multiline Text, Setting Text Styles.	**10 Hrs**
Unit 2	**Use of Layers**	
	Use of **LAYERS** in 2D drawing, Annotation and Layers toolbars.	**02 Hrs**
Unit 3	**Geometric Dimensioning and Tolerance**	
	Geometric Dimensioning Types of Dimensions: Linear, Aligned, Radius, Diameter, Angle Styles of Dimensioning: Baseline, Continue, Setting Dimension Styles (Setting the Method of Tolerances). Tolerancing For 2-D Objects: Applying various tolerance symbols like Straightness, Flatness, Perpendicularity, Angularity, Roundness, Concentricity, Cylindricity, Run out, Profile, Parallelism etc. Entering limits, fits, tolerances surface finish symbols and Machining Symbols on drawings.	**02 Hrs**
Unit 4	**Details and Assembly Drawings**	
	Preparing detail and assembly drawings in 2D. Preparing Bill of Material (BOM). Maximum number of parts to be limited. Entering limits, fits, Tolerances and surface finish symbols on detail and assembly drawings.	**02 Hrs**
Unit 5	**Production Drawing**	
	Production drawing including removed cross section, detailedviews, Cross sectional views, dimensions and tolerances etc.	**02 Hrs**
Unit 6	**Introduction to 3D**	
	Concept of UCS, Extrude, Cut, Revolve, Slice, Boolean operations-Union, Subtract Intersect, Fillet, Chamfer, Solid Editing, using any advance CADsoftware.	**06Hrs**

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Practicals:

Sr. No.	Practical/Experiment/Tutorial Topic	Hrs	Cognitive levels of attainment As per Bloom's
1	List out 2D and 3D commands shortcut keys.	4	Knowledge
2	Computer aided drafting of two simple components and print out of the same on A4 size sheet.	6	Application
3	3-D drawing of two or three simple components and plotting its 2-D views along with 3-D object drawing. Print out of the same on A4 size sheet.	6	Application
4	Drawing details and assembly with limit, fit, tolerances& Bill of material of assembly containing 6-8 major components .Print out of the same on A3 size sheet.	8	Application

Mapping of POs & COs:

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

References:

Text Books	
1	Ajeet Sing, "Working with AutoCAD 2000", Tata McGraw Hill.
2	"Machine drawing", N.D. Bhat and V.M. Panchal, Charotar Publication House, Anand,42nd Edition, 2007.
3	"Machine drawing", Basudeb Bhattacharyya, Oxford university press.
Reference Books	
1	"Auto cad 2014 for Engineers and Designers", Sham Tickoo, Dreamtech press, NewDelhi, 2014.
2	"Auto Cad 2014", Ellen Finkelsten, Wiley India Manuals and Tutorials of referredsoftware".

Note: Latest drafting software like Auto cad and any advance 3-D modeling software are tobe used.

ME409A - AUDIT COURSE-IV [GENERAL PROFICIENCY]

Practicals: 2 hrs / week
Credits: Non-Credit

Examination Scheme: --
Audit Point: 2

Instruction for Audit Course :
Student has to undergo any one general proficiency course mentioned below. This course must have minimum Two weeks duration. Student can do this course from the training institutes which are recommended and suggested by the department for respective academic year. At the end of semester, student has to submit the **COURSE COMPLETION CERTIFICATE** to the department.
Languages
1) English Speaking Course 2) German Language Course 3) Japanese Language Course (Any one Online / Offline Course Certificate course of two weeks)

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