B. E. SYLLABUS

MECHANICAL ENGINEERING

III & IV SEMESTER

With

Scheme of Teaching

& Examination

DEPARTMENT: MECHANICAL ENGINEERING

Sl. No	Name		Designation
1.	Prof. Gopinath	B.Sc. Engg.	Professor / Adjunct Faculty
2.	Dr. G. Ravichandran	Ph.D.	Professor /Adjunct Faculty
3.	Dr. Shrinivasa Rao B. R.	Ph.D.	Professor/Vice Principal /
4.	Prof. Vinaya B. R.	M.Tech	Asso. Professor/1st year
5.	Dr. Subrahmanya Bhat	Ph.D.	Professor and Dean Student
6.	Dr. Sudesh Bekal	Ph.D.	Professor/ Dean(R&D)
7.	Dr. Shashikanth Karinka	Ph.D.	Professor & HoD
8.	Dr. Srinivasa Pai P.	Ph.D.	Professor/DCOE
9.	Dr. Narasimha Marakala	Ph.D.	Professor
10.	Dr. Muralidhara	Ph.D.	Professor and PG Coordinator
11.	Dr. Mallikappa	Ph.D.	Professor
12.	Dr. Narasimha Bailkeri	Ph.D.	Professor
13.	Mr. Manjunath Shenoy	M.Tech	Associate Professor
14.	Mr. T.R. Venugopal	M.Tech	Associate Professor
15.	Mr. Gururaj Upadhyaya	M.Tech	Associate Professor
16.	Mr. Suresh Shetty	M.Tech	Associate Professor
17.	Mr. Ananthakrishna Somayaji	M.Tech	Associate Professor
18.	Mr. Udaya	M.Tech	Associate Professor
19.	Mr. Ravishankar Bhat	M.Tech	Asst. Prof, Gd III
20.	Mr. P. Venkatesh Murthy	M.Tech	Asst. Prof, Gd III
21.	Mr. Ravindra	M.Tech	Asst. Prof, Gd III
22.	Mr. Austin Dinesh D'Souza	M.Tech	Asst. Prof, Gd III
23.	Mr. Kumar H. S.	M.Tech	Asst. Prof, Gd II
24.	Mr. Adarsh Rai	M.Tech	Asst. Prof, Gd II
25.	Mrs. Rashmi P. Shetty	M.Tech	Asst. Prof, Gd II
26.	Mr. Dilip Kumar K.	M.Tech	Asst. Prof, Gd II
27.	Mr. Ravikiran Kamath B.	M.Tech	Asst. Prof, Gd II
28.	Mr. Nithin Kumar	M.Tech	Asst. Prof, Gd II
29.	Mr. Srinivas Prabhu	M.Tech	Asst. Prof, Gd II
30.	Mr. Veeresh R.K	M.Tech	Asst. Prof, Gd II
31.	Mr. Grynal D'Mello	M.Tech	Asst. Prof, Gd II

32.	Mr. Aneesh Jose	M.Tech	Asst. Prof, Gd I
33.	Mr. Divijesh P.	M.Tech	Asst. Prof, Gd II
34.	Mr. Vishwanath J. S.	M.Tech	Asst. Prof, Gd II
35.	Mr. Ajith M Hebbale	M.Tech	Asst. Prof, Gd I
36.	Mr. Krishna Prasad	M.Tech	Asst. Prof, Gd I
37.	Mr. Manjunath Maiya	M.Tech	Asst. Prof, Gd I
38.	Mr. Sharathchandra	M.Tech	Asst. Prof, Gd II
39.	Mr. Santhosh G.	M.Tech	Asst. Prof, Gd I
40.	Mr. Rajath N. Rao	M.Tech	Asst. Prof, Gd II
41.	Mrs. Kshatriya Akshatha Manjunath	M.Tech	Asst. Prof, Gd I
42.	Mr. Goutham Hebbar	M.Tech	Asst. Prof, Gd I
43.	Mr. Melwyn Rajesh Castelino	M.Tech	Asst. Prof, Gd I
44.	Mr. Vincent Linish D'souza	M.Tech	Asst. Prof, Gd I
45.	Mr. Bhaskar P. Achar	M.Tech	Asst. Prof, Gd I
46.	Mr. Mohan Poojari	M.Tech	Asst. Prof, Gd I
47.	Mr. Vidyasagar Shetty	M.Tech	Asst. Prof, Gd II
48.	Mr. Ragavendra Pai	M.Tech	Asst. Prof, Gd I
49.	Mr. Sunil Kumar Shetty	M.Tech	Asst. Prof, Gd I

DEPARTMENT OF MECHANICAL ENGINEERING

Vision Statement:

To produce Mechanical engineers of the highest quality who are professionally competent and highly qualified to suit the needs of industries and organizations by promoting excellence in teaching, learning and research.

Mission Statement:

The Dept. of Mechanical Engineering is committed to –

- Provide high quality education to the students, to fulfill the requirements of a 'Global Engineer'.
- Constantly strive to improve the teaching-learning methods, in order to deliver good academic programs.
- To respond to the fast evolving scientific and technological challenges in a highly competitive world.
- To inculcate, ethics, integrity, honesty, credibility, social and environmental consciousness.

Programme Educational Objectives (UG)

To satisfy the mission of the mechanical engineering program, the graduates will:

1. Be able to research, design, develop, test, evaluate, and implement engineering solutions to problems that are of a complexity encountered in professional practice.
2. Be able to communicate and perform as an effective engineering professional in both individual and team-based project environments.
3. Consider the ethical implications and societal impacts of engineering solutions.
4. Continuously improve through lifelong learning.

Programme outcomes (UG):

Programme Outcomes (PO) for Department of Mechanical Engineering (U.G)
PO1: ***Engineering knowledge:*** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: ***Problem analysis***: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: ***Design/development of solutions:*** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural,

societal, and environmental considerations.
P04: ***Conduct investigations of complex problems:*** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: ***Modern tool usage:*** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: ***The engineer and society***: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7: ***Environment and sustainability***: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8: ***Ethics***: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
P09: ***Individual and team work:*** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10: ***Communication:*** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clearinstructions.
PO11: ***Project management and finance:*** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: ***Life-long learning:*** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs):

PSO 1: Ability to identify and use mechanical engineering literature and apply it in written, oral, and graphical communication in technical environments.

PSO2: Ability to apply mechanical engineering principles to write specifications, do fabrication, testing, operation and documentation of basic mechanical systems or processes.

Graduate Attributes:

The Graduate Attributes are the knowledge skills and attitudes which the students have at the time of graduation. These attributes are generic and are common to all engineering programs. These Graduate Attributes are identified by National Board of Accreditation.

Sl. No.	Graduate Attributes
a.	Engineering Knowledge
b.	Problem Analysis
c.	Design / development of solutions
d.	Conduct investigations of complex problems
e.	Modern tool usage
f.	The engineer and society
g.	Environment and sustainability
h.	Ethics
i.	Individual and team work
j.	Communication
k.	Project management and finance
l.	Life-long learning

DEPARTMENT OF MECHANICAL ENGINEERING
SCHEME OF TEACHING AND EXAMINATION

III SEMESTER B.E. **33 Hours / Week**

Sl. No.	Sub. Code	Subject	Theory/Tuto./Prac./ Self Study	Total Hrs./Week	C.I.E	S.E.E	Credits
1	16ME301	Engineering Mathematics - III	4+0+0+0	4	50	50	4
2	16ME302	Material Science & Metallurgy*	3+0+0+S	3	50	50	3
3	16ME303	Basic Thermodynamics	2+2+0+0	4	50	50	3
4	16ME304	Manufacturing Processes-I	3+0+0+S	3	50	50	3
5	16ME305	Mechanics of Materials*	4+0+0+0	4	50	50	4
6	16ME306	Computer Aided Machine Drawing	3+0+3+0	6	50	50	3
7	16ME307	Material Testing Lab.	0+0+3+0	3	50	50	2
8	16HU311	Enhancing Self Competence	1+0+2+0	3	50	50	2
9	16ME309	Foundry, Forging & Welding shop	0+0+3+0	3	50	50	2
TOTAL			**33**	**33**	**450**	**450**	**26**

***Choice based courses students have to select any two of the four in third and fourth semester**

DEPARTMENT OF MECHANICAL ENGINEERING
SCHEME OF TEACHING AND EXAMINATION

IV SEMESTER B.E. **30 Hours / Week**

Sl. No.	Sub. Code	Subject	Theory/Tuto./Prac./ Self Study	Total Hrs./Week	C.I.E	S.E.E	Credits
1	16ME401	Engg. Mathematics-IV	4+0+0+0	4	50	50	4
2	16ME402	Kinematics of Machines*#	3+2+0+0	5	50	50	4
3	16ME403	Applied Thermodynamics	2+2+0+0	4	50	50	3
4	16ME404	Manufacturing Processes - II	4+0+0+S	4	50	50	4
5	16ME405	Fluid Mechanics*	4+0+0+0	4	50	50	4
6	16ME406	Engineering Economics	3+0+0+0	3	50	50	3
7	16ME407	Energy Conversion Engineering Lab.	0+0+3+0	3	50	50	2
8	16ME408	Machine Shop	0+0+3+0	3	50	50	2
TOTAL			**30**	**30**	**400**	**400**	**26**

*** Choice based courses students have to select any two of the four in third and fourth semester**
 # Course includes project based learning

ENGINEERING MATHEMATICS – III

Sub Code: 16ME301	**Credits : 04**
Hrs/Week: 4+0+0+0	**Total Hours : 52**

Course Learning Objectives:

This Course will enable students to

1. Apply operators like gradient, divergence and curl to both scalar as well as vector functions.
2. Evaluate surface integrals and volume integrals in terms of line integrals using various integral theorems.
3. Apply various concepts of complex functions in real life problems.
4. Represent periodic functions in both analytic as well as geometric forms.
5. Obtain Z-transform of standard functions using properties of Z-transforms.

UNIT – I

VECTOR CALCULUS

Vector algebra, Vector differentiation-gradient, divergence, curl, Laplacian, solenoidal and irrotational vectors, curvilinear, spherical & cylindrical co- ordinates. **10 Hours**

UNIT – II

VECTOR INTEGRATION

Line, Surface & Volume integrals. Green's, Gauss divergence & Stoke's theorems-Applications. **8 Hours**

UNIT – III

THEORY OF COMPLEX VARIABLES

Functions of complex variables, Cauchy Riemann equations. Properties of analytic functions, conformal mapping. Bilinear transformations.

Line integrals in complex plane, Cauchy's theorem, Power series, Residues, Cauchy's residue theorem. **12 Hours**

UNIT - IV

FOURIER ANALYSIS

Periodic functions, Euler's formulae, Fourier series of odd and even functions, functions with arbitrary period, half range series. Harmonic Analysis. Fourier integral theorem, Fourier Transforms, Inverse Fourier transform, Convolution theorem and Parseval's identity. Fourier sine and Fourier cosine transforms, Inverse Fourier sine and Inverse Fourier cosine transforms. **11 Hours**

UNIT - V

Z TRANSFORMS

Z-transform, standard forms, linearity property, damping rule, shifting rule. Inverse Z-transform, Finite differences and difference equations, solving difference equations using Z-transforms. **11 Hours**

Course Outcomes:

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

C-16ME301.1. Know the areas in which vector functions and their derivatives can be used. Apply operators like curl, gradient, divergence and find directional derivatives.

C-16ME301.2. Define and compute line, surface and volume integrals over general regions. Apply Green's, Stoke's and Gauss divergence theorem in relevant fields.

C-16ME301.3. Determine analyticity of a function and find the derivative of a function, evaluate an integral using Cauhy's integral formula. Compute the residue of function and use the residue theory to evaluate integrals.

C-16ME301.4. Find Fourier series of a function, obtain the half-range series, harmonics, find the Fourier transform and the inverse Fourier transform of a function.

C- 6ME301.5. Find the Z-transform and the inverse Z-transform of a function. Apply this to obtain the solutions of difference equations.

Mapping of POs & COs:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C-16ME301.1	**H**	**H**	M	**M**	**L**	-	-	-	-	-	**L**	**L**	**H**	**H**
C-16ME301.2	**M**	**H**	**H**	M	**L**	-	-	-	-	-	**L**	**L**	**H**	**H**
C-16ME301.3	M	**H**	H	**M**	**L**	-	-	-	-	-	**L**	**M**	**M**	**M**
C-16ME301.4	**M**	**H**	M	**M**	**M**	-	-	-	-	-	**L**	**M**	**M**	**H**
C-16ME301.5	M	**H**	L	**M**	**M**	-	-	-	-	-	**L**	**L**	**M**	**M**

L: Low M: Medium H: High

TEXT BOOKS:

1. Kreysizg, "Advanced Engineering Mathematics", John Wiley and Sons, VI-Edition.
2. B.S.Grewal, "Higher Engineering Mathematics", 42nd Edition, Khanna publishers, 2012.

REFERENCE BOOKS:

1. Wylie Ray, "Advanced Engineering Mathematics", 6th Edn., McGraw Hill.Inc.,1995.
2. Murray R. Spiegal, "Vector Analysis", Schuam publishing Co., 2009.

MOOC/NPTEL Resources:

1. http://www.nptelvideos.in/2012/11/mathematics-iii.html

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MATERIAL SCIENCE AND METALLURGY

Sub code	**: 16ME302**	**Credits**	**03**
Hrs/Week	**: 3+0+0+S***	**Total Hours**	**39**

*** Self Study to be exercised under the supervision of course instructor and to be restricted to not more than 10% of the total teaching hours.**

Course learning objectives:

This Course will enable students to

1. Understand basics knowledge about crystalline solids and their nature.
2. Analyze the mechanism of solidification and phase formation and transformation.
3. Know about the Iron and carbon system and different alloy formation and structurally their nature.
4. Understand the change in material behavior when thermal and mechanical loads are applied on them.
5. Learn about the different ferrous and nonferrous alloys and also gain brief knowledge about advanced materials.

UNIT – I

Chapter 1: Introduction, Classification of engineering materials, Structure of crystalline solids, Fundamental concepts of unit cell,

Self Study: X- ray diffraction technique for determination of crystal structures, Crystal imperfections-point, line, surface & volume defects. Diffusion, Diffusion Mechanisms, Fick's laws of diffusion. **7 Hours**

Chapter 2: Fundamentals of solidification, nucleation and its types, crystal growth, cast structure. Solid solutions, Types,

Self Study: Rules governing the formation of solids solutions. **3 Hours**

Chapter 3: Phase diagrams: Basic terms, phase rule, cooling curves, construction of phase diagrams, interpretation of equilibrium diagrams, Types of phase diagrams. Lever rule, Problems on Phase diagrams. **5 Hours**

UNIT – II

Chapter 4: Iron carbon equilibrium Diagram, Micro constituents in the Fe–C system, Invariant reactions, critical temperatures, Microstructure of slowly cooled steels, effect of alloying elements on the Fe-C diagram, ferrite & Austenite stabilizers. Solidification of iron-carbon alloys, The TTT diagram, drawing of TTT diagram, TTT diagram for hypo & hypereutectoid steels, effect of alloying elements,

Self Study: CCT diagram. **5 Hours**

Chapter 5: Physical metallurgy: Heat treatment processes, Annealing and its types, normalizing, hardening, tempering, martempering, austempering, surface hardening: case hardening, carburizing, cyaniding, nitriding, Induction hardening. Hardenabilty, Jominy end-quench test.

Self Study: Age hardening of Al & Cu alloys. **5 Hours**

UNIT – III

Chapter 6: Mechanical metallurgy: Plastic deformation, slip and twinning. Fracture: types, stages in cup & cone fracture, Griffith's criterion. Notch effect, ductile-brittle transition. Fatigue: fatigue tests, mechanism, S-N curves, Factors affecting fatigue life, and protection methods. Creep: Various stages of creep, Mechanisms of creep, effect of temperature, creep fracture,

Self Study: Stress relaxation **7 Hours**

Chapter 7: Engineering Alloys: Steel: Method of designation as per AISI–SAE. Properties, composition and uses of low, medium, and high carbon steels. Cast irons: Microstructures & properties of White CI, Grey CI. Copper & its alloys: Brasses & Bronzes.

Self Study: Light alloys: Aluminum, Magnesium & Titanium alloys.

Advanced Materials: Ceramics, Polymers, Composites materials, classification based on matrix and reinforcement types, applications. **7 Hours**

Course Outcomes:

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

C-16ME302.1. Identify and analyze the various crystal structure and defects responsible for change in the material properties.

C-16ME302.2. The students demonstrate the knowledge of homogenous and heterogeneous nucleation, Crystal growth and its structure. solid solution types and Unary and types of binary phase diagram

C-16ME302.3. To know different phases in Iron carbon diagram for steels and cast-iron and selection of best heat treatment process (annealing, normalizing, tempering, hardening, and other heat treatment process) according to the requirement.

C-16ME302.4. Become competent to identify possible cause of failure due to fatigue, Creep and types of failures

C- 6ME302.5. Shall demonstrate to identify the composition, properties and application of various ferrous, nonferrous and composite materials.

Mapping of POs & COs:

POs / COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C-16ME302.1	H	L	L	-	-	H	M	-	-	-	-	H	M	-
C-16ME302.2	H	H	M	-	-	M	M	-	-	-	-	H	M	-
C-16ME302.3	H	H	H	-	-	L	L	-	-	-	-	H	M	-
C-16ME302.4	H	H	M	-	-	L	M	-	-	-	-	H	M	-
C-16ME301.5	H	L	L	-	-	M	H	-	-	-	-	H	H	-

L: Low M: Medium H: High

TEXT BOOKS:

1. "Essentials of Materials Science and Engineering", Donald R. Askeland, Pradeep P.Phule Thomson-Engineering, 2006.
2. "Materials Science & Engineering- An Introduction", William D. Callister Jr. Wiley India Pvt. Ltd. 6th Edition, 2010, New Delhi.

REFERENCE BOOKS:

1. "Foundations of Material Science and Engineering", W.F.Smith, 4th Edition, McGraw Hill, 2005.
2. "Physical Metallurgy, Principles & Practices", V Raghavan. PHI, 3rd Edition, 2015, New Delhi.
3. "Introduction to Material Science for Engineering", 6th edition James F. Shackel Ford. Pearson, Prentice Hall, New Jersy, 2006.

MOOC/NPTEL Resources:

1. http://nptel.ac.in/courses/113106032/
2. https://www.edx.org/course/materials-science-engineering-misisx-mse1x

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BASIC THERMODYNAMICS

Sub Code : 16ME303 **Credits : 03**
Hrs/Week : 2+2+0+0 **Total Hours : 39**

Course Learning Objectives:

This Course will enable students to

1. Get the idea basic concepts of thermodynamic systems, properties, zeroth law of thermodynamics and also thermodynamic definition of work and heat. How to use the concept of First Law of Thermodynamics for energy conservation analysis to a control mass or control volume at an instant and also the restrictions imposed by the first law of thermodynamics on conversion from one form to another.
2. To learn the application of Second Law of Thermodynamics and entropy concepts in analyzing the thermal efficiencies of heat engines and the coefficients of performance for refrigerators. To learn the concept of entropy and entropy principle.
3. Understand the meaning, properties & phase diagrams of pure substance. Also, calculate the change of entropy of pure substance and ideal gas under different thermodynamics processes. Get the idea to use the ideal gas laws to individual gases and gas mixtures with the application of thermodynamic laws.

Pre- requisites: Calculus, Engineering physics and chemistry, Elements of mechanical engineering.

UNIT - I

Fundamental Concepts & Definitions:

Characteristics of thermodynamic system, boundary and surroundings. Fixed, moving and imaginary boundaries, examples. Thermodynamic state, state point, identification of a state through properties; definition and units. Intensive and extensive properties. Path and process. Quasi-static process, cyclic and non-cyclic processes. Thermodynamic equilibrium. Zeroth law of thermodynamics. Temperature as an important property- temperature measurement. Numerical problems. **3 Hours**

Work and Heat

Mechanics: definition of work and its limitations. Thermodynamic definition of work and heat. Examples & sign convention. Displacement work as part of a system boundary and as whole of a system boundary. Expressions for displacement work in various processes through p-v diagrams. Numerical problems. **4 Hours**

First Law of Thermodynamics

Statement of the First law of thermodynamics for a cycle, derivation of the First law for processes. Internal energy as a property, thermodynamic distinction between energy and work; concept of enthalpy, definitions of specific heats at constant volume and at constant

pressure. Extension of the First law to control volume; steady state-steady flow energy equation. Important applications such as flow in a nozzle, diffuser, throttling, compressor, turbine etc. Numerical problems. **7 Hours**

UNIT - II

Second Law of Thermodynamics

Devices converting heat to work and vice versa in a thermodynamic cycle, thermal reservoirs. heat engine and a heat pump. Schematic representation and efficiency and coefficient of performance. Carnot cycle-explanation and arrangements. Identifications of directions of occurrences of natural processes, Offshoot of II law from the Ist. Kelvin-Planck and Clausius's statements of Second law of Thermodynamic; Equivalence of the two statements. Reversible heat engines, refrigerators and heat pumps. Irreversible process. Numerical problems.

7 Hours

Entropy

Entropy; definition, a property, principle of increase of entropy, entropy as a quantitative test for irreversibility; Calculation of entropy, role of T-s, h-s diagrams. Use of steam table and mollier chart for determining entropy. Representation of heat quantities; Entropy generation in closed system. Numerical problems. **6 Hours**

UNIT - III

Pure Substances

Definition of a pure substance, phase of a substance, triple point and critical points. Sub-cooled liquid, saturated liquid, vapour pressure, two phase mixture of liquid and vapour, saturated vapour and superheated vapour states of a pure substance. Representation of properties of pure substance on p-T and p-V diagrams. Simple numerical problems.

5 Hours

Ideal & Real Gas Mixtures

Differences between perfect, ideal and real gases. Equation of state. Evaluation of properties of perfect and ideal gases. Introduction. Van der Waal's Equation of state, Van der Waal's constants in terms of critical properties, law of corresponding states, compressibility factor; compressibility chart. Ideal gas mixtures: Dalton's law, Properties of ideal gas mixtures. Numerical problems.

7 Hours

Course Outcomes:

At the end of the course the student should be able to

C-16ME303.1. Summarize the basic concepts of thermodynamics and thermodynamic systems. Use the First Law of Thermodynamics for energy conservation analysis to a control mass or control volume at an instant of time, and understand the different forms of energy and restrictions imposed by the first law of thermodynamics on conversion from one form to another.

C- 6ME303.2. Apply Second Law of Thermodynamics and entropy concepts in analyzing the thermal efficiencies of heat engines and the coefficients of performance

for refrigerators. Illustrate the concept of entropy and entropy principle, and the meaning.

C- 6ME303.3. Understand the properties & phase diagrams of pure substance. Use the ideal gas laws to individual gases and gas mixtures with the application of thermodynamic laws.

Course Articulation Matrix:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C-16ME303.1	H	H	L	M	L	L						M	M	M
C-16ME303.2	H	H	L	M	L	L						M	M	M
C-16ME303.3	H	H	L	M	L	L						M	M	M

L: Low M: Medium H: High

TEXT BOOKS:

1. Engineering Thermodynamics, P.K.Nag , McGraw Hill, III Edition, 2005
2. Thermodynamics- an Engineering Approach, Yunus A Cengel /Michael A Bolas, McGraw Hill, 3rd edition, 1998

REFERENCE BOOKS:

1. Fundamentals of Thermodynamics, Sonntag, Borgnakke, Van Wylen, 6th edition, 2003
2. Engineering Thermodynamics, Gordon Rogers/Yon Mayhew, AWL, 4th edition 2001

MOOC/NPTEL Resources:

1. https://www.coursera.org/learn/thermodynamics-intro
2. http://nptel.ac.in/courses/112105123/1

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MANUFACTURING PROCESSES – I

Sub Code : 16ME304	**Credits 03**
Hrs/week : 3+0+0+S	**Total Hours 39**

*** Self Study to be exercised under the supervision of course instructor and to be restricted to not more than 10% of the total teaching hours. Evaluation of same can be included for the task.**

Course Learning Objectives:

This Course will enable students to

1. Get an idea about the criteria for selection of manufacturing processes for a particular product and to understand about casting process.
2. Know about various casting processes available for manufacturing various types of products.
3. Know the difference between hot and cold working of metals. They will also learn about various processes by which the metal can be given required shape.
4. Learn about various non-metals available and the various ways to process them.
5. Know about various welding techniques available to join two components along with various advanced welding techniques.

UNIT – I

Introduction: Classification of engineering materials and processing techniques. Concept of Manufacturing process, its importance. Classification of Manufacturing processes.
Introduction to Casting process: Steps involved. Patterns: Definition, classification, function, and materials used, pattern allowances. Sand Moulding: Types of base sand, requirement of base sand, desirable properties. Binder: Definition, Types of binder used in moulding sand. Additives: Need, Types of additives used and their properties. Cores: Definition, Need, Types. Fettling and cleaning of castings. Moulding Machines: Jolt type, Squeeze type, Jolt & Squeeze type and Sand slinger.

Special moulding Process: No bake moulds, Flaskless moulds, Sweep mould, CO_2 mould, Shell mould, Investment mould. Metal moulds: Gravity die-casting, Pressure die casting, Centrifugal casting, Squeeze Casting, Vacuum mould casting, Evaporative pattern casting, Continuous Casting Processes. Introduction to Melting furnaces. Casting defects: Causes and remedies, Introduction to 3-D printing

Self Study : Stir casting.

15 Hours

UNIT – II

Metal Shaping and Forming: Hot and cold working: Introduction & comparison. Rolling, Principle and operations. Forging operations, Extrusion, Wire and tube drawing processes. Cold working processes: Shearing, Drawing, Squeezing, Blanking, Piercing, deep drawing, Coining and embossing, dies used for various processes. Powder metallurgy.

Processing of non-metals: Processing of glass: glass melting and forming, glass annealing. Processing of ceramics: ceramic powder preparation, fabrication of ceramic products from powders: pressing, casting, vapour phase techniques, sintering.
Processing of plastics: Mechanical properties of plastics, thermoplastics and thermosets, Fabrication: Extrusion. Injection moulding. Thermoforming. Compression moulding. Transfer moulding.

15 Hours

UNIT – III

Joining processes: Welding process: Arc Welding: Principle, Metal Arc welding (MAW), Flux Shielded Metal Arc Welding (FSMAW), Inert Gas Welding (TIG & MIG) Submerged Arc Welding (SAW). Gas Welding: Principle, Oxy – Acetylene welding. Resistance welding – principles. Friction welding, Explosive welding, Thermit welding. Plastic welding. Principles of soldering & brazing. Adhesive bonding.

Self Study :: Laser Welding, Electron Welding, Welding Defects

9 Hours

Course Outcomes:

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

C-16ME304.1. Know what is manufacturing and to understand the casting process.
C-16ME304.2. Know about various special casting techniques used in industries along with their advantages and disadvantages.
C-16ME304.3. Evaluate how the properties and the shape of a raw material can be altered by rolling, forging, extrusion, press working etc.
C-16ME304.4. Classify about various non-metals available and the ways to process them.
C- 6ME304.5. Discover how two materials can be joined together by welding and the various advanced welding techniques which are used in the industries.

Course Articulation Matrix:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C-16ME304.1	L	L	-	-	L	-	-	-	M	-	-	H	-	H
C-16ME304.2	M	M	-	-	H	-	-	-	M	-	-	H	-	H
C-16ME304.3	M	M	-	-	H	-	-	-	M	-	-	H	-	
C-16ME304.4	M	M	-	-	H	-	-	-	M	-	-	H	-	H
C-16ME304.5	M	M	-	-	H	-	-	-	M	-	-	H	-	H

L: Low M: Medium H: High

TEXT BOOKS:

1. *"Manufacturing technology"*, Foundry, Forming and welding by P. N. Rao, Tata McGraw Hill, New Delhi.
2. *"Manufacturing Engineering Technology"*, by Scrope Kalpakjian.
3. *"Production Technology"*, O.P.Khanna.

REFERENCE BOOKS:

1. *"Materials and processes in manufacturing"*, by E.Paul Degarmo.
2. *"Processes and materials of manufacture"*, By Roy A. Lindburg.
3. *"Principles of metal casting"*, by Rosenthal.

MOOC/NPTEL Resources:

1. *"Manufacturing Processes 1"* by NPTEL.
2. http://nptel.ac.in/courses/112107145/

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MECHANICS OF MATERIALS

Sub Code : 16ME305 **Credits : 04**
Hrs/Week : 4+0+0+0 **Total Hours: 52**

Course Learning Objectives:

This Course will enable students to

1. Understand the concept of stress and strain and analyze the variation of stress, strain and change in dimensions of simple bars.
2. Obtain elastic constants and analyze thick & thin cylinders.
3. Analyze and draw Shear force and Bending Moment diagrams for different beams.
4. Understand the theory of simple bending, bending and shear stresses in beams.
5. Apply Macaulay's method/ Double Integration method to determine deflection and slope in various beams, concept of pure torsion.

UNIT – I

Simple stress and strain: Introduction, stress, strain, Mechanical properties of materials, Linear elasticity, Hook's Law and Poisson's ratio, Stress-Strain relation - behavior in Tension for Mild steel and non ferrous metals. Extension / Shortening of a bar, bars with cross sections varying in steps bars with continuously varying cross sections (circular and rectangular) Elongation due to self weight, Principle of super position. **8 Hours**

Introduction to Compound Stresses: Stresses on an inclined plane. Elements subjected to uniaxial direct stress and biaxial stresses with simple shear. Plane stress and plane strain conditions. (Derivations & Problems not included) **2 Hours**

UNIT – II

Volumetric strain, expression for volumetric strain and numerical elastic constants, simple shear stress, shear strain, Temperature stresses (compound bars/ plates not included).

6 Hours

Thick and thin cylinders: Stresses in thin cylinders, changes in dimensions of cylinder (diameter, length and volume), Thick cylinders subjected to internal and external pressures (Lame's equation). **4 Hours**

Introduction to Columns: Introduction to columns, Euler's theory for axially loaded elastic long columns, Rankin's formula. (Derivations & Problems not included) **2 Hours**

UNIT – III

Bending moment and Shear force in beams: Introduction, Types of beams, loads and reactions, shear forces and bending moments, rate of loading, sign conventions, relationship between shear force and bending moments, shear force and bending moment diagrams for different beams subjected to concentrated loads, Uniform distributed load (UDL) and couple for different types of beams (UVL not included). **8 Hours**

UNIT – IV

Bending and shear stresses in beams: Introduction, theory of simple bending, assumptions in simple bending, relationship between bending stresses and radius of curvature, relationship between bending moment and radius of curvature, moment carrying capacity of a section. Shearing stresses in beams, shear stress across rectangular, circular and symmetrical I and T sections. **8 Hours**

UNIT – V

Deflection of beams: Introduction, differential equation for deflection, Equations for deflections, slope and moments, Double integration method/ Macaulay's method for cantilever and simply supported beams for point load, UDL and Couple. **7 Hours**

Torsion of circular shafts: Introduction, pure torsion, assumptions, derivation of torsional equations, polar modulus, torsional rigidity / stiffness of shafts, Derivation of power transmitted by solid and hollow circular shafts and simple problems. **7 Hours**

Course Outcomes:

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

C-16ME305.1. Appreciate the concept of stress, strain for varying cross-sections with varying loads for varying physical systems and plane stress – plane strain conditions.

C-16ME305.2. Analyze volumetric stresses, strains and relation between elastic constants and stresses in cylinders.

C-16ME305.3. Illustrate the shear force and bending moment for different types of beams subjected to different loads.

C-16ME305.4. Determine the shear stress and bending stresses in beams for different cross sections.

C- 6ME305.5. Discuss the concept of deflection of beams, twisting moment in shafts and power transmitted by circular shafts.

Course Articulation Matrix:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010	PO11	PO12	PSO1	PSO2
C-16ME305.1	H	H	H	H	M	-	H	M	M	-	-	-	H	H
C-16ME305.2	H	H	H	H	M	-	M	M	M	-	-	-	M	H
C-16ME305.3	H	M	H	M	H	-	H	L	H	-	-	-	H	H
C-16ME305.4	H	H	H	H	M	-	H	L	M	-	-	-	H	H
C-16ME305.5	H	H	H	H	M	-	H	L	H	-	-	-	H	H

L: Low M: Medium H: High

TEXT BOOKS:

1. Punmia B.C, Ashok Kumar Jain, Arun Kumar Jain, "Strength of materials and Theory of Structures", Volume I & Volume II, Laxmi Publications (P) Ltd.,2015
2. Mechanics of materials, by Ferdinand P. Beer, E. Russell Johnson, Jr. John T.Dewolf, McGraw Hill International.

REFERENCE BOOKS:

1. Strength of Materials by S.S. Bhavikatti, 4th edition, Vikas Publications, 2013.
2. Strength of materials by S. Ramamrutham, 2012.
3. Mechanics of Materials, by E.P.Popov, Prentice Hall India Pvt. Ltd. 1978.
4. Engineering Mechanics by Timoshenko & Young, Tata McGraw Hill Book publishing co.ltd. 1985
5. Mechanics of Materials, by James Gere – Thomson learning

MOOC/NPTEL Resources:

1 http://nptel.ac.in/courses/112107147/
2 https://ocw.mit.edu/courses/mechanical-engineering/2-001-mechanics-materials-i-fall-2006/index.htm
3 https://www.coursera.org/learn/mechanics-1

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COMPUTER AIDED MACHINE DRAWING

Sub code : 16ME306 **Credits 03**
Hrs/Week : 3+0+3+0 **Total Hours 39**

Course Learning Objectives:

This Course will enable students to

1. Apply the concepts of Orthographic projections and sectional views in drawing different views of geometric shapes like solids and 3D machine parts.
2. Apply the concepts of graphical representation of fits and tolerances in different part drawings of machine parts.

3. Understand the concepts of usage of Geometric tolerencing in drawing of machine parts and represent them in 2D views of machine parts.
4. Understand the application of assembly drawing concept and apply them in simple assemblies such as joints and couplings. Represent the 2D views (including the sectional views) of these machine parts.
5. Understand the usage of different tools of software packages such as Creo parametric 2.0/ Solid Edge and apply them in 3D modeling, assembly and drafting of assemblies such as Screw Jack, Plummer Block, Machine Vice, Drill Jig and Non Return Valve.

UNIT – I

INTRODUCTION: Introduction to machine drawing: Importance of sectional view in machine drawing. Section of solids: sectional views and true shape of cut surface of simple solids like prism, pyramid, cone, cylinder, cube and tetrahedron. (Resting on base only- 3 problems) Free hand sketching of: Orthographic views of simple machine parts with section from Isometric views. **6 Hours**

UNIT – II

FITS AND TOLERANCES: Limits, fits and tolerances-need, types, representation of tolerances on drawing, calculation of minimum and maximum clearances and allowances. Geometric tolerance: uses, types of form and position tolerances, symbols, method of indicating geometric tolerances on part drawings. Surface finish symbols- methods of indicating the surface roughness. Blue print reading exercises. **3 Hours**

ASSEMBLY CONCEPTS: Methods and concepts of assemblies-assembly requirements, Bill of materials. Methods of assembly of bolts, nuts, studs, screws and pins. Methods of arresting motion of members in an assembly, Assembly and dismantling exercise of a typical assemblies with emphasis on assembly sequence and appropriate fits. **2 Hours**

ASSEMBLY DRAWING PRACTICE: Making free hand sketches of typical subassemblies-flange coupling, stuffing box, journal bearings, rolling element bearings, keyed joints, cotter joints, C clamp. **6 Hours**

UNIT – III

ASSEMBLY USING SOLID MODELING: Modeling and assembly using software-extracting views and sections. Drawing assemblies of: Plummer block, machine vice, stop valve, screw jack, tail stock, 3 jaw chucks and simple drill jig. Creation of bill of materials; checking Interference between solids. **22 Hours**

Course Outcomes:

At the end of this course, student shall be able to:

C-16ME306.1. Apply the concepts of Orthographic projections and sectional views in drawing different views of geometric shapes like solids and 3D machine parts.

C-16ME306.2. Apply the concepts of graphical representation of fits and tolerances in different part drawings of machine parts.

C-16ME306.3. Make use of the concepts of Geometric tolerencing in drawing of machine parts.

C-16ME306.4. Construct simple assemblies such as joints and couplings using assembly drawing.

C-16ME306.5. Develop 3D models of assemblies such as Screw Jack, Plummer Block, Machine Vice, Drill Jig and Non Return Valve using different tools of software packages such as Creo parametric 2.0/ Solid Edge.

Mapping of POs & COs:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	P O 12	PSO 1	PSO 2
C-16ME306.1	M	M	L	M	H	L	L	M	M	H	L	M	H	L
C-16ME306.2	M	M	L	M	H	M	L	H	M	H	L	M	H	H
C-16ME306.3	M	M	L	M	H	M	L	H	H	H	L	M	H	H
C-16ME306.4	H	M	L	H	H	M	L	M	M	H	M	H	H	M
C-16ME306.5	H	M	L	H	H	M	L	H	M	H	H	H	H	M

L: Low M: Medium H: High

TEXT BOOK:

1. A Primer on CAMD, VTU, 2007
2. Machine Drawing by K. R. Gopala Krishna, Subhas Stores, 2014

REFERENCE BOOKS:

1. A Text book of CAMD, Tryambaka murthy, CBS Publishers, New Delhi, 2007
2. Machine Drawing by N.D. Bhatt and V.M. Panchal, Charotar Publishing House Pvt. Ltd.; 49th edition (2013)

Evaluation Scheme

CIE Scheme

Assessment	Weightage in Marks
MSE	30
Tasks/ Submissions	20
Total	**50**

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MATERIAL TESTING LABORATORY

Sub code	**: 16ME307**	**Credits**	**02**
Hrs/Week	**: 0+0+3+0**	**Total Hours : 39**	

Course Learning Objectives:

This Course will enable students to

1. Understand the mechanical properties of materials and its characteristics.
2. Analyze and to conduct the various mechanical tests.
3. Learn the preparation of specimens for different metallographic examinations.
4. Understand the basics about heat treatment process.
5. Estimate the tribological properties of materials.

PART – A
[Major Experiments]

1. Tensile and compression tests of metallic and non-metallic specimens using a Universal Testing Machine.
2. Torsion tests.
3. Bending Test on metallic and nonmetallic specimens.
4. Fatigue Test for ferrous, non-ferrous materials.

[Minor experiments]

5. Single shear and double shear tests.
6. Izod and Charpy tests on M.S. Specimen.
7. Brinell, Rockwell and Vickers' Hardness test.
8. To study the wear characteristics of ferrous, non-ferrous and composite materials for different parameters.

PART – B
[Demonstration with PPT]

1. Preparation of specimen for Metallographic examination of different engineering materials. Identification of microstructures of materials like, plain carbon steel, tool steel, gray C.I, SG iron, Brass, Bronze and composites.
2. Heat treatment: Annealing, normalizing, hardening and tempering of steel. Hardness studies of heat-treated samples.
4. Non-destructive test experiments like,
   (a) Ultrasonic flaw detection
   (b) Magnetic crack detection
   (c) Dye penetration testing, to study the defects of Cast and Welded specimens

Course Outcomes:

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

1. Classify the mechanical properties of materials and its characteristics.
2. Conduct the various mechanical tests and to analyze the results.
3. Prepare the samples individually for different metallographic examinations.
4. Explain about the heat treatment process.
5. Recognize the basic tribological aspects of the materials.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010	PO11	PO12	PSO1	PSO2
C-16ME307.1	L	L	L	L	L	L	L	L	L	L	L	M	M	L
C-16ME307.2	M	L	M	M	M	L	L	L	L	L	M	L	M	M
C-16ME307.3	L	L	M	M	M	L	L	L	L	M	M	L	M	H
C-16ME307.4	L	L	L	M	L	L	L	L	L	L	L	L	M	H
C-16ME307.5	L	L	L	L	L	L	L	L	L	L	L	L	M	H

L: Low M: Medium H: High

REFERENCE BOOKS:

1. Mechanics of materials, by Ferdinand P. Beer, E. Russell Johnson, Jr. John T.Dewolf, McGraw Hill International
2. Strength of Materials by S.S. Bhavikatti, 4th edition, Vikas Publications, 2013.
3. Strength of materials by S. Ramamrutham, 2012.

Scheme of Examination:

Two experiments to be conducted from part - A
One experiment from Part – B
Viva - Voce: 10 Marks
Total: 50 Marks

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ENHANCING SELF COMPETENCE

Sub Code : 16HU311	**Credits : 02**
Hrs/Week : 1+2+0+0	**Total Hours : 26**

Course Learning Objectives:

This Course will enable students to

1) Introspect and learn more about oneself
2) Learn social behaviour and etiquette
3) Develop positive attitude and values in life
4) Learn to be effective in communication and interactive skills
5) Educate on writing and presentation skills and also to educate onself on legal and ethical aspects

UNIT – I

Self Awareness and Emotional Quotient:
SWOT Analysis; Johari Window

4 Hours

UNIT – II

Grooming and Etiquette:
Personal grooming, hygiene, dressing for different occasions, making small talk, showing respect to women, eye contact, being appreciative, dos and don'ts in a conversation; Time Management.

4 Hours

UNIT - III

Attitude Development:
Building self worth, confidence, developing empathy; Goal Setting; Motivation.

5 Hours

UNIT – IV

Interactive Behavior:
Active listening, verbal & non-verbal communication, interview skills, group discussions, dealing with people in an organization, handling feed back and criticism.

7 Hours

UNIT - V

Writing and Presentation:
Formal and informal e-mails, framing requests, accepting or rejecting proposals, greetings, salutations, Close. Plagiarism, Presentation Skills. **6 Hours**

Course Outcomes:

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

1. Develop awareness of his or her strengths and weaknesses and handle emotions.
2. Ensure a refined behaviour.
3. Become an asset to the society.
4. Become a good communicator.
5. Present to a group, on a one to one basis and create an impact.

REFERENCE BOOKS :

1) "Communicating at work – Principles and Practices for Business and the Professions" - Ronald B Adler & Jeanne Marquardt Elmhorst; McGraw-Hill College; Sixth Edition.
2) "Organizational Behaviour", - Stephen P Robbins; Prentice Hall, India.
3) "Organizational Behaviour", - Fred Luthans; McGraw Hill International Edition.

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FOUNDRY, FORGING & WELDING SHOP

Sub code : 16ME309	**Credits 02**
Hrs/Week : 0+0+3+0	**Total Hours 39**

Course Learning Objectives:

This Course will enable students to

1. Prepare different types of moulds with the help of patterns.
2. Estimate the raw materials requirement and to create simple smithy models
3. Develop the skills of electric arc welding.
4. To acquire knowledge about sand testing experimentation.

PART – A

1. WELDING

Preparation of specimens for welding and conduction of the welding exercises of following joints:

1) Lap Joint
2) Butt Joint
3) L-Joint.
4) T-Joint

PART – B

2. Forging Operations

Preparation of minimum forged models involving: Upsetting, Drawing, bending operations

[Simple models like L-nail, EYE-nail, and Bolts etc].

PART – C

3. Foundry Practice

Study and practice of: Use of foundry tools and other equipments.
Preparation of moulds using two molding boxes using: Patterns (Split pattern, Match plate pattern and Core boxes).
Preparation of moulds using: Two molding boxes without patterns.

PART –D

4. Demonstration of the following tests through PPT

1) Compression, Shear and Tensile tests on Universal Sand Testing
2) Permeability test
3) Clay content test.
4) Moisture content test.

5. **Industry visit**

Compulsory 3 hrs visit to a Foundry to study Foundry processes.

Course Outcomes:

At the end of the course the students will be able to

C-16ME309.1. Acquire the skills of making different types of moulds with the help of patterns.
C-16ME309.2. Create simple smithy models like L-nail, EYE-nail, Bolts etc and their estimation.
C-16ME309.3. Demonstrate electric arc welding.
C- 6ME309.4. Interpret results of sand testing experimentation.

Mapping of POs & COs:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C-16ME309.1	L	-	M	L	-	L	L	-	H	H	-	-	M	H
C-16ME309.2	L	-	M	M	-	L	L	-	H	H	-	-	M	H
C-16ME309.3	-	-	M	L	-	L	L	-	M	M	-	-	M	H
C-16ME309.4	L	L	-	H	L	-	-	-	L	L	-	-	-	L

L: Low M: Medium H: High

REFERENCE BOOKS:

1. Hajra Choudhury S.K. and Bose S.K., "Elements of Workshop Technology", Vol.-I, Media Promotors & Publishing Pvt. Ltd., Mumbai, 2012.
2. O. P. Khanna "*A Textbook of Welding Technology*" Dhanpat Rai Publications, 22nd edition, 2008

Scheme of Examination:

One question is to be set from Part-A: 10 marks
One question is to be set from either Part-B or Part-C: 30 marks
Viva-Voce: 10 marks.
Total: 50 marks.

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ENGINEERING MATHEMATICS - IV

Sub Code : 16ME401	**Credits : 04**
Hrs/Week : 4+0+0+0	**Total Hours : 52**

Course Learning Objectives:

This Course will enable students to

1. Apply the concepts of probability to situations like unconditional probability, conditional probability, independent events and use Bayesian concept in life related situations.
2. Apply various probability distributions in relevant fields, fit a curve for a given data and to use correlation and regression concepts in life related problems.
3. Apply numerical methods to solve various engineering problems.
4. Solve first order ordinary differential equations using multi step methods and to apply finite difference concepts in the appropriate situation.
5. Classify and appreciate the idea of generating functions and to use the techniques to solve related problems.

UNIT – I

INTRODUCTION TO PROBABILITY:
Finite sample space, conditional probability and independence(overview), Bayes' theorem. One dimensional random variable: discrete and continuous random variable, probability functions, cumulative distribution function, mean and variance. **10 Hours**

UNIT – II

PROBABILITY DISTRIBUTION AND DATA ANALYSIS:
Binomial, Poisson, Normal, Exponential distributions. Curve fitting: curve fitting by the method of least squares: $y=a+bx$, $y=a+bx+cx^2$, $y=ab^x$ .Correlation and regression.

10 Hours

UNIT – III

NUMERICAL ANALYSIS:
Roots of algebraic and transcendental equations: Regula falsi & Newton Raphson method. Finite differences, Newton-Gregory forward and backward difference interpolation formulae,

Lagrange's interpolation formula, Lagrange's inverse interpolation formula. Numerical differentiation using Newton's forward & backward formulae.
Numerical integration: General quadrature formula, Trapezoidal rule, Simpson's one third rule, Simpson's three eigth rule. **12 Hours**

UNIT – IV

NUMERICAL SOLUTION OF FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS:
Taylor's series Method, Modified Euler's method, Runge -Kutta 4^{th} order Method.
Numerical solution partial differential equations: Laplace and Poisson equations by standard five point formulae, heat and wave equations by explicit method. **10 Hours**

UNIT – V

SERIES SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS AND SPECIAL FUNCTIONS:
Series solution-Frobenius method, Series solution of Bessel's differential equation leading to Bessel's function of first kind, equations reducible to Bessel's differential equation. Generating function for $J_n(x)$, orthogonality of Bessel functions. Series solution of Legendre's differential equation leading to Legendre polynomials, Rodrigue's formula. **10 Hours**

Course Outcomes:

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

C-16ME401.1. Understand the basic concepts of probability and ist applications.
C-16ME401.2. Understand and appreciate some of the important distributions of discrete and continuous random variables. Fit a curve for a given data.
C-16ME401.3. Understand the principles of numerical methods and be able to apply these methods to solve engineering problems.
C-16ME401.4. Identify and formulate parabolic, hyperbolic and elliptic partial differential equations and solve by grid analysis.
C-16ME401.5. Understand the importance of Bessel and Legendre's polynomial in engineering problems.

Mapping of POs & COs:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C-16ME401.1	H	H	M	M	L	-	-	-	-	-	-	L	H	H
C-16ME401.2	M	H	H	M	L	-	-	-	-	-	-	L	H	H
C-16ME401.3	M	H	H	M	L	-	-	-	-	-	-	M	H	H
C-16ME401.4	H	H	M	M	M	-	-	-	-	-	-	M	M	H
C-16ME401.5	M	H	L	M	M	-	-	-	-	-	-	L	M	M

L : Low M: Medium H : High

TEXT BOOKS:

1. P.L. Meyer, "Introduction of probability and statistical applications", second Edn., 1975, American Publishing Co.
2. B.S.Grewal, "Higher Engineering Mathematics", 42nd Edition, Khanna publishers,2012.

REFERENCE BOOKS:

1. S.S.Sastry, "Introductory Methods of Numerical Analysis", 2nd Edn.,1990, Prentice Hall.
2. Wylie Ray, "Advanced Engineering Mathematics", 6th Edn., McGraw Hill.Inc,1995.

MOOC/NPTEL Resources:

1 http://nptel.ac.in/courses/111105041/1

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KINEMATICS OF MACHINES

Sub Code : 16ME402 **Credits 04**
Hrs/Week : 3+2+0+0 **Total Hours 52**

Course Learning Objectives:

This Course will enable students to

1. Understand the mechanism and their inversions that are required to construct a machine with the help of different linkages.
2. Analyze the mechanisms and determine the velocity and acceleration of mechanisms graphically.
3. Design and analyze cam and velocity, angular acceleration of links using Klein's construction.
4. Develop student's ability to understand the basic terminologies of gear and its characteristics.
5. Understand the knowledge of power transmission in gear trains, belt and rope drives.

UNIT – I

INTRODUCTION: Definitions: Link or element, kinematic pair, Kinematic chain, structure, mechanism, degrees of freedom, Grubler's Criteria (without derivation) Mobility of Mechanism, Inversion, Machine. Kinematic chain with three lower pairs, Practical applications of four bar chain. **4 Hours**

KINEMATIC CHAINS AND INVERSIONS: Inversions of Single slider crank chain and Double slider crank chain.

MECHANISMS: Quick return mechanisms – Crank and slotted lever Mechanism, Whitworth mechanism, Drag link mechanism. Straight line motion mechanism– Peaucellier's mechanism, Intermittent motion mechanism – Geneva mechanism and Ratchet and Pawl mechanism, Toggle mechanism, Pantograph. **6 Hours**

UNIT – II

Velocity and **Acceleration** analysis of mechanisms (GRAPHICAL METHOD): Velocity and acceleration analysis of four bar mechanism, slider crank mechanism and Simple mechanisms by vector polygons, Relative velocity and acceleration of particles in a common link.

6 Hours

Velocity analysis by instantaneous centre method: Definition, Kennedy's Theorem and its applications to locate number of instantaneous centers, Determination of linear and angular velocity using instantaneous centre method.

5 Hours

UNIT – III

Relative velocity and accelerations of coincident particles on separate links – Coriolis component of acceleration, Angular velocity and angular acceleration of links KLEIN'S CONSTRUCTION: Analysis of velocity and acceleration of single slider crank mechanism.

5 Hours

CAMS: Types of cams, Types of followers, Displacement, velocity and acceleration time curves for cam profiles. disc cam with reciprocating follower having knife edge, roller and flat faced follower, Disc cam with oscillating roller follower, Follower motions including SHM, Uniform velocity, Uniform acceleration and retardation and Cycloidal motion.

6 Hours

UNIT – IV

SPUR GEAR: Gear terminology, Law of gearing, velocity of sliding, Involumetry, Involute function, Characteristics of Involute action, Comparison of involute and cycloidal teeth, Path of contact, arc of contact, contact ratio, Interference in Involute gears, Methods of avoiding interference, Determination of backlash. **10 Hours**

UNIT – V

GEAR TRAINS: Simple gear trains, Compound gear trains, reverted gear trains, Epicyclic gear trains, Tabular method of finding velocity ratio of epicyclic gear trains. Tooth load and torque calculations in epicyclic gear train. **5 Hours**

Belt and Rope drives: Ratio of tensions, Centrifugal stress in a belt or rope, Power transmitted, effect of centrifugal tension on power transmitted, Numerical problems.

5 Hours

Project Based Learning:

Student teams will develop and demonstrate at least one of the mechanism models.

Course Outcomes:

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

C-16ME402.1. Explain the terminologies connected with the subject kinematics of machines and working principle of some machines.

C-16ME402.2. Apply relative velocity and instantaneous centre methods to determine the velocity and acceleration in different mechanisms.

C-16ME402.3. Design the cam profile for various follower motions.
C- 6ME402.4. Outline the terminologies and concepts connected with gear design.
C-16ME402.5. Analyze the power transmission in gear trains, belt and rope drives.

Mapping of POs & COs:

Course Outcome	Programme Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
C16ME402.1	H	H	M	M	M		L		M	M		H	M	M
C16ME402.2	H	M	M	L	L				M	L		L	H	L
C16ME402.3	H	H	M	L	L				M	L		M	H	L
C16ME402.4	H	H	H	H	M	L	L	L	H	M	L	M	H	H
C16ME402.5	H	M	H	M	M	L	L	L	H	M	L	M	H	H

L: Low M: Medium H: High

TEXT BOOKS:

1. Theory of Machines, by Rattan S.S., Tata Mc Graw – Hill, 3rd edition 2009.
2. Theory of Machines by Thomas Bevan-CBS Publishers ,3rd edition-2005.
3. Mechanisms and Dynamics of machinery by Mabie and Ocvirk, 4th edition,1987
4. Mechanics of Machines by Ham, Cranes and Rogers, Mc Graw– Hill, 4th edition, 1958.

REFERENCE BOOKS:

1. Theory of Machines by V.P.Singh, 4rd edition, 2014.
2. Theory of Machines & Mechanisms by Shigley J.V. & Uickers J.J.2nd Edition, 1995.
3. Theory of Machines by Ballaney, 25th Edition, 2011.

E-BOOKS:

1. The Theory of machines by J.S.Rao, New Age International Publishers,2006.
2. Theory of machines by Sadhu Singh, Pearson Education, 2nd Edition,2009.
3. Theory of mechanisms and machines by C.S. Sharma and K.Purohit, Prentice Hall of India Pvt. Ltd., 2006.
4. Theory of machines-Kinematics and Dynamics by B.V.R. Gupta, I.K. International Publishing house, 2011.
5. Mechanics of Machines by V.Ramamurthy, CRC Press, Narosa Publishing House, 2002.

MOOC/NPTEL Resources

1. https://www.mooc-list.com/course/mechanics-kinematics-and-dynamics-edx
2. http://nptel.ac.in/courses/112104121/6

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APPLIED THERMODYNAMICS

Sub Code : 16ME403 **Credits : 03**
Hrs/Week : 2+2+0+0 **Total Hours : 39**

Course Learning Objectives:

This Course will enable students to

1. Understand how the performance of power plants based on the Rankine cycle, including the effect of enhancements such as superheat, reheat and regeneration can be improved. Analyze the performance of I.C. engines based on the otto cycle, diesel cycle and dual cycle, and gas turbines based on the Brayton cycle.
2. Compute thermodynamic analysis of refrigeration systems and air-conditioning systems.
3. Know how the work of compression can be minimized for both single stage as well as multi stage compressor. Determine the theoretical air or minimum air required for the combustion of a fuel and analyze the products of combustion. Also, calculate performance characteristics of I.C. engines.

Prerequisites: Basic thermodynamics, Elements of mechanical engineering

UNIT - I

Vapour Power Cycles

Carnot vapour power cycle & its associated difficulties; Simple Rankine cycle – description, T-s diagram & analysis of performance; Application to thermal power plants. Comparison of Carnot and Rankine cycles; Effect of pressure and temperature on Rankine cycle performance; Numerical problems without using mollier chart. Reheat Rankine cycle, regenerative Rankine cycles (description only)

8 Hours

Gas Power Cycles

Air standard cycle approximations; Carnot, Otto, Diesel, Dual Cycles – p-v and T-s diagrams; Numerical Problems. Stirling cycle; Basic Gas turbine (Brayton) cycle (for open and closed systems). Efficiency of gas turbine cycle. Actual gas turbine cycle. Numerical problems.

7 Hours

UNIT - II

Refrigeration Cycles

Reversed Carnot cycle and its limitations; Basic vapour compression refrigeration system; Refrigeration effect; COP; Unit of refrigeration; p-h & T-s diagrams. Practical vapour compression refrigeration system; Numerical problems. Vapour absorption refrigeration system & COP; Comparison between VCRS and VARS and their applications (descriptive only). Air cycle refrigeration; Reversed Brayton cycle; Numerical problems

7 Hours

Psychrometry

Basic definitions, properties of atmospheric air, psychrometer, adiabatic saturation process. Simple numerical problems without using psychrometric chart.

Use of psychrometry for air conditioning application: Brief review on construction and use of psychometric chart; Representation of various processes – heating, cooling, dehumidifying and humidifying. Adiabatic mixing of stream; sensible cooling load and latent cooling load, Numerical problems by using psychrometric chart on psychometric processes only. Summer and winter air conditioning (descriptive only). **3 Hours**

UNIT - III

Reciprocating Compressors

Single stage reciprocating compressor cycle without clearance; Work input and power through p-v diagrams; Effect of clearance on volumetric efficiency and, Work input through p-v diagrams; Adiabatic, isothermal and mechanical efficiencies; Multi-stage compressors: Advantages. Effect of intercooling on work input in multi-stage compression; Optimum intermediate pressure (general case); Numerical problems. **7 Hours**

I C engine & combustion

Stoichiometric air for combustion of fuels; Excess air; Insufficient air, Mass balance; A/F ratio; exhaust gas analysis (Orsat apparatus); Simple Numerical problems. I C engine performance measurement; calculation of IP, BP, bmep, bsfc, brake thermal efficiency; volumetric efficiency; and heat balance sheet. Numerical problems.

7 Hours

Course Outcomes:

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

C-16ME403. 1. Quantify the behaviour of power plants based on the Rankine cycle, including the effect of enhancements such as superheat, reheat and regeneration and P-V, T-S and H-S diagram for the same. Analyze the performance of I.C. engines based on the otto cycle, diesel cycle and dual cycle, and gas turbines based on the Brayton cycle.

C-16ME403. 2. Develop a systematic approach to thermodynamic cycle analysis of various refrigeration cycles.

C- 6ME403. 3. Compute work of compression, power required to drive the air compressor, for both single stage as well as multi stage compressor. Calculate performance characteristics for a given 2-stroke or 4 - stroke petrol or diesel engines and prepare the heat balance sheet.

Course Articulation Matrix:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C16ME403.1	H	H	L	M	L	L						M	M	M
C16ME403.2	H	H	L	M	L	L						M	M	M

C16ME403.3	**H**	**H**	**L**	**M**	**L**	**L**						**M**	**M**	**M**

L: Low M: Medium H: High

TEXT BOOKS:

1. Engineering Thermodynamics, P.K.Nag, *Tata McGraw-Hill* Education, 2005
2. Engineering Thermodynamics, C.P.Gupta, Rajendra Prakash, , Nemi Chand & Bros,2009

REFERENCE BOOKS:

1. Applied Thermodynamics, Roy and Chaudary, Prentice Hall of India.2014
2. Energy Conversion, Kadambi& Prakash, John Wiley & Sons (March 1978)
3. Applied thermodynamics, D Eastop and A McConkey, V Ed, Pearson,2009
4. Thermal Engineering, R K. Rajput, Laxmi Publications, 2005
5. Thermodynamics, by Yunus A Cengel, Michael A Boles , McGraw-Hill Higher 2005
6. Thermodynamic Data Hand Book by Dr. Nijaguna & Dr. B. S. Samaga, 2010

MOOC/NPTEL Resources

1. http://nptel.ac.in/courses/112106133/

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MANUFACTURING PROCESSES – II

Sub code : 16ME404 **Credits 04**
Hrs/Week : 4+0+0+S* **Total Hours 52**

*** Self-Study to be exercised under the supervision of course instructor and to be restricted to not more than 10% of the total teaching hours.**
Pre-requisites: Basic course in science and mathematics

Course Learning Objectives:

This Course will enable students to

1. Understand machining process and the influence of various elements involved in metal cutting. Study merchant's analysis of orthogonal cutting.
2. Study the constructional features and mechanisms of centre lathe, Capstan &Turret lathe and drilling machines.
3. Study the constructional features and operations of milling machines.
4. Study the constructional features and operations of grinding machines.
5. Study the mechanism of material removal and process parameters of various non-conventional machining processes.

UNIT - I

Theory of metal cutting

- Single point tool – terminology
- Chip formation and types.
- Merchant's analysis
- Tool wear
- Tool life
- Machinability

12 Hours

Self Study: Cutting tool materials, Cutting Fluids

UNIT – II

Lathe

- **Centre Lathe** – Constructional features - Driving and feeding mechanisms, operations.
- **Production lathe** – Capstan and Turret lathe – Constructional Features- mechanisms – tool layout
- **Drilling machine** – Classification – Construction of Upright and Radial drilling machines. Drilling machine operations, drilling machine tools –Terminology of Twist drills, Reamers and taps.

10 Hours

Self-Study: Tool materials and designation.

UNIT - III

Milling Machines

Classification, construction of column and knee type and planer type milling machines

- Milling cutters, classification and terminology.
- Milling operations.
- Indexing: universal dividing head and indexing operations
- Principle of shaping, Planning and slotting machines.

10 Hours

Self-Study: Quick return mechanisms used in reciprocating machine tools.

UNIT – IV

Grinding Machine

- Abrasives: Natural and Artificial.
- Grinding wheel: Construction, designation, selection, mounting, balancing,
- Glazing, loading, truing and dressing of grinding wheels.
- Grinding machines: classification and construction of Cylindrical and Surface grinding **10 Hours**

Self-Study: Micro finishing operations – lapping – honing – super finishing.

UNIT - V

Non-conventional machining

- Mechanical – USM – AJM – WJM.
- Thermal & electro thermal – EDM, LBM, PAM.

Self-Study: Chemical – Electro Chemical – ECM, ECH.

10 Hours

Course Outcomes:

At the end of the course the student should be able to

C-16ME404.1. Suggest suitable cutting tools and process parameters for conventional machining and also estimate various force components and tool life in metal cutting operations.

C-16ME404.2. Summarize the construction and working of centre lathe, capstan and turret lathe, drilling machines and the various machining operations performed on them.

C-16ME404.3. Appreciate the construction and working of milling machines and various milling operations including gear milling.

C-16ME404.4. Explain the working principle of different grinding machines, manufacture, marking and selection of grinding wheels

C-16ME404.5. Contrast the working principles of non-conventional machining processes like EDM, ECM.PAM, LBM, USM, AJM etc. with their specific characteristics.

Mapping of Pos & Cos:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C-16ME404.1	M	L	M	L	L	L	L	-	L	L	M	M	L	H
C-16ME404.2	L	L	-	-	L	-	L	-	H	M	L	M	L	H
C-16ME404.3	M	L	-	-	L	-	L	-	H	M	L	L	L	H
C-16ME404.4	M	L	L	-	L	-	L	-	H	M	L	L	L	H
C-16ME404.5	M	L	L	-	L	-	L	-	H	M	L	L	L	H

L: Low M: Medium H: High

TEXT BOOKS:

1. Manufacturing Technology: Metal cutting and machine tools by P N Rao. McGraw Hill Education 2013.
2. Fundamentals of metal cutting and machine tools by Juneja and G S Shekhon, NEW AGE (2008)
3. Workshop technology – vol. II – S.K.Hajra Choudury.A.K. Hajra Choudury,Media Promoters and Publishers (2010)

REFERENCE BOOKS:

1. Production Technology – R K Jain. Khpub. 2014
2. A Text book of Manufacturing Technology-II By Dr. P.C.Sharma, S.Chand(2012)
3. Production technology – H M T. Tata McGraw-Hill Education, 2001
4. Manufacturing technology – Serope Kalpakajin. Prentice Hall 2005
5. Processes and Materials of manufacture. By Roy A. Lindberg, Phi Learning 2008
6. NPTEL Resources.

MOOC/NPTEL Resources

1. http://nptel.ac.in/courses/112105126/

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FLUID MECHANICS

Sub Code : 16ME405 **Credits : 04**
Hrs/Week : 4+0+0+0 **Total Hours : 52**

Course Learning Objectives:

This Course will enable students to

1. Have knowledge of fundamentals of fluid mechanics and various laws.
2. Understand fluid kinematics and derive Eulers and Bernoulli's equation for fluid flow.
3. Use Dimensional analysis concepts in engineering and effects of laminar and viscous flow.
4. Study various types of fluid flow measuring equipments.
5. Apply boundary layer concept and Understand drag, Lift, pressure drag and friction drag.

UNIT – I

Properties of fluid: Introductory concepts and definitions, properties of fluids and its classification. Fluid Statics: Pascal's law of pressure, pressure variation in static fluid, manometers, hydrostatic force on submerse plane. **11 Hours**

UNIT – II

Buoyancy and stability criteria:
Fluid kinematics: Fluid flow concepts, lines flow, Types of functions for 2-D flow, relationship between them and flow nets.
Fluid Dynamics: general energy and momentum equation. Euler's equation, Bernoulli's equation for real fluids. **10 Hours**

UNIT – III

Dimensional analysis: Introduction-derived quantities, dimensions of physical quantities, dimensional homogeneity, Buckingham's **theorem**, Raleigh's method, dimensionless numbers, similitude, types of similitude, Model testing

Laminar and viscous flow effects: Reynolds number, critical Reynolds number, laminar flow through circular pipe, Hagen Poiseulle's equation, laminar flow between parallel and stationary plates. **10 Hours**

UNIT – IV

Fluid flow measurements: Venturimeter, orificemeter, pitot tube, V and rectangular notch, Flow through pipes: frictional losses in pipe flow, Darcy- Weisbach equation, Chezy's equation for loss of head due to friction in pipes, hydraulic gradient and total energy line **11 Hours**

UNIT – V

Flow past immersed bodies: Drag, Lift, expressions for lift and drag, pressure drag and friction drag, boundary layer concept, displacement thickness, momentum thickness and energy thickness. **Introduction to Compressible flow:** Velocity of sound in a fluid, Mach number, propagation pressure wave in compressible fluid. **10 Hours**

Course Outcomes:

At the end of the course the student should be able to

C-16ME405. 1. Recall the fluid mechanics fundamentals and explain hydrostatic law and Pascal law.
C-16ME405. 2. Apply the Bernoulli equation for ideal and real fluids.
C-16ME405. 3. Make use of dimensional analysis for problems in fluid mechanics.
C-16ME405. 4. Explain the basic concepts involving fluid flow measuring equipments.
C-16ME405. 5. Illustrate the basic concepts of boundary layer, lift and drag for flow past immersed bodies.

Course Articulation Matrix:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C-16ME405.1	H	-	-	-	-	-	M	-	-	M	-	-	H	H
C-16ME405.2	H	H	H	M	M	-	H	-	M	L	H	H	H	H
C-16ME405.3	H	H	M	H	H	M	M	-	-	M	H	H	L	H
C-16ME405.4	H	H	H	H	H	M	M	-	H	M	H	H	M	M
C-16ME405.5	H	H	H	H	H	H	H	-	L	-	M	H	M	-

L : Low M: Medium H : High

TEXT BOOKS:

1. Fluid Mechanics by Yunus A Cengel, John M, Tata Mc Graw Hill, 2013
2. Fluid Mechanics by Dr. R K Bansal, Laxmi publications, 2005

REFERENCE BOOKS:

1. Engineering Fluid Mechanics by K.L. Kumar. Eurosia Publishing House (P) Ltd, 1992.
2. Fluid mechanics by White, 5th Edition Tata Mc Graw Hill, 2003.

3. Fluid mechanics by Binder, ,Prentice Hall of India Pvt. Ltd. 1964.
4. Fluid Mechanics by Dr. Jagadish Lal, Metropolitan Book company Ltd, 1997

MOOC/NPTEL Resources

1. http://nptel.ac.in/courses/112105171/1

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ENGINEERING ECONOMICS

Sub code : 16ME406	**Credits : 03**
Hrs/Week : 3+0+0+0	**Total Hours : 39**

Course Learning Objectives:

This Course will enable students to:

1. Understand and analyse the time value of money.
2. Evaluate the worth of creations, by comparing the alternatives visa, vis the cost (cost-benefit analysis)
3. Take decisions with the limited resources, the relevant course of action, with the help of suitable tools.
4. Determine the cost involved in each operations, a product should undergo with an aim to fix suitable selling price for the product
5. Know the different terminology of Economics and to prepare ledgers, journals, balance sheets and profit and loss accounts.

UNIT – I

Fundamental economic concepts

Consumer goods, Producer goods, Factors of production, Economy of organization, Demand theory, Law of demand, Exceptions to law of demand, Law of supply, Determinants of supply, Law of increasing returns and law of diminishing returns(No exercises)

5 Hours

Interest

Rate of interest, Determining rate of interest, Time value of money, Simple interest, Compound interest, Nominal and effective interest rate, Equivalence involving interest, Interest formulae [single payment, uniform series and arithmetic gradient only], problems using interest formulae [discrete compounding only].

7 Hours

UNIT – II

Economic Analysis of Alternatives

Analysis based on: Present Worth [equal life and unequal life situations], Future Worth, Payback Period, Capitalized Worth, Equivalent Annual Worth, Exercises.

Rate of Returns
Analysis based on Rate of Return, Exercises, cost of capital concepts.

13 hours

UNIT – III

Depreciation
Causes of depreciation, Depletion, Methods of depreciation [Straight line, Declining balance, Double declining balance, SYD method, Sinking Fund method], Exercises

6 **Hours**

Estimating and Costing
Components of cost [Material cost, Labour cost, Overhead expenses, Prime cost, Factory cost, Total cost], Determination of selling price of a product, Exercises.
Mensuration, Machine shop calculations, Forging shop calculations, Exercises

7 Hours

Financial management
Terminologies used in accounting, Journal and ledger, Profit and loss statement, Balance sheet, Understanding basic financial ratios, Simple exercises.

6 Hours

Course Outcomes:

Upon completion of this course, graduates will be

C-16ME406.1. Able to know and analyse the time value of money.
C-16ME406.2. Able to evaluate the worth of creations, by comparing the alternatives visa, vis the cost (cost-benefit analysis)
C-16ME406.3. Able to make decisions with the limited resources, the relevant course of action, with the help of suitable tools.
C-16ME406.4. Able to determine the cost involved in each operation, a product should undergo with an aim to fix suitable selling price for the product
C- 6ME406.5. Know the different terminology of Economics and to prepare ledgers, journals, balance sheets and profit and loss accounts.

Course Articulation Matrix:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C-16ME406.1	M	L	L	M	L	L	-	M	M	H	H	M	M	L
C-16ME406.2	M	L	L	H	M	L	L	M	M	H	H	M	M	L
C-16ME406.3	M	L	L	H	H	M	L	H	M	H	H	M	M	L
C-16ME406.4	L	L	L	H	L	M	L	M	M	M	H	M	M	M
C-16ME406.5	L	M	L	M	L	L	-	M	M	H	H	L	L	L

L : Low M: Medium H : High

TEXT BOOKS:

1. Engineering Economics, Riggs J.L.,4th edition, Tata McGraw-Hill, 2004
2. Mechanical Estimating and Costing, Banga and Sharma, 16th edition, Khanna Publishers, 2012

REFERENCE BOOKS:

1. Engineering Economy, E Paul Degarmo, Macmillan Publishing, 2001
2. Engineering Economy, Gerald J Thuesen & W J Fabrycky, Prentice Hall of India, 9th ed.
3. Engineering Economics, Tarachand, Nemchand & Bros, 1996
4. Financial Management, I M Pandey, Vikas Publishing House, 2002

MOOC/NPTEL Resources:

1. http://nptel.ac.in/courses/112107209/

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ENERGY CONVERSION ENGINEERING LAB

Sub Code : 16ME407	**Credits 02**
Hrs/Week : 0+0+3+0	**Total Hours 39**

Course Learning Objectives:

This Course will enable students to

1. Find flash and fire point of lubricating oil using Abel Pensky and Pensky Martins apparatus.
2. Find caloric value of solid, liquid and gaseous fuels and select the fuel for combustion.
3. Find viscosity of lubricating oils using Redwood, Saybolt viscometers and study the
4. Find variation of viscosity with temperature, select proper lubricating oil for various applications.
5. Draw valve timing/port opening diagram of four stroke and two stroke I.C engines and also find area of an regular/irregular surfaces using Planimeter.
6. Conduct performance tests and calculate IP, BP, Thermal efficiencies, SFC,FP and prepare heat balance sheet for four stroke Diesel engines, four stroke petrol engine, multi cylinder Diesel/Petrol engine(Morse test) and variable compression ratio I.C engine

PART A

1. Determination of Flash point and Fire point of lubricating oil using Abel Pensky and Pensky Martins Apparatus.
2. Determination of Caloric value of solid, liquid and gaseous fuels.

3. Determination of Viscosity of lubricating oil using Redwoods, Saybolts and Torsion Viscometers.
4. Valve, Timing/port opening diagram of an I. C. engine (4 stroke/2 stroke).
5. Use of planimeter.

PART B

Performance Tests on I. C. Engines, Calculations of IP, BP, Thermal efficiencies, SFC, FP, heat balance sheet for:

(a) Four stroke Diesel Engine.
(b) Four stroke petrol Engine.
(c) Multi cylinder Diesel/Petrol Engine (Morse test)
(d) Two stroke Petrol Engine
(e) Variable Compression Ratio I. C. Engine.

Course Outcomes:

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

1. Find flash and fire point of lubricating oil using Abel Pensky and Pensky Martins Apparatus.
2. Calculate the caloric value of solid, liquid and gaseous fuels.
3. Determine the viscosity of lubricating oils using Redwood, Saybolt viscometers.
4. Draw valve timing/port opening diagrams for four stroke and two stroke I.C engines.
5. Conduct performance tests and calculate IP, BP, Thermal efficiencies, SFC,FP and prepare heat balance sheet for different types of engines.

Mapping of POs & COs:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C-16ME407.1	H	-	-	H	M		M	-	-	-	-	-	H	M
C-16ME407.2	H	H	H	H	M	M	M	-	-	-	-	-	M	M
C-16ME407.3	H	H	H	H	M	M	M	-	-	-	-	-	M	M
C-16ME407.4	L	-	-	H	M	M	M	-	-	-	-	-	H	M
C-16ME407.5	H	H	H	H	M	M	M	-	M	-	-	-	H	M

L : Low M: Medium H : High

Scheme of Examination:
One Question Part-A: 15 marks
One Question Part-B: 25 marks
Viva Voce: 10 marks
Total: 50 marks

TEXT BOOK:

1. Engineering Thermodynamics, P.K.Nag , McGraw Hill, III Edition, 2005

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MACHINE SHOP

Sub code : 16ME408 **Credits : 02**
Hrs/Week : 0+0+3+0 **Total Hours : 39**

Course Learning Objectives:

This Course will enable students to

1. Preparation of models involving various types of turning operations on lathe.
2. Preparation of models involving various milling & shaping operations

Course Contents

1) Study of constructional features of following machines through drawings/ Sketches:
   a) Lathe
   b) Radial drilling machine
   d) Universal milling machine
   e) Shaper and planer
   g) Grinding machines (Surface, cylindrical)
2) Advanced exercises on Lathe where the students will work within specified tolerances, cutting of V- threads and square threads (internal as well as external).
3) Production of machined surfaces on shaper and planner.
4) Exercises on milling machines; generation of plane surfaces, production of spur gears and helical involute gears, use of end mill cutters.
5) Grinding of single point cutting tool, cutter and drills.
6) Study of recommended cutting speeds for different tool- work material combinations.
7) Identification of different cutting tool and work materials.

A student shall make models of 5 to 6 components (Composite Job), (excluding standard and commercial components). Job shall involve operations like Turning, Boring, Drilling, Taping, Threading, Milling, Shaping, Taper turning, surface grinding etc. and also a welding exercise. The models should be preserved to be used in Metrology & Measurements Lab 16ME507.

Course Outcomes:

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

1. Construct models involving different types of operations on lathe.
2. Prepare simple models involving various milling & shaping operations.

Mapping of POs & COs:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C-16ME408.1	L	M	M	L	L	L	H	L	H	L	L	L	M	H
C-16ME408.2	H	H	M	H	M	M	H	L	M	L	M	M	M	H

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