Academic Program: UG

Academic Year 2021-22

Syllabus

III & IV Semester B.E.

Mechanical Engineering

SHRI DHARMASTHALA MANJUNATHESHWARA COLLEGE OF ENGINEERING & TECHNOLOGY,

DHARWAD – 580 002

(An Autonomous Institution approved by AICTE & Affiliated to VTU, Belagavi)

Ph: **0836-2447465Fax: 0836-2464638 Web:** www.sdmcet.ac.in

SDM College of Engineering & Technology, Dharwad

It is certified that the scheme and syllabus for III & IV semester of UG program in Mechanical Engineering is recommended by Board of Studies of Mechanical Engineering Department and approved by the Academic Council, SDM College of Engineering &Technology, Dharwad. This scheme and syllabus will be in force from the academic year 2021-22 till further revision.

Principal Chairman BoS & HoD

SDM College of Engineering & Technology, Dharwad

Department of Mechanical Engineering

College

Vision:
To develop competent professionals with human values.

Mission:
1. To have contextually relevant Curricula.
2. To promote effective Teaching Learning Practices supported by Modern Educational Tools and Techniques.
3. To enhance Research Culture.
4. To involve Industrial Expertise for connecting classroom content to real life situations.
5. To inculcate Ethics and impart soft-skills leading to overall Personality Development.

SDMCET- Quality Policy
- In its quest to be a role model institution, committed to meet or exceed the utmost interest of all the stake holders.

SDMCET- Core Values
- Competency
- Commitment
- Equity
- Team work and
- Trust

Department

Vision:

To establish a synergetic Mechanical Engineering program anchored in fundamentals and relevant state of the art technologies, thereby enabling the students to achieve all round development for careers in industry and for higher learning, being responsible to society and environment.

Mission:

1. To establish a curricula & syllabi consisting of robust core courses with emphasis on imparting fundamental principles of mechanical engineering coupled with adaptive and relevant electives catering to the cutting edge technologies.
2. To promote interactive teaching practices using modern educational tools & techniques to attain synergy in teaching, research and industrial practices.
3. To imbibe industrial expertise for connecting class room learning to real life situation.
4. To impart soft skills and professional ethics enabling students to achieve an all-round personality development, making them responsive to societal needs and environmental concerns.

Programme Educational Objectives (PEOs):

1. Graduates will be successful in industry, research and higher learning.
2. Graduates will formulate, analyze and solve engineering problems.
3. Graduates will work in teams to address industrial and socially relevant problems / projects.
4. Graduates exhibit awareness and commitment to lifelong learning & practice professional ethics.

Program Outcomes (POs)

Engineering Graduates will be able to:

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

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

3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

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

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

13. **Industrial interactions:** Enhance knowledge of mechanical engineering with industrial practices and standards by exposure to industries.
14. **Role of economics and costing:** Learn the concepts of economics and costing to provide effective solutions to mechanical engineering problems.

Scheme for III Semester

Course Code	Course Category	Course Title	Teaching		Examination				
			L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
					Max. Marks	*Max. Marks	Duration in Hrs.	Max. Marks	Duration In Hrs.
18UMAC300	BS	Engineering Mathematics-III	3 - 0 - 0	3	50	100	3	-	-
18UMEC300	PC	Basic Thermodynamics	3 - 2 - 0	4	50	100	3	-	-
18UMEC301	PC	Materials Science	4 - 0 - 0	4	50	100	3	-	-
18UMEC302	PC	Strength of Materials	3 - 2 - 0	4	50	100	3	-	-
18UMEC303	PC	Manufacturing Processes - I	3 - 0 - 0	3	50	100	3	--	--
18UMEC304	PC	Machine Drawing	2 - 0 - 2	3	50	100	3	--	--
18UMEL305	PC	Materials Science & Materials Testing Lab	0 - 0 - 3	1.5	50	--	--	50	3
18UMEL306	PC	Foundry & Forging Lab	0 - 0 - 3	1.5	50	--	--	50	3
		Total	**18- 4- 8**	**24**	**400**	**600**		**100**	

BS- Basic Science, **PC**- Program Core
CIE: Continuous Internal Evaluation **SEE**: Semester End Examination
L: Lecture **T**: Tutorials **P**: Practical
*SEE for theory courses is conducted for 100 marks and reduced to 50 marks

Scheme for IV Semester

Course Code	Course Category	Course Title	Teaching		Examination				
			L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
					Max. Marks	*Max. Marks	Duration in Hrs.	Max. Marks	Duration In Hrs.
18UMAC400	BS	Engineering Mathematics-IV	3 - 0 - 0	3	50	100	3	-	-
18UMEC400	PC	Fluid Mechanics	3 - 2 - 0	4	50	100	3	-	-
18UMEC401	PC	Manufacturing Processes - II	4 - 0 - 0	4	50	100	3	-	-
18UMEC402	PC	Applied Thermodynamics	3 - 2 - 0	4	50	100	3	-	-
18UMEC403	PC	Metrology and Measurements	3 - 0 - 0	3	50	100	3	--	--
18UMEC404	PC	Design of Machine Elements-I	2 - 2 - 0	3	50	100	3	--	--
18UMEL405	PC	Measurements Lab	0 - 0 - 3	1.5	50	--	--	50	3
18UMEL406	PC	Thermal Engineering Lab - I	0 - 0 -3	1.5	50	--	--	50	3
18UMEL407	PC	Introductory Project	0 - 0 -2	1	50	--	--	--	--
		Total	**18 - 6 - 8**	**25**	**450**	**600**		**100**	

BS- Basic Science, **PC**- Program Core

CIE: Continuous Internal Evaluation **SEE**: Semester End Examination

L: Lecture **T**: Tutorials **P**: Practical

*SEE for theory courses is conducted for 100 marks and reduced to 50 marks

III Semester

18UMAC300	Engineering Mathematics-III	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

To have an insight into Laplace transforms, Fourier series, Fourier transforms, Difference equations andZ-transforms. To develop the proficiency in variational calculus and solving ODE's arising inengineering applications, using numerical methods.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Transform the given function using Laplace/Fourier transforms depending on the nature of engineering applications.	--	--	1
CO-2	Express periodic function as a Fourier series and obtain the various harmonics of the Fourier series expansion for the given numerical data.	--	--	1,2
CO-3	Solve difference equations using Z-transform.	--	--	1
CO-4	Solve first and second order ordinary differential equations arising in engineering problems using single step and multistep numericalmethods.	--	1,2	--
CO-5	Determine the extremals of functional using calculus of variations and solve problems arising in engineering.	--	--	1,2

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Mapping Level	1.2	1.3	-	-	-	-	-	-		-	-	-

Pre-requisites: A basic course on differentiation and integration of function.

Contents:

Unit-I

Laplace Transforms: Definition and Properties. Laplace transform of elementary functions. Laplace transforms of Periodic functions and unit-step function problems. **Laplace Transforms**: Inverse Laplace transform - problems, Convolution theorem (without proof) to find the inverse Laplace transform and problems, solution of linear differential equations using Laplace transform. **8 Hrs**

Unit-II

Fourier Series: Periodic functions, Dirichlet's condition. Fourier series of periodic functions of period 2® and arbitrary period. Half- range Fourier series. Practical harmonic analysis, examples from engineering field.**8 Hrs**

Unit-III

Fourier Transforms: Infinite Fourier transforms, Fourier sine and cosine transforms. Inverse Fourier transforms. Simpleproblems.

Z-Transforms and Difference Equations: Z-transform- definition, Standard Z-transforms, Damping and shifting rules, Initial value and Final value theorems (without proof) with problems. Inverse Z-transform. Simple problems. Difference equations-basic definition. Application of Z-transform to solve Difference equation. **8 Hrs.**

Unit-IV

Numerical Solutions of Ordinary Differential Equations (ODE's): Numerical solution of ODE's of first order and first degree-Taylor's series method, Modified Euler's method. Runge–Kutta method of fourth order, Milne's predictor and corrector method (No derivations of formulae).Problems. **7 Hrs.**

Unit-V

Numerical Solution of Second Order ODE's: Runge-Kutta method and Milne's predictor and Corrector method. (No derivations of formulae).

Calculus of Variations: Variation of function and functional, variational problems, Euler's equation (without proof), Geodesics (plane), hanging chain problems. **8 Hrs**

Reference Books:

1) B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 44th edition,2017.
2) E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 10th edition(Reprint),2016.
3) Srimanta Pal et al: Engineering Mathematics, Oxford University Press, 3rd edition, 2016.

18UMEC300	Basic Thermodynamics	(3-2-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs): The objectives of this course are to make the student to learn:

1. Learn about thermodynamics, thermodynamic systems and its equilibrium.
2. Understand various forms of energy - heat transfer and work; important applications.
3. Study the basic laws of thermodynamics including, zeroth law, first law and second law; their use to analyze energy conversion systems.
4. Study of Entropy, Availability and Irreversibility in thermodynamic systems.
5. Interpret the behaviour of pure substances and its application in practical problems.
6. Study of Ideal and real gases and evaluation of thermodynamic properties relations.
7. Study of Thermodynamic processes using P-V, T-S and H-S diagrams.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Explain the basic thermodynamics terms and concepts.	1	2	-
CO-2	Apply first law of thermodynamics/SFEE for different applications.	1	2	5
CO-3	Apply Second Law of Thermodynamics to determine efficiencies of heat engines and change in entropy.	1	2	5
CO-4	Analyze the behavior of pure substances using thermodynamic data.	1	2	5
CO-5	Explain the concepts of availability and irreversibility.	1	2	
CO-6	Evaluate thermodynamic properties of ideal and real gas mixtures using various relations.	1	2	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	3	2	-	-	1	-	-	-	-	-	-	-	-	-

Prerequisites: Nil

Course Contents:

Unit - I

Fundamental Concepts & Definitions: Thermodynamic definition and scope, Microscopic and Macroscopic approaches. Open, Closed and Isolated systems, Some practical applications of engineering thermodynamic Systems, Characteristics of system boundary and control surface, examples. Thermodynamic properties; definition and units, intensive, extensive properties, specific properties, pressure, specific volume, path and point functions, Thermodynamic state, state point, state diagram, path and process, quasi-static process, cyclic and non-cyclic; processes;

Thermodynamic equilibrium; definition, mechanical equilibrium, thermal equilibrium, chemical equilibrium, electrical equilibrium and phase equilibrium Zeroth law of thermodynamics, Temperature; concepts, scales, international fixed points and measurement of temperature. Constant volume gas thermometer, constant pressure gas thermometer, mercury in glass thermometer. **8L+2T Hrs**

Unit - II

Work and Heat: Mechanics, definition of work and its limitations. Thermodynamic definition of work; examples, sign convention. Displacement work; as a part of a system boundary, as a whole of a system boundary, expressions for displacement work in various processes through p-v diagrams. Shaft work; Electrical work. Other types of work. Heat; definition, units and sign convention. Problems.

First Law of Thermodynamics: Joules experiments, equivalence of heat and work. Statement of the First law of thermodynamics, extension of the First law to non - cyclic processes, internal energy, internal energy as a property, modes of energy, Extension of the First law to control volume; steady flow energy equation(SFEE), some important applications and numerical problems. **10L+2T Hrs**

Unit - III

Second Law of Thermodynamics: Limitations of first law of thermodynamics, Thermal reservoir, heat engine and heat pump:

Schematic representation, efficiency and COP. Reversed heat engine, schematic representation, importance and superiority of a reversible heat engine and irreversible processes, internal and external reversibility. Kelvin - Planck statement of the Second law of Thermodynamics; PMM I and PMM II, Clausius statement of Second law of Thermodynamics, Equivalence of the two statements; Carnot cycle, Carnot principles, problems.

Entropy: Clausius inequality, Statement- proof, Entropy- definition, a property, change of entropy, entropy as a quantitative test for irreversibility, principle of increase in entropy, entropy as a coordinate. **8L+2T Hrs**

Unit - IV

Availability and Irreversibility: Introduction**,** Availability (Exergy), Unavailable energy, Relation between increase in unavailable energy and increase in entropy. Maximum work, maximum useful work for a system and control volume, irreversibility.

Pure Substances: P-T and P-V diagrams, triple point and critical points. Sub-cooled liquid, saturated liquid, mixture of saturated liquid and vapor, saturated vapor and superheated vapor states of pure substance with water as example. Enthalpy of change of phase (Latent heat). Dryness fraction (quality), T-S and H-S diagrams, representation of various processes on these diagrams. Steam tables and its use. Throttling calorimeter, separating and throttling calorimeter. Problems using h-s diagram, Mollier chart. **8L+2T Hrs**

Unit - V

General Thermodynamic property relations: Introduction, Maxwell's equations, problems, energy relations for simple systems, T-ds equations, specific heat relations, relation for internal energy and enthalpy, numerical, Joule-Thomson coefficient.

Real and Ideal gases: Introduction, Vander wall's equation, Vander wall's constants in terms of critical properties, law of corresponding states, compressibility factor, compressibility chart, ideal gas, equation of state, universal and particular gas constants, evaluation of heat, work, ideal gas mixture; Dalton's law of additive pressure, Amagat's law of additive volumes, evaluation of properties, analysis of various processes.

8L+2T Hrs

Text Books:

1) P. K. Nag, "Basic and Applied Thermodynamics", 2nd edition, TMH Publishing Co. Ltd, New Delhi, Revised and enlarged 2011.
2) Yunus A Cengel and M.A. Boles, "Thermodynamics and Engineering Approach", TATA Mc Hill Publications edition, 2008.

3) R K. Rajput, “Engineering Thermodynamics”, 4th edition, Laxmi Publications (P) Ltd., Daryaganj, New Delhi – 2, 2010

Reference Books:

1) Gorden Van Wylen, Richard Sonntag and Claus Borgenakke, “Fundamentals of Classical Thermodynamics”, 4th edition, John Wiley & sons, New York, 1997.
2) D. B. Spalding and E. H. Cole, “Engineering Thermodynamics”, ELBS / Edward Arnold (Publishers) Ltd., London, 3rd edition,1973.
3) David Burghardt, Engineering Thermodynamics with Applications, 3rd edition, Harper & Row Publishers, New York, 1986.

DATA HAND BOOK:

1) Prof. B.T. Nijaguna and Prof. B.S. Samaga, KREC, Surathkal, Thermodynamics Data Hand Book and now published by Sudha Publishers, Avenue Road, Bangalore, 1995

18UMEC301	Materials Science	(4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs): The objectives of this course are to make the student to learn:

1. Diverse activities involved with materials science.
2. Basic concepts regarding structure-property-processing relations across all material classes.
3. Formation, properties and significance of the alloys.
4. Modern materials like – Special steels, Super alloys and Composites.
5. Many factors that ultimately determine a material selection for a given application.

Course outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Discuss various crystal structures, imperfections in materials and industrial applications of atomic diffusion.	-	1,2	-
CO-2	Describe mechanical properties, strengthening mechanisms of materials and their significance.	1,2	-	-
CO-3	Interpret the phase diagrams for simple solid solutions and Iron-Iron carbide system.	1	2	3
CO-4	Discuss TTT, CCT curves and heat treatment schemes.	1	2	-
CO-5	Outline the classification, properties and applications of ferrous, nonferrous, ceramics & composites.	-	1	-

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	2.6	2.2	1	-	-	-	-	-	-	-	-	-	-	-

Prerequisites: Nil

Course Contents:

Unit - I

Crystal Structures: Classification of materials, BCC, FCC & HCP crystal structures, imperfections in crystals-point, line & surface defects, X-ray diffraction for crystal structure identification, Microscopic examination.
Atomic Diffusion: Basic concepts, significance of diffusion, Fick's laws of diffusion, Factors influencing diffusion, Industrial applications of diffusion.
11 Hrs

Unit - II

Mechanical Properties of Metals: Elastic deformation, Plastic deformation, Materials Failure: Fundamentals of fracture – Brittle & ductile fractures, Impact fracture testing, Tensile test, Hardness tests, Fatigue: Cyclic stresses, S-N curve, crack initiation & propagation, fatigue test. Creep: Generalized creep behavior, stresses & temperature effects, creep test.
Strengthening mechanisms: characteristics of dislocations, slip systems, Mechanisms of strengthening in metals-Grain size reduction, solid solution strengthening and strain hardening. **10 Hrs**

Unit - III

Phase Diagrams: Fundamentals of alloying, Types of solid solutions, Hume – Rothery rules, Lever rule. Classification and construction & interpretations of phase diagrams, Isomorphous, Eutectic, eutectoid & Peritectic systems.
Iron-Iron carbon diagram – Construction and Interpretation, development of microstructure in Iron-Carbon alloys. **11 Hrs**

Unit - IV

Phase transformations: Kinetics of phase transformations, homogeneous and heterogeneous nucleation. Micro structural and property changes in Iron-carbon alloys, Isothermal transformation diagrams (TTT curves) and continuous cooling transformation diagrams (CCT curves), Mechanical behaviour of Iron-carbon alloys.
Heat treatments: Basic concepts, objectives, Annealing – types and applications, Hardening – Harden ability, Jominy end quench test, Precipitation hardening. **10 Hrs**

Unit - V

Metal alloys: Ferrous alloys: Classification, AISI / UNS designations mechanical characteristics of steels, - Low carbon steels, medium carbon steels and high carbon steels. SAE designations & mechanical characteristics

of cast Irons – gray cast iron, ductile iron, white / malleable iron. Processing of Ferrous alloys.

Non-Ferrous Alloys: Copper and its alloys – UNS designations, compositions & properties. Aluminum and its alloys - UNS designations, compositions & properties.

Ceramics: A basic concept, Classification, features of glasses, clay products, refractories, abrasives and advanced ceramics & applications.

Composites: Classification of composites, types of composites- MMCs, CMCs, FRPs & Sandwich structures - advantages, limitations & industrial applications. **10 Hrs**

Text Books:

1) William D. Callister, "Materials science & Engg", An Introduction, John Wiley & Sons Inc, 2010.
2) V Raghavan, "Materials Science & Engg.", 4th Edition, Prentice Hall of India, 2002.

Reference Books:

1) William F. Smith, "Principles of Materials Science Engg.", 3rd International Edition, McGraw Hill Publishing Co.1996
2) Donald R. Askelandad Pradeep P. Phule, "The Science and Engineering of Materials", Thomson Books/Cole, 2010.

18UMEC302	Strength of Materials	(3-2-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs): The objectives of this course are to make the student to learn:

1. Theory behind design and analysis and procedures of rod like members subject to axial force, twisting and bending
2. Compound stresses and equations to calculate the same (analytical and graphical)
3. Buckling of columns & calculation of buckling load.
4. Nature of stresses in thick and thin cylinders and calculations.

Course outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Evaluate stresses and strains for structural members subjected to different loads.	1, 2	-	-
CO-2	Calculate principal stresses and maximum shear stress under combined loading.	1, 2	-	-
CO-3	Compute shear force, bending moment and deflection of beams subjected to different loads.	1, 2	3	-
CO-4	Use concepts of theory of simple bending and torsion to calculate stresses in elements.	1, 2	3	-
CO-5	Analyze stresses and deformation in thin and thick cylinders subjected to internal and / or external pressures.	1, 2	3	-
CO-6	Calculate critical load in columns using Euler's or Rankine's equations	1, 2	3	-

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	3	3	2	-	-	-	-	-	-	-	-	-	-	-

Pre-requisites: Nil

Course Contents:

Unit - I

Stress and Strain: Introduction, mechanical properties of materials, Linear elasticity, Hooke's law, Poisson's ratio, stress-strain relationship, Extension and shortening of a bar, bars with varying cross section in steps, bars with continuously varying cross sections (circular and rectangular), Elongation due to self-weight, factor of safety, thermal stresses. Volumetric strain, expression for volumetric strain, elastic constants, simple shear stress, shears strain.

9L+2T Hrs

Unit - II

Torsion of circular shaft: Introduction, pure torsion, assumptions, torsion equation, pure torsion equation, power transmitted in circular shaft, Compound Cylinder.

Compound stresses: Introduction, Plane stress, stresses on inclined sections, analytical and graphical (Mohr's Circle) methods, Principal Stresses, Maximum shear Stress. **10 Hrs**

Unit - III

Bending moment and shear forces in beams: Introduction, types of beams, loads and reactions, shear force and bending moments, sign convention, relationship between shear force and bending moment, shear force and bending moment diagrams for different beams subjected to uniformly distributed load, concentrated load, and couples.

Deflection in beams: Introduction, equation for deflection, slope and moments, double integration method, Macaualy's Method. **8L+4T Hrs**

Unit - IV

Stresses in beams: Introduction, theory of simple bending, Euler's equation of bending, shear stresses in beams, shear stresses across rectangular, circular, symmetrical and unsymmetrical and T sections. **7L+2T Hrs**

Unit - V

Columns: Introduction to columns, Euler formula for different end conditions, its limitations, Rankine formula.

Thick and thin cylinders: Stresses in thin cylinders, changes in dimensions of thin cylinders, thick cylinders subjected to internal and external pressure.

10 Hrs

Text Book:

1) Singer & Pytel, “Strength of Materials”, Harper and Row publications.4th edition, 1999.

Reference Books:

1) Dr. S. S. Bhavikatti, “Strength of Materials”, 2nd edition, Vikas Publishing House Pvt. Ltd., 2003.
2) Ferdinand Beer & Russel Johnston, “Mechanics of materials”, 5th edition, Tata McGraw Hill, 2010.
3) Egor P Popov, “Mechanics of Materials”, Pearson Education India, 2nd edition, 1998.

18UMEC303	Manufacturing Processes- I	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs): The objectives of this course are to make the student to learn:

1. Concepts of heating the metal to molten state and cooling it in a cavity of desired shape and size.
2. Methods of joining two metal pieces with application of heat, with or without pressure and extra metal (filler metal)
3. Basic concepts of forces in different plastic deformation processes.
4. Process of obtaining objects of high quality and precision by sintering using different metal powders.
5. Theory of non-traditional machining methods to obtain desired shape and size of parts.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Explain the principles of casting, welding, forming and powder metallurgy.	-	1	-
CO-2	Describe constructional and operational features of moulding machines.	1	2	-
CO-3	Select appropriate material and process of manufacture for a given part.	1	2	-
CO-4	Explain the methods of production of metal powders in powder metallurgy with applications.	-	1, 2	-
CO-5	Describe high energy rate forming process.	-	1, 2	-
CO-6	Outline defects and remedies in manufacturing processes.	-	-	1, 2, 3

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2.6	1.8	1	-	-	-	-	-	-	-	-	-	-	-

Prerequisites: Nil

Course Contents:

Unit - I

Casting process: Introduction, steps involved in casting process, advantages, dis-advantages and applications of the casting process.

Pattern: Definition, materials used for patterns (any four), pattern allowances and their importance, types of patterns (any six).

Sand moulding: Ingredients in moulding sand, types of moulding sand, properties of an ideal moulding sand. Sand testing: compression test, shear test, Clay content test, permeability test, grain fineness test (GFN test).

Core: core sand, binders, core making, types of cores. **8 Hrs**

Unit – II

Moulding: Hand, Jolt-squeeze machine moulding, sand slinger, CO_2 moulding, Investment casting, permanent moulding, semi-centrifugal casting, centrifugal casting, continuous casting.

Casting defects: Causes and remedies.

Melting furnaces: Cupola, Direct arc, Indirect electric arc and Induction furnace. **9 Hrs**

Unit - III

Welding: Working of arc welding, TIG, MIG, SAW, Resistance (any one), Friction (any one), Explosive, EBW, and Laser Beam Welding.

Metal forming: Flow curve, Cast and Wrought product, Metal working process: Classification based on applied force & temperature. Merits & demerits. **7 Hrs**

Unit - IV

Forging: Introduction, Classification, defects: causes and remedies.

Rolling: Introduction, classification of rolling mill, force & geometry relationship, rolling load and power (no derivation), rolling defects: causes and remedies.

Drawing & Extrusion: C/s of drawing die, wire, tube, plug & moving mandrel drawing.

Extrusion: Introduction, direct & indirect extrusion, applications. **9 Hrs**

Unit - V

Powder metallurgy: Steps involved, merits, demerits and applications of PM process.

High Energy Rate Forming: Working of Explosive, Electro Hydraulic & Electro Magnetic Forming. **6 Hrs**

Text Books:

1) Serope Kalpakjian, Steven R. Schmid, "Manufacturing Technology", 4th edition, Pearson Education Asia, 2000.
2) George E Dieter, "Mechanical Metallurgy", S I Metric Edition, McGraw Hill, 2000.

Reference Books:

1) Amitabh Ghosh & A. K. Mallik, "Manufacturing Science", 2nd edition, East West Press, 2010.
2) O. P. Khanna "Manufacturing Process", Dhanpat Rai Publishing Co. Pvt. Ltd, 2009.

18UMEC304	Machine Drawing	(3-0-0) 3

Contact Hours: 39

Course learning objectives (CLOs): The objective of this course is to make the student aware of:

1. Importance of making drawings of machine parts as per standards.
2. Detailed drawings of machines parts from assembly drawing and vice versa.
3. Geometrical dimensioning & tolerancing
4. Solid modeling of Screw Jack, Plummer Block using software.

Course outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Convert the given pictorial views to orthographic views of machine parts/objects.	1	-	-
CO-2	Draw the orthographic views of plates fastened with threaded fasteners.	1	-	-
CO-3	Express the tolerances on parts using GD & T.	1	2	-
CO-4	Draw part/assembly drawings of simple mechanical devices.	1	-	-
CO-5	Create 3D models of mechanical parts and relevant assembly using the software.	-	1, 5	-

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	2.8	2	-	-	2	-	-	-	-	-	-	-	-	-

Prerequisites: Nil

Course Contents:

Unit - I

Orthographic views (2D): BIS conventions. Conversion of pictorial views into orthographic views of simple machine parts with/without section.

7 Hrs

Unit - II

Thread forms and threaded fasteners: Sectional views of threads, ISO Metric (Internal & External), and square threads. Assembly of two plates using Hexagonal headed bolt and nut with washer, simple assembly using stud with nut and washer.

Couplings (2D): Protected type flange coupling assembly. **8 Hrs**

Unit - III

GD & T: Part drawings of a press tool representing various geometrical features and their tolerances. **6 Hrs**

Unit - IV

Assembly Drawings (2D): Assembly drawing of Screw jack (Bottle type), assembly drawing of simple jig. **11 Hrs**

Unit – V

Computer aided 3D modelling (using Solid edge software):
3D modeling of Screw jack, Plummer block. **7 Hrs**

Text Book:

1. K.R.Gopalkrishna, 'Machine Drawing', 22nd Edition, Subhas Publication 2013.

Reference Books:

1) N.D.Bhatt, 'Machine Drawing', 45th edition, Charotar Publishers, 2008
2) A Primer on Computer Aided Machine Drawing-2007', VTU, Belgaum
3) Sham Tickoo,N. Siddeshwar, P. Kanniah, V.V.S. Sastri, 'Auto CAD 2006, for engineers and designers', Dream tech 2005, Tata McGraw Hill, 2006.
4) K C John 'Text Book of Machine Drawing' PHI Learning Pvt Ltd, 2009.

NOTE:

1) The QP pattern of IA and SEE are different from that of all other subjects as it involves only drawing work.

2) The unit wise marks distribution is also different
   Unit -I: 2 Questions, each of 25 marks

   Unit-II: 2 Questions, each of 25 marks

   Unit-III: 2 Questions, each of 10 marks

   Unit-IV: 2 Questions, each of 40 marks

3) Unit-V: NO QUESTIONS IN *IA* OR *SEE. (Only for CTA)* The QP pattern / assessment of CIE and SEE modalities have been approved by the BOS.

18UMEL305	Materials Science & Materials Testing Lab	(0-0-3) 1.5

Contact Hours: 36

Course Learning Objectives (CLOs): The objectives of this course are to make the student to learn:

1. Mathematics and engineering in calculating the mechanical properties of structural materials.
2. To quantify whether a specific property of material is suitable for intended applications.
3. To function in teams in the area of materials testing.
4. To use the techniques, skills and modern engineering tools necessary for engineering.
5. Professional and ethical responsibility in the area of material testing.

Course outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Characterize the properties of materials subjected to tension, compression, bending, torsion and shear.	1, 4, 9	5	6
CO-2	Determine relevant parameters of fatigue and wear tests.	1, 4, 9	5	6
CO-3	Determine the impact strength of given specimen.	1, 4, 9	5	6
CO-4	Estimate the hardness of heat treated/untreated materials.	1, 4, 9	-	6
CO-5	Identify different materials by microstructure examination.	1, 4, 9	5	6
CO-6	Detect various defects in materials using non-destructive tests.	1, 4, 9	-	6

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	3	-	-	3	2	1	-	-	3	-	-	-	-	-

Prerequisites: Nil

Course Contents:

1. Preparation of specimen for metallographic examination of engineering materials and study the microstructure of plain carbon steel, tool steel, gray C.I, SG iron, Brass, Bronze.
2. Heat treatment: Annealing, normalizing, hardening and tempering of steel & to study their hardness (demonstration only).
3. Testing of metals
    - Tensile test
    - Shear test
    - Compression test
    - Torsion and bending test
    - Izod test
    - Charpy test
4. Testing of non-metals like wood composites etc.
5. Determination of frictional force and wear using POD apparatus.
6. Brinell, Rockwell and Vicker's Hardness tests.
7. Determination of fatigue life using Fatigue Test
8. Non-destructive test experiments
   (a) Ultrasonic flaw detector,

   (b) Magnetic crack detector,

   (c) Dye penetrant testing.

18UMEL306	Foundry & Forging Lab	(0-0-3) 1.5

Contact Hours: 36

Course Learning Objectives (CLOs): The objectives of this course are to make the student to learn:

1. Identify various foundry and forging tools & equipments.
2. Preparation of sand molds through hands on practice
3. Preparation of forging models using open hearth furnace by performing upsetting, drawing and bending operations.
4. Experimental procedures to determine different properties of sand samples

Course outcomes (COs):

-Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Identify the various tools and operations used in foundry & forging process.	1	-	5
CO-2	Prepare different types of sand moulds using foundry tools and operations.	-	4	-
CO-3	Determine different properties of sand using appropriate tests.	-	4	-
CO-4	Prepare forging models using appropriate tools and operations.	-	4	-

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	3	-	-	3	1	-	-	-	-	-	-	-	-	-

Prerequisites: Nil

Course Contents:

1. **Testing of moulding sand and Core sand:**
   - Compression test, shear test and tensile test
   - Permeability test
   - Core hardness & Mould hardness tests

- Grain fineness test
- Clay content test

2. **Foundry Practice:** Use of foundry tools and other equipment's. Preparation of moulds (ready to pour) using two boxes, use of split pattern, match plate pattern and Cores.
3. **Forging Models:** Preparing minimum three models involving upsetting, drawing and bending operations.

IV Semester

18UMAC400	Engineering Mathematics-IV	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs): To provide an insight into applications of conformal mapping, integration of complex functions and application of probability distributions in Engineering.

Course Outcomes (COs):

Description of the Course Outcomes: At the end of the course the student will be able to:		Mapping to POs(1-12)		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Construct and use the concepts of analytic function to solve the problems arising in Engineering field.	--	--	1
CO-2	Utilize conformal transformation and complex integral to transform irregular domain onto a relatively simple domain.	--	1	--
CO-3	Apply discrete and continuous probability distributions in analyzing the probability models arising in engineering field.	--	1	--
CO-4	Make use of the correlation and regression analysis to fit a suitable mathematical model for the statistical data.	--	1,2	--
CO-5	stimate the correlation, covariance using joint probability distributions. Also use student's t-distribution, Chi-square distribution as a test of goodness of it.	--	1,2	--

POs	1	2	3	4	5	6	7	8	9	10	11	12
Mapping Level	1.8	2	-	-	-	-	-	-		-	-	-

Pre-requisites: 1.A basic course on Differentiation and integration of function.

2. A basic course on probability and statistical averages.

Contents:

Unit-I

Calculus of complex functions: Review of function of a complex variable, limits, continuity, and differentiability. Analytic functions: Cauchy-Riemann equations in Cartesian and polar forms. Construction of analytic functions: Milne-Thomson method-Problems. **7 Hrs.**

Unit-II

Conformal transformations: Introduction. Discussion of transformations $w = e^z; w = z^2, w = z + \frac{1}{z}, z \neq o)$.Bilinear transformations- Problems.

Complex integration: Line integral of a complex function, Cauchy's theorem and Cauchy's Integral theorem. **8 Hrs.**

Unit-III

Statistical Methods: Correlation and regression-Karl Pearson's coefficient of correlation and rank correlation-problems. Regression analysis- lines of regression–problems.

Curve Fitting: Curve fitting by the method of least squares- fitting the curves of the form $= ax + b; y = ax^2 + bx + c; y = ax^b$. **8 Hrs.**

Unit-IV

Probability Distributions: Review of basic probability theory. Random variables (discrete and continuous), probability mass/density functions. Binomial, Poisson, exponential and normal distributions-problems (No derivation for mean and standard deviation)-Illustrative examples. **8 Hrs.**

Unit-V

Joint probability distribution: Joint Probability distribution for two discrete random variables, expectation and covariance.

Sampling Theory: Introduction to sampling distributions, standard error, Type-I and Type-II errors. Test of hypothesis for means, student's t-distribution, Chi-square distribution as a test of goodness of fit. **8 Hrs.**

Reference Books:

1) E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons 10th edition.(Reprint) 2016.
2) B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 44th edition, 2017.
3) Srimanta Pal et al: Engineering Mathematics, Oxford University Press, 3rd edition, 2016.

18UMEC400	Fluid Mechanics	(3-2-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs): The objectives of this course are to make the student to learn, Fluid and its properties, Laws of fluids, fluid flow concepts, fluid dynamics, flow through pipes, compressible flow and boundary layer concepts.

Course outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12)/ PSOs (13,14)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Evaluate fluid properties and fluid pressure for static fluids.	1, 2	-	-
CO-2	Determine hydrostatic forces on submerged surfaces and kinematic properties of fluid.	1, 2	-	-
CO-3	Apply laws governing fluid dynamics to flow measurement and carry out dimensional analysis.	1, 2	-	3
CO-4	Apply equations of fluid friction for flow through pipes.	1, 2	-	3
CO-5	Explain the concepts of boundary layer theory and its applications.	-	1, 2	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2.8	2.8	1	-	-	-	-	-	-	-	-	-	-	-

Prerequisites: Nil

Course Contents:

Unit - I

Properties of Fluids: Introductory concepts and definitions, properties of fluids, classification of fluids and regimes of flow.

Fluid Statics: Pascal's law, pressure variation in static fluid, manometers (simple and differential U tube) and mechanical gauges. **10L+2T Hrs**

Unit - II

Submerged surfaces & Floatation: Hydrostatic force on submerged plane surfaces (horizontal, vertical and inclined). Buoyancy and stability criteria (no derivations for Meta centre).

Fluid Kinematics: Fluid flow concepts, types of flow, lines of flow, stream function and velocity potential function for 2D flow, Relationship between them and flow nets, Ideal flow concepts (Uniform flow, Source and sink flow, Doublet, Flow past the cylinder), continuity equation. **10L+2T Hrs**

Unit - III

Dimensional Analysis: Dimensions of physical quantities, dimensional homogeneity-Buckingham's pi theorem, the Rayleigh's method, important dimensionless numbers, Critical Reynolds number, similitude.

Fluid Dynamics & its applications: Euler's Equation of motion, Bernoulli's equation, venturimeter, orifice meter, pitot tube, V- notch, Rota meter, Hot wire Anemometer and Methods of fluid flow visualization. **9L + 3T Hrs**

Unit - IV

Flow through Pipes: Hagen Poisuille's equation, minor and major losses in pipe flow - Energy line and hydraulic gradient line, Darcy and Chezy equations. **8 Hrs**

Unit - V

Boundary layer theory: Hydrodynamic boundary layer, boundary layer thickness, displacement, momentum & energy thickness, (Qualitative discussions and No derivations) Flow over a flat plate, Flow inside a pipe. Flow past immersed Bodies: Lift and Drag force, skin friction, Introduction to compressible Flow. Introdctio to navier stoke equation and CFD. **8 Hrs**

Text Book:

1) Dr. R K. Bansal, "A Text Book of Fluid Mechanics and Hydraulic Machines" 9th edition, Laxmi Publication (P) Ltd., New Delhi. 2013

Reference Books:

1) Yunus Cengel “Fluid Mechanics(SI units)” McGraw Hill, 2014
2) Dr.Jagadishlal, “Fluid Mechanics and Hydraulics” Metropolitan Book Co. Pvt. Ltd., New Delhi, 1995.
3) K.L.Kumar Engineering Fluid Mechanics S. Chand Publishing,
4) White, “Fluid Mechanics” 6th edition, Tata McGraw Hill 2010.
5) Open course ware and MOOCS

18UMEC401	Manufacturing Processes – II	(4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs): The objectives of this course are to make the student to learn basics of metal cutting, various machine tools, various modern machining processes, cutting tool materials and design of jigs and fixtures.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Explain principles, constructional features & operations of machine tools.	1	-	-
CO-2	Compute machining time for jobs on various machine tools.	1, 2	-	-
CO-3	Discuss various systems of tool signatures, forces and velocity relationships in machining.	1, 2	-	-
CO-4	Explain different cutting tool materials, tool life equation and machinability aspects.	1	-	4
CO-5	Explain principles and working of Nontraditional machining.	1	2	5
CO-6	Discuss principles of jigs and fixtures.	1	2	3

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	3	2.5	1	1	1	-	-	-	-	-	-	-	-	-

Prerequisites: Nil

Course Contents:

Unit - I

Machine Tools: Introduction, Definition, requirements of machine tools, primary and secondary motions – tool and work movements for producing flat, cylindrical surfaces and holes.

Lathe: Description and functions of lathe parts in brief, tool and work holding devices. Operations on lathe in brief, taper turning methods and thread cutting (with numericals).

Drilling: Drilling types of drilling machines and related operations. **10 Hrs**

Unit - II

Milling: Principle of milling, types of milling machines, Description and working of horizontal and vertical milling machines and milling operations**.**

Grinding: Classification, surface, centre less and internal grinders. Abrasives - bonds, grit, grade and structure of wheels. Designation of wheels. Machining time Calculation (turning, milling and drilling).

Gear manufacturing: Indexing (direct and plain indexing with simple Numericals) and hobbing. **12 Hrs**

Unit - III

Theory of metal cutting: Aims and objectives in machining. Single point cutting tool geometry and nomenclature – machine reference (ASA), orthogonal rake system (ORS) and normal rake system (NRS). Mechanics of chip formation, types of chips, orthogonal and oblique cutting, relationship between chip thickness ratio, shear angle and rake angle in orthogonal machining. Velocity relationships. Merchant's analysis, Merchant's theory.

9 Hrs

Unit - IV

Cutting tool materials: Desired properties, types; HSS, carbides, coated carbides, ceramics, coronite, cermets, CBN, and diamond. CVD and PVD (principle in brief). Broad classification of carbide tools (PMK classification).

Tool wear, cutting fluids and Machinability: Types, mechanism, tool life criterion. Taylor's tool life equation. Cutting fluids - desired properties, types, selection. Factors affecting Machinability. Constraints in fulfilling machining objectives and control over the machining constraints, (With empirical formulae). **11 Hrs**

Unit - V

Jigs and Fixtures for aiding machining: Purpose, considerations, principles, functions & design, design for few specific machining requirements

Modern machining processes: Principles, equipment, operations and applications of Electric Discharge Machining, LBM, ECM. **10 Hrs**

Text Books:

1. A.B. Chattopadhyay, "Machining and Machine tools", Willey India, 2011.
2. Serope Kalpakjian and Steven R Schmid, "Manufacturing Engineering and Technology", Pearson Education Asia, 4th edition,2001
3. Geoffrey Boothroyd and Winston A. Knight, Fundamentals of Machining and Machine Tools, 3rd edition, CRC Press. Taylor and Francis Group.

Reference Books:

1. Amitabh Ghosh & A. K. Mallik, Manufacturing Science, 2nd edition, East West Press Pvt. Ltd, New Delhi.
2. HMT, Production Technology, Tata McGraw Hill, 2000.
3. S. K. Hajra Choudhury, A. K. Hajra Choudhury and Nirjhar Roy, "Elements of Workshop Technology", Vol II. 14th edition,2010.

18UMEC402 Applied Thermodynamics (3-2-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs): The objectives of this course are to make the student to learn:

1. Applications of various gas and vapour power cycles.
2. Performance calculations of reciprocating air compressors.
3. Concepts of combustion thermodynamics and testing of I. C. Engines
4. Concepts related to Refrigeration and Air conditioning.
5. Psychrometric Charts, Psychrometric processes, human comfort conditions.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Apply thermodynamic laws to gas and vapour power cycles.	1	2	3
CO-2	Apply thermodynamic equations to assess the performance of single and multistage air compressor.	1	2	3
CO-3	Evaluate mass and energy balance equation for fuels.	1	2	3
CO-4	Explain the performance analysis of IC Engines.	1	2	-
CO-5	Discuss the performance parameters of refrigeration and air-conditioning systems.	1	2	-

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	3	2	1	-	-	-	-	-	-	-	-	-	-	-

Prerequisites: Nil

Course Contents:

Unit - I

Gas power cycles: Air standard cycles, Otto, Diesel, Dual, P-V and T-S diagrams, description, efficiencies and mean effective pressure, comparison of Otto, diesel and dual combustion cycles. Gas Turbines: Classification of

Gas turbines, Brayton cycle, analysis of open and closed cycle gas turbine, methods to improve thermal efficiency of the cycle, Effect of Regeneration, Inter cooling and Reheating. **8L+2T Hrs**

Unit - II

Vapour power cycles: Carnot vapour power cycle, drawbacks as a reference cycle, simple Rankine cycle; description, T-S diagram, analysis for performance, comparison of Carnot and Rankine cycle. Effects of pressure and temperature on Rankine cycle performance. Actual vapour power cycles, regenerative Rankine cycle, open and closed feed water heaters, reheat Rankine cycle. **7L+2THrs**

Unit - III

Reciprocating Air Compressors: Operation of a single stage reciprocating compressors: work input through p-v diagram, effect of clearance and volumetric efficiency, adiabatic, isothermal and mechanical efficiencies. Multi-stage compressor, saving in work, optimum intermediate pressure, inter-cooling, minimum work for compression. **7L+2THrs**

Unit-IV

Combustion Thermodynamics: Theoretical (Stoichiometric) air for combustion of fuels, excess air, mass balance, actual combustion. Exhaust gas analysis. A/F ratio, energy balance for a chemical reaction, enthalpy of formation, enthalpy and internal energy of combustion, combustion efficiency

Internal Combustion Engines: Performance Testing of Two-stroke and Four-stroke I.C. engines - Measurement of speed, air flow, fuel consumption, Measurement of Brake Power and Indicated Power, Performance curves, Heat Balance sheet and Multi cylinder Engines testing, Morse test.

10L+2THrs

Unit - V

Refrigeration: Vapour compression refrigeration system; description, analysis, refrigerating effect, capacity, power required, units of refrigeration, COP, reversed Carnot cycle, vapour absorption refrigeration system and Air refrigeration system. Use of refrigeration tables and p-h chart. Classification of Refrigerants. Desirable properties of refrigerants.

Psychrometrics: Atmospheric air and Psychrometric properties: DBT, WBT, DPT, partial pressure, specific and relative humidity and relation between the enthalpy and adiabatic saturation temperatures. Construction and use of psychrometric chart. Analysis of various processes: Heating, cooling, dehumidifying and humidifying. Adiabatic mixing of stream of moist air. Analysis of summer and winter air-conditioning systems. **10L+2T Hrs**

Text Books:

1) P. K. Nag, Basic and Applied Thermodynamics TMH Publishing Co. Ltd, New Delhi, 2nd edition, 2011.
2) Yunus A Cengel, Michael A Boles, Thermodynamics An engineering approach McGraw Hill Companies, New-Delhi, 6th edition, 2008
3) Thermal Engineering by R. K. Rajput, Laxmi Publishers (P) Ltd., New Delhi, 6th edition, 2006.

Reference Books:

1) Refrigeration and Air Conditioning by C. P. Arora, Tata-McGraw-Hill publishing Co. Ltd. New Delhi, 2nd edition, 2004.
2) Internal combustion engines – M L Mathur and R P Sharma, DhanapathRai Publications. 3rd edition 2007.

Data Handbook:

1) Tables and Charts on Refrigerants and Psychometric Properties (S. I. Units) by P. N. Maskara and Satish Chand, Technical Publishers of India, Subhas Nagar, Allahabad, 1994.
2) Thermodynamics Data Hand Book (S. I. Units) by Prof. B. T. Nijaguna and Prof.B.S. Samaga, Sudha Publishers, Avenue Road, Bangalore

18UMEC403	Metrology and Measurements	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs): The objectives of this course are to make the student to learn:

1. Need, standards and principles of measurement.
2. Basics of limits, fits and tolerances and their importance to the real manufacturing.
3. Principles of various mechanical elements – such as screws, threads and gears.
4. Basics of measurements systems.
5. Principles of transducers.
6. Working of force, torque, pressure, temperature, strain measurement systems.

Course outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Explain standards of measurements and principles of limits, fits & tolerances.	1,	-	13
CO-2	Design limit gauges for internal and external dimensions and explain the working of various comparators.	1, 2	-	-
CO-3	Describe principle of interferometry, screw thread and angular measurement.	1, 2	-	4
CO-4	Explain concepts of advanced metrology and gear measurement.	1	2, 3	
CO-5	Discuss various methods of measurement of force, strain, torque, pressure and temperature.	1, 2	-	-

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	3	2.8	2	1	-	-	-	-	-	-	-	-	1	-

Prerequisites: Nil

Course Contents:

Unit - I

Standards of measurement: Definition and Objectives of metrology, Standards of length - International prototype meter, Imperial standard yard, Wave length standard, subdivision of standards, line and end standard, comparison, calibration of end bars (Numerical), Slip gauges, Wringing phenomena, Indian Standards (M-87, M-112), Numerical problems on building of slip gauges.
System of limits, Fits, Tolerances: concept of limits of size and tolerances, Specification in assembly, Principle of inter changeability and selective assembly, compound tolerances, accumulation of tolerances, definition of fits, types of fits and their designation (IS 919 -1963), geometrical tolerance, positional - tolerances, hole basis system, shaft basis of system.

8 Hrs

Unit - II

Limit gauges and gauge design: classification of gauges, brief concept of design of gauges (Taylor's principles), Wear allowance on gauges, Types of gauges- plain plug gauge, ring Gauge, snap gauge, limit gauge and gauge materials.
Comparators: Introduction to Comparator, Characteristics, classification of comparators, mechanical comparators -Johnson Mikrokator, Sigma Comparators, Optical Comparators -principles, Zeiss ultra-optimeter, Electric and Electronic Comparators -principles, LVDT, Pneumatic Comparators, back pressure gauges, Solex Comparators. **8 Hrs**

Unit - III

Angular measurement: Angular measurements, Bevel Protractor, Sine Principle and. use of Sine bars, Sine center, use of angle gauges, (numericals on building of angles) Clinometers.
Interferometry and Screw thread measurement: Interferometer Principle of interferometry, autocollimator, Optical flats, Toolmakers microscope. Terminology of screw threads, measurement of major diameter, minor diameter pitch, angle and effective diameter of screw threads by 2-wire and 3-wire methods, Best size wire. **8 Hrs**

Unit - IV

Gear measurement: gear terminology, use of gear tooth Vernier caliper and gear tooth micrometer.
Advanced metrology: Co-ordinate measuring machine (CMM) need, construction, types- applications in measurements and machine tool metrology, Introduction to computer aided inspection. **7 Hrs**

Unit - V

Measurement of Force, Torque and pressure: Principle, platform balance, proving ring, Torque measurement, Prony brake, hydraulic dynamometer. Pressure Measurements, Principle, Bridgeman gauge, Mcloed gauge.

Temperature and strain measurement: Thermocouple, laws of thermocouple, materials used for construction, pyrometer, Optical Pyrometer. Strain Measurements, Strain gauge, gauge factor. **8 Hrs**

Text Books:

1) Beckwith Marangoni and Lienhard, "Mechanical measurements" Pearson Education, 6th Ed., 2007.
2) R. K. Jain, "Engineering Metrology", 25th edition, Khanna Publishers, 2011.
3) I. C. Gupta, "Engineering Metrology", 7th edition, Dhanpat Rai Publications, Delhi, 2012.

Reference Books:

1) Alsutko, Jerry. D.Faulk, "Industrial Instrumentation" Thompson Asia Pvt. Ltd. 2002
2) Ernest O. Doebelin & Dhanish N. Manik, "Measurement Systems", 6th editions, McGRAW Hill Book Co. 2011

18UMEC404	Design of Machine Elements – 1	(2-2-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs): The objectives of this course are to make the student to learn:

1. Materials and properties used in machine elements.
2. Theories of failures and application.
3. Designing commonly used machine elements used for joining and power transmission.
4. Use of design data book and BIS standards.

Course outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Solve problems on eccentric loading & theories of failure in design of machine components using factor of safety.	-	1, 2	-
CO-2	Design of power transmission elements like shafts, keys and couplings.	1, 2	3	6
CO-3	Evaluate stress concentration and fatigue strength of machine elements.	1, 2	3	-
CO-4	Design Knuckle joint and power screws.	1, 2	3	6
CO-5	Design joints using threaded fasteners, welded and riveted joints.	1, 2	3	6

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	2.8	2.8	2	-	-	1	-	-	-	-	-	-	-	-

Prerequisites: Nil

Course Contents:

Unit - I

Introduction: Design methodologies, stress analysis, problems on axial, bending, torsional, eccentric loading for simple members of circular & rectangular cross section, stress due to impact loading (no derivation).

Role of materials, material selection, factor of safety, calculation of allowable stresses, theories of failure (max. of principal stress theory, shear stress theory, distortion energy theory). **9 Hrs**

Unit - II

Keys & coupling: Selection of keys, check for stresses, design of flange coupling.

Design of shafts: Strength & deflection–ASME code for transmission shafting, including axial loads – (problems not involving more than 2 transmitting elements).

3L+3T Hrs

Unit - III

Stress concentration: Effects of stress concentration, problems on stress concentration (discontinuity of max. two discontinuities)

Design for fatigue strength: Introduction, S-N diagram, low cycle fatigue, high cycle fatigue, and Endurance limit. Modifying factors – size effect, surface effect, stress concentration effects; Fluctuating stresses, Fatigue strength under fluctuating stresses, Goodman's and Soderberg's relationship; stresses due to combined loading. **6L+2T Hrs**

Unit - IV

Design of knuckle joint: Modes of failures in various parts of knuckle joint.

Design of Power Screws Mechanics of power screw, stresses in power screws, Efficiency and self-locking. **5L+2T Hrs**

Unit - V

Design of Fasteners: Fastener, initial tension concept eccentrically loaded bolted joints – for Brackets & hangers & base of crane etc.

Riveted joints: Types, failures, design of structural joints – lap & butt joints, eccentric loading problems to be given as assignment (No boiler joints) Lozenge Joint.

Design of welded joints: Lap joint, butt joint, eccentric welded joint subjected to torsional and bending moments (standard configuration only)

6L+3T Hrs

Text Book:

1) Robert L. Norton, "Machine Design an integrated approach", 2nd edition, Pearson Education Asia University Press, 2013.

Reference Books:

1) Joseph. E Shigley & Charles R MirchKe, “Mechanical Engg. Design”, 6th edition, Tata, McGraw Hill, 2003.
2) C. S. Sharma and Kamlesh Purohit, “Design of Machine Elements”, PHI 2003.
3) Maleev & Hartman, “Machine Design”, CBS Publishers & Distribution, New Delhi.
4) V. B. Bhandari, “Design of Machine Elements”, 3rd edition, Tata McGraw Hill Pub. New Delhi, 2010.

Design Data Hand Books:

1) K. Mahadevan & Balaveera Reddy, “Design Data Hand Book”, CBS Publication, 2014.
2) K. Lingaiah, “Design Data Hand Book”, McGraw Hill, 2006.

18UMEL405	Measurements Lab	(0-0-3) 1.5

Contact Hours: 36

Course Learning Objectives (CLOs): The objectives of this course are to make the student to learn:

1. Importance/need of mechanical measurements and metrology in day to day practical life.
2. Different measurements systems and the errors associated with them.
3. Importance of calibration of measurement instruments.
4. Various Sensors, traducers and strain gauges employed in measuring system.
5. Linear and angular measurements and calibration.

Course outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Calibrate pressure gauge, thermocouple, LVDT, load cell and micrometer.	1	4	5
CO-2	Measure angular dimensions using bevel protractor and sine bar.	-	-	1,5
CO-3	Determine screw thread and gear tooth parameters.	-	4	1,5
CO-4	Inspect parts using profile projector, tool maker's microscope and gauges.	1	-	6
CO-5	Determine modulus of elasticity using strain gauges.	-	4	1, 5
CO-6	Measure surface roughness of parts.	-	4	1,5

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	2	-	-	2	1	1	-	-	-	-	-	-	-	-

Prerequisites: Nil

Course Contents:

1. Calibration of Pressure Gauge.
2. Calibration of Thermocouple.
3. Calibration of LVDT.
4. Calibration of Load cell.
5. Determination of modulus of elasticity of a mild steel specimen using strain gauges.
6. Measurements using Optical Projector/Tool maker's Microscope.
7. Determination of angle using Sine Center / Sine bar / bevel protractor.
8. Determination of alignment using Autocollimator / roller set.
9. Determination of Screw thread parameters using two wire / three wire method.
10. Measurements of Surface roughness using Talysurf / mechanical Comparator.
11. Determination of gear tooth profile using gear tooth Vernier / gear tooth micrometer.
12. Calibration of a micrometer using slip gauges.
13. Measurement using Optical Flats.
14. Checking of circular components for roundness.
15. Setting the snap gauges for the given tolerance grade and checking the components.
16. Use of ring gauges and plug gauges for inspection of components.

18UMEL406	Thermal Engineering lab - I	(0-0-3) 1.5

Contact Hours: 36

Course Learning Objectives (CLOs): The objectives of this Laboratory are to make the student to learn:

1. Different types of oils used in energy conversion devices and their application.
2. Fuel properties such as calorific value, viscosity and flash and fire point.
3. Parameters affecting the Internal Combustion Engine performance and their measurement.
4. Parameters to know performance of Internal Combustion Engine.

Course outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Determine flash and fire point using different apparatus	-	4	3
CO-2	Determine the viscosity of given oil and calorific value of fuels.	-	4	3
CO-3	Evaluate performance parameters of CI engines.	-	3, 4	9
CO-4	Evaluate performance parameters of SI engines.	-	3, 4	9
CO-5	Determine irregular area using planimeter.	-	3, 4	-

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	-	-	1.6	2	-	-	-	-	1	-	-	-	-	-

Pre-requisites: Nil

Course Contents:

1. Determine the flash point and fire point of a given oil using Cleveland open cup apparatus.
2. Determine the flash point of given oil using Pensky-Martin closed cup apparatus.

3. Determine the flash point of given oil using Abels closed cup apparatus.
4. Determine the viscosity of oil using Red wood viscometer.
5. Determine the viscosity of oil using Say-bolt viscometer.
6. Determine the area of irregular shape using Planimeter.
7. Performance test on four stroke IC engine and Heat balance sheet.
8. Performance test on VCR engine and Heat balance sheet.
9. Performance test on 2 stroke Bajaj engine.

18UMEL407	Introductory Project	(0-0-2) 1

Contact Hours: 26

Course Learning Objectives (CLOs): The objectives of this course are to make the student to learn:

1. Practical significance of projects.
2. Engineering concepts and its application to real world problems.
3. Literature review for engineering problems
4. Existing solutions to engineering problems.

Course outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Perform literature review for proposed topic or study industrial drawing standards.	1,2	-	13
CO-2	Identify societal / industrial problem from literature review or industrial drawing.	1,2	-	13
CO-3	Establish objectives and methodologies for the problem defined or interpret industrial drawings.	1, 2	3, 4	13
CO-4	Propose modified solution for the identified problem or reproduce manual/computer aided drawings.	1, 2	3, 4	5, 6, 7, 12, 13, 14
CO-5	Prepare a report and present their findings using PPT.	10	9	8,12

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping level	3	3	2	2	1	1	1	1	2	3	-	1	-	1

Course Contents:

Introductory project is introduced with an objective of understanding and identifying the community expectation in terms of possible Engineering solutions by applying the fundamental knowledge of basic sciences and basic engineering courses. The project shall be engineering oriented in terms of problem definition, related literature survey and existing solutions. The team consisting of 10-12 students shall be asked to identify the problems related to community and try to propose a

solution. The faculty members handling the courses for that semester shall guide the students. A committee consisting of minimum 3 faculty members shall evaluate at the end for CIE. There is no SEE for introductory project