RAMAIAH
Institute of Technology

CURRICULUM

for the Academic year 2019 – 2020

(Revised Scheme)

MECHANICAL ENGINEERING

III & IV SEMESTER B.E

RAMAIAH INSTITUTE OF TECHNOLOGY
(Autonomous Institute, Affiliated to VTU)
Bangalore – 560054.

About the Institute:

Ramaiah Institute of Technology (RIT) (formerly known as M. S. Ramaiah Institute of Technology) is a self-financing institution established in Bangalore in the year 1962 by the industrialist and philanthropist, Late Dr. M S Ramaiah All engineering departments offering bachelor degree programs have been accredited by NBA. RIT is one of the few institutes with faculty student ratio of 1:15 and achieves excellent academic results. The institute is a participant of the Technical Education Quality Improvement Program (TEQIP), an initiative of the Government of India. All the departments are full with competent faculty, with 100% of them being postgraduates or doctorates. Some of the distinguished features of RIT are: State of the art laboratories, individual computing facility to all faculty members. All research departments are active with sponsored projects and more than 130 scholars are pursuing PhD. The Centre for Advanced Training and Continuing Education (CATCE), and Entrepreneurship Development Cell (EDC) have been set up on campus. RIT has a strong Placement and Training department with a committed team, a fully equipped Sports department, large air-conditioned library with over 80,000 books with subscription to more than 300 International and National Journals. The Digital Library subscribes to several online e-journals like IEEE, JET etc. RIT is a member of DELNET, and AICTE INDEST Consortium. RIT has a modern auditorium, several hi-tech conference halls, all air-conditioned with video conferencing facilities. It has excellent hostel facilities for boys and girls. RIT Alumni have distinguished themselves by occupying high positions in India and abroad and are in touch with the institute through an active Alumni Association. RIT obtained Academic Autonomy for all its UG and PG programs in the year 2007. As per the National Institutional Ranking Framework, MHRD, Government of India, Ramaiah Institute of Technology has achieved 45th rank in 2017 among the top 100 engineering colleges across India and occupied No. 1 position in Karnataka, among the colleges affiliated to VTU, Belagavi.

About the Department:

The Department of Mechanical Engineering started in the year 1962 with an intake of 40 students. The department has grown strong over the last 52 years and today has an intake of 180 students and 50 teaching staff. All the faculty members are well qualified and possess post graduate degree with 20 doctorates. The department offers four-year degree course and also offers two Master's Degree in Manufacturing Science & Engineering and Computer Integrated Manufacturing, with an intake of 18 each. The Department also offers research program which includes MSc Engineering by research and PhD degree from Visvesvaraya Technological University and at present 24 researchers are pursuing PhD. The department received software grants from Autodesk a leading Computer Aided Design multinational company and has been using them in the curriculum. The faculty members have taken up number of research projects funded by external agencies like DRDO, DST, AICTE and Visvesvaraya Technological University and received funding to the tune of 1 Crore. In view of the golden jubilee celebrations, the department has conducted a national level project exhibition and an International Conference on "Challenges and Opportunities in Mechanical Engineering, Industrial Engineering and Management Studies" – ICCOMIM. Faculty members from the department have published books on different domains of Mechanical Engineering and are recommended by Visvesvaraya Technological University Board of Studies as reference text books.

The students from the department participate both at the national and international competition throughout the year, in the year 2013 – AeRobusta – 4-member student team from the department participated in SAE Aero Design competition and stood 18th position out of 64 teams from all over the world. The team AeRobusta stood FIRST AMONG THE ASIAN COUNTRIES.

Another team from the department also participated in the "Unmanned Air Vehicle System "conducted by U.S. Navy at Maryland, USA. The team secured 5th Place in the technical session out of 36 participating teams from all over the world.

A team of two students also participated in the CAD Design Competition conducted by Autodesk, a CAD multinational company, in association with IIT Madras and secured FIRST PLACE among the teams from all over India with a cash prize of Rs1,20,000 and also received a free Trip to Autodesk University, held at Las Vegas, USA.

VISION OF THE INSTITUTE

To be an Institution of International Eminence, renowned for imparting quality technical education, cutting edge research and innovation to meet global socio economic needs

MISSION OF THE INSTITUTE

MSRIT shall meet the global socio-economic needs through

- Imparting quality technical education by nurturing a conducive learning environment through continuous improvement and customization
- Establishing research clusters in emerging areas in collaboration with globally reputed organizations
- Establishing innovative skills development, techno-entrepreneurial activities and consultancy for socio-economic needs

QUALITY POLICY

We at M S Ramaiah Institute of Technology strive to deliver comprehensive, continually enhanced, global quality technical and management education through an established Quality Management System complemented by the synergistic interaction of the stake holders concerned

VISION OF THE DEPARTMENT

To be a centre of International repute in Mechanical Engineering and to create qualified human resources needed to meet the demanding challenges in different areas and emerging fields of Mechanical Engineering and allied sciences.

MISSION OF THE DEPARTMENT

To impart quality technical education to meet the growing needs of the profession through conducive and creative learning environment, to produce qualified and skilled human resources, create R&D environment, to be a centre of excellence and to offer post graduate programs in the emerging fields of Mechanical Engineering.

Program Educational Objectives (PEOs)

To produce engineers with sound basic theoretical knowledge along with required practical skills in various specialized fields of Mechanical Engineering.

To inculcate team work capabilities and communication skills among students through co-curricular activities.

To motivate students for higher studies in specialised areas of Mechanical Engineering and explore possible profession in R & D, academic and self-employment opportunities.

To bring in awareness on environmental issues and commitments towards Professional ethics, social responsibilities and need for lifelong learning

PROGRAM OUTCOMES (POs):

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.

PO4: 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.

PO9: 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 clear instructions.

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.

PSOs of the program offered

Mechanical Engineering Graduates will be able to:

PSO1: Ability to apply their knowledge in engineering mechanics, materials science, design, thermal engineering, production, management, CAD/CAM, robotics - on an applied basis.

PSO2: Ability to apply the learned principles to the analysis, design, development and implementation to advanced mechanical systems and processes, be prepared to work professionally in Mechanical Engineering domain.

Semester wise Credit Breakdown for B E Degree Curriculum

Batch 2018-22

Semester / Course Category	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth	Total Credits
Basic Sciences (BSC)	9	8	4	4					**25**
Engineering Sciences (ESC)	11	10							**21**
Humanities, Social Sciences and Management (HSMC)		2			3		3		**8**
Professional Courses – Core (PCC)			21	21	15	11	10		**78**
Professional Courses– Elective (PEC)					3	3	6	3	**15**
Other Open Elective Courses (OEC)					3	3			**6**
Project Work (PROJ), Internship (IN)						4	1	17	**22**
Total Credits	**20**	**20**	**25**	**25**	**24**	**21**	**20**	**20**	**175**

III SEMESTER B.E. MECHANICAL ENGINEERING

Sl.No	Course Code	Course Name	Category	Credits			
				L	T	P	Total
1	ME31	Engg. Mathematics III	BSC	3	1	0	4
2	ME32	Materials science & Metallurgy	PCC	4	0	0	4
3	ME33	Basic Thermodynamics		3	1	0	4
4	ME34	Mechanics of Materials		4	0	0	4
5	ME35	Manufacturing Process-I		4	0	0	4
6	ME36	Energy Engineering		3	0	0	3
7	MEL37	Materials Testing Laboratory		0	0	1	1
8	MEL38	Computer Aided Machine Drawing		0	0	1	1
9	AM01*	Additional Mathematics - I	BSC	3	0	0	0
Total				**24**	**2**	**2**	**25**

* Non Credit Mandatory Course L – Lecture (one hour) T - Tutorial (Two hours) P - Practical (Two hours)

Note:

1. The Non Credit Mandatory Course, Additional Mathematics – I is prescribed for III Semester Lateral Entry Diploma students admitted to III Semester of BE Program. The student shall register for this course along with other III semester courses. The students shall attend classes for the course during the semester and complete all formalities of attendance and CIE to appear for SEE. This Course shall not be considered for vertical progression, but completion of the course shall be mandatory for the award of the degree.
2. **AICTE Activity Points to be earned by students admitted to BE program (For more details refer to Chapter 6, AICTE, Activity Point Program, Model Internship Guidelines):**
   Every regular student, who is admitted to the 4 year degree program, is required to earn 100 activity points in addition to the total credits earned for the program. Students entering 4 years Degree Program through lateral entry are required to earn 75 activity points in addition to the total credits earned for the program. Students transferred from other Universities/Colleges to 5th Semester are required to earn 50 activity points from the year of entry to VTU. The activity points earned by the student shall be reflected on the students 8th Semester grade card. The activities to earn the points can be spread over the duration of the course. However, minimum prescribed duration should be fulfilled. Activity Points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression.
   Incase student fail to earn the prescribed activity points, Eight semester Grade Card shall be issued only after earning the required activity Points. Students shall be eligible for the award of degree only after the release of the Eight Semester grade card.

IV SEMESTER B.E. MECHANICAL ENGINEERING

Sl.No	Course Code	Course Name	Category	Credits			
				L	T	P	Total
1	ME41	Engg. Mathematics IV	BSC	3	1	0	4
2	ME42	Manufacturing Process II	PCC	4	0	0	4
3	ME43	Applied Thermodynamics		3	1	0	4
4	ME44	Kinematics of Machines		4	0	0	4
5	ME45	Fluid Mechanics		4	0	0	4
6	ME46	Mechanical Measurements & Metrology		3	0	0	3
7	MEL47	Applied Thermodynamics Laboratory		0	0	1	1
8	MEL48	Manufacturing Process Laboratory – I		0	0	1	1
9	AM02*	Additional Mathematics - II	BSC	3	0	0	0
		Total		**24**	**2**	**2**	**25**

* Non Credit Mandatory Course L – Lecture (one hour) T - Tutorial (Two hours) P - Practical (Two hours)

Note:

1. The Non Credit Mandatory Course, Additional Mathematics – II is prescribed for IV Semester Lateral Entry Diploma students admitted to BE Program. The student shall register for this course along with other IV semester courses. The students shall attend classes for the course during the semester and complete all formalities of attendance and CIE to appear for SEE. This Course shall not be considered for vertical progression, but completion of the course shall be mandatory for the award of the degree.
2. **AICTE Activity Points to be earned by students admitted to BE program (For more details refer to Chapter 6, AICTE, Activity Point Program, Model Internship Guidelines):**
   Every regular student, who is admitted to the 4 year degree program, is required to earn 100 activity points in addition to the total credits earned for the program. Students entering 4 years Degree Program through lateral entry are required to earn 75 activity points in addition to the total credits earned for the program. Students transferred from other Universities/Colleges to 5th Semester are required to earn 50 activity points from the year of entry to VTU. The activity points earned by the student shall be reflected on the students 8th Semester grade card. The activities to earn the points can be spread over the duration of the course. However, minimum prescribed duration should be fulfilled. Activity Points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression.
   Incase student fail to earn the prescribed activity points, Eight semester Grade Card shall be issued only after earning the required activity Points. Students shall be eligible for the award of degree only after the release of the Eight Semester grade card.

III SEMESTER B.E. MECHANICAL ENGINEERING SYLLABUS

ENGINEERING MATHEMATICS-III

Course Code:ME31 **Course Credits: 3:1:0**

Prerequisite:Calculus **Contact Hours:42 L+14T = 56**

Course Coordinators: Dr. G. NEERAJA & Mr. VIJAYA KUMAR

- **Course Learning Objectives:**

The students will

1) Learn to solve algebraic, transcendental and ordinary differential equations numerically.
2) Learn to fit a least squares curve and find correlation and regression for a statistical data.
3) Learn the concepts of consistency and solve linear system of equations and system of ODE's using matrix method.
4) Learn to test for convergence of positive terms and to represent a periodic function in terms of sine and cosine functions.
5) Understand the concepts of calculus of functions of complex variables.

UNIT I

Numerical solution of Algebraic and Transcendental equations: Method of false position, Newton - Raphson method.

Numerical solution of Ordinary differential equations: Taylor's series method, Euler's & modified Euler's method, Fourth order Runge-Kutta method.

Statistics: Curve fitting by the method of least squares, Fitting linear, quadratic and geometric curves, Correlation and Regression.

UNIT II

Linear Algebra: Elementary transformations on a matrix, Echelon form of a matrix, Rank of a matrix, Consistency of system of linear equations, Gauss elimination and Gauss – Seidel method to solve system of linear equations, Eigen values and Eigen vectors of a matrix, Rayleigh power method to determine the dominant Eigen value of a matrix, Diagonalization of a matrix, Solution of system of ODE's using matrix method.

UNIT III

Fourier Series: Convergence and divergence of infinite series of positive terms. Periodic functions, Dirichlet's conditions, Fourier series of periodic functions of period 2π and arbitrary period, Half range Fourier series, Practical harmonic analysis.

UNIT IV

Complex Variables - I: Functions of complex variables, Analytic function, Cauchy-Riemann Equations in Cartesian and polar coordinates, Consequences of Cauchy-Riemann Equations, Construction of analytic functions.

Transformations: Conformal transformation, Discussion of the transformations $w = e^z$, $w = z^2$ and $w = z + \frac{a^2}{z}$, $(z \neq 0)$, Bilinear transformations.

UNIT V

Complex Variables-II: Complex integration, Cauchy theorem, Cauchy integral formula. Taylor's & Laurent's series (statements only). Singularities, poles and residues, Cauchy residue theorem (statement only).

TEXT BOOKS:

1. Erwin Kreyszig –Advanced Engineering Mathematics – Wiley publication – 10th edition-2015.
2. B. S. Grewal –Higher Engineering Mathematics – Khanna Publishers – 44th edition – 2017.

REFERENCE BOOKS:

1. David C. Lay – Linear Algebra and its Applications – Pearson Education – 3rd edition – 2011.
2. Glyn James – Advanced Modern Engineering Mathematics – Pearson Education – 4th edition – 2010.
3. Dennis G. Zill and Patric D. Shanahan- A first course in complex analysis with applications- Jones and Bartlett publishers – 2nd edition–2009.

Course Learning Outcomes (COs):

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

1. Apply numerical techniques to solve engineering problems and fit a least squares curve to the given data.[PO1,PO2,PSO1 & PSO2]
2. Test the system of linear equations for consistency and solve ODE's using matrix method. [PO1,PO2,PSO1 & PSO2]
3. Construct the Fourier series expansion of a function/tabulated data. [PO1,PO2,PSO1 & PSO2]
4. Examine and construct analytic functions. [PO1,PO2,PSO1 & PSO2]
5. Classify singularities of complex functions and evaluate complex integrals. [PO1,PO2,PSO1 & PSO2]

MATERIAL SCIENCE & METALLURGY

Course Code: ME32 **Course Credits: 4:0:0**
Prerequisite: Nil **Contact Hours: 56**
Course Coordinator: Dr K R PHANEESH

Preamble

In this advanced age that we live in, a wide array of materials are used all around us and at the same time a constant challenge is being posed by the ever increasing demands for better materials of greater strength, lightness, hardenability, cutting power, toughness, cost-effectiveness, resistance to corrosion & heat, and so on. The main objectives of this subject to make the students understand and appreciate the properties of materials at both macro and at micro levels in a way that it would help them conceive and build these materials. Without adequate information and knowledge, the selection of appropriate materials for the specific applications would not become an optimized one resulting in products which minimize profit and utility of the end product. The subject gives an introduction about the correlations that exist between composition, structure, property and applications of engineering materials.

Course Learning Objectives

1. To introduce students to the fundamentals of structure-property correlation by familiarizing them with crystalline materials, their properties and their defects.
2. To make students learn the basics of stress-strain diagrams and properties associated with them. To also introduce students to failure in crystalline materials due to creep and fatigue.
3. To give an introduction to the studies of solidification, solid solutions and phase diagrams. To solve problems in phase-diagrams.
4. To understand the importance of Fe-C equilibrium diagram and the TTT diagrams and the difference between them to get an introduction to the various heat treatment processes and to understand the world of important engineering alloys and composites regarding their production and applications.
5. To learn the role of engineering materials in shaping products having desired mechanical properties by understanding their compositions, structures, defects and properties.

UNIT I

Structure of crystalline solids: Fundamental concepts of unit cell space lattice, Bravais space lattices, unit cells for cubic structure & HCP, calculations of radius, Coordination Number and Atomic Packing Factor for different cubic structures.
Crystal imperfections: Classification, point, line, surface & volume defects, Diffusion, Diffusion mechanisms, and factors affecting diffusion, Fick's laws of diffusion Stress & Strain: - Stress strain diagrams to show ductile & brittle behavior of metals. Linear & non-linear elastic properties,

UNIT II

True stress & strain, Plastic deformation of single crystals: Concept of true stress and strain, Plastic deformation of metals by slip and twinning, strain hardening, mechanism of strain hardening.
Fracture& Creep: types, transition from ductile to brittle fracture, Fatigue, types of fatigue load, mechanism of fatigue failure, fatigue properties, S-N diagram, factors affecting fatigue strength Creep:- Definition, Three stages of creep, creep properties,

UNIT III

Solidification, **Solid solutions & Phase diagrams:** Nucleation, homogeneous & heterogeneous nucleation, crystal growth, cast metal structures. Solid solutions, Types, Rules governing the formation of solids solutions.

Phase diagrams: Basic terms, phase rule, Lever rule, cooling curves, construction of phase diagrams, Types of phase diagrams, interpretation of equilibrium diagrams - eutectic, eutectoid, peritectic & peritectoid, problems in phase diagrams.

UNIT IV

Iron carbon equilibrium diagram& TTT diagram: Equilibrium phases in the Fe-C system, Invariant reactions, Microstructure of slowly cooled steels, TTT diagram, construction of TTT diagram, Superimposing cooling curves on TTT diagram, non-equilibrium phases in Fe-C system, CCT diagram.

Heat Treatment: Annealing and its types, Normalizing, Hardening, Tempering, Martempering, Austempering, Surface hardening like case hardening, carburizing, cyaniding, nitriding, Induction hardening, hardenability, Jominy end-quench test, Age hardening taking the example of duralumin.

UNIT V

Engineering Alloys: Properties, composition and uses of low carbon, mild, medium & high carbon steels. Cast irons, gray CI, white CI, malleable CI, Spheroidal Graphite iron. Microstructures of cast irons, Al & Mg & Titanium alloys, Copper & its alloys, brasses and bronzes.

Composite Materials: Definitions, classification, types of matrix materials and reinforcements, fundamentals of production of FRP's - hand lay-up technique, bag moulding, filament winding and Pultrusion processes, advantages and applications of composites.

TEXT BOOKS:

1. Introduction to Material Science for Engineering, 6th edition, James F.Shackel Ford, Pearson, Prentice Hall, New Jersey, 2006.
2. Physical Metallurgy, Principles & Practices, V.Raghavan, PHI, 2nd edition, 2006,New Delhi.

REFERENCE BOOKS:

1. Materials Science & Engineering- An Introduction, William D.Callister Jr., Wiley,India Pvt. Ltd., 6th edition, 2006, New Delhi.
2. Essentials of Materials for Science And Engineering, Donald R. Askeland, PradeepP.Phule Thomson-Engineering, 2nd edition 2006
3. Foundation of Material Science and Engineering, Smith, 3rdEdition,McGraw Hill,1997 edition.

Course Learning Outcomes (COs):

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

1. **Discuss** the concept of crystal structure, crystal imperfections and Mechanical properties in metals. [PO1,PO2,PO4,PO7,PO8,PO11, PSO1 & PSO2]
2. **Explain** the concept of true stress and true strain, plastic deformation and various modes of failure. [PO1,PO2,PO4,PO7,PO8,PO11 & PSO2]
3. **Summarize** the solidification of metals and alloys and classify draw phase diagrams. [PO1,PO2,PO4,PO7,PO8,PO11, PSO1 & PSO2]
4. **Distinguish** between various heat treatment processes for metals and alloys [PO1,PO2,PO4,PO7,PO8,PO11, PSO1 & PSO2]
5. **Examine** composite manufacturing processes and list advantages and applications of engineering and composite materials[PO1,PO2,PO4,PO7,PO8,PO11, PSO1 & PSO2]

BASIC THERMODYNAMICS

Course Code: ME 33 **Course Credits: 3:1:0**
Prerequisite:Nil **Contact Hours:42 L+14T = 56**
Course Coordinator: Mr ASHOK KUMAR K

Course Learning Objectives

1. To learn the fundamental concepts of thermodynamics and related definitions to understand the temperature concept, thermodynamic properties, state, system, equilibrium, work and heat
2. To understand the concept of law of conservation of energy for a process or cycle and to create awareness of principle of working of various thermodynamic systems to learn their practical applications.
3. To learn the principle of entropy, availability, irreversibility and combustion thermodynamics
4. To study the behavior of pure substance, ideal and real gases during various thermodynamic processes and to study change in various properties.
5. Prepare students to apply principle of thermodynamics to solve numerical and design problems of various thermodynamic processes and systems to provide useful solutions.

UNIT I

Fundamental concepts and definitions: Thermodynamics; definition and scope, microscopic and macroscopic approaches, types of system, thermodynamic properties, thermodynamic state, path and process, path and point function, quasistatic process, cyclic and non cyclic processes, thermodynamic equilibrium, Zeroth law of thermodynamics, Temperature concepts and scales, Comparison of temperature scales,

Work and heat, Thermodynamic definition of work, expressions for displacement work in various processes through p v diagrams, electrical work, shaft work, paddle wheel work, flow work, heat definition, unit and sign convention, equivalence of heat and work

UNIT II

First Law of Thermodynamics: Statement of first law of thermodynamics, extension of first law to non cyclic processes, energy, energy as a property of the system, enthalpy, specific heat at constant volume and constant pressure, Steady state, steady flow energy equation, some important applications

Second Law of thermodynamics: Thermal reservoir, Heat engine, schematic representation and efficiency, reversed heat engine, schematic representation and coefficient of performance, Kelvin-Planck statement and Clasius' statement of second law of thermodynamics, PMMI and PMMII, equivalence of the two statements, reversible and irreversible processes, factors that make a process irreversible, reversible heat engines, carnot cycle, carnot principle, thermodynamic temperature scale.

UNIT III

Entropy: Clasius' inequality; statement, proof, application to a reversible cycle, entropy a property, entropy definition, principle of increase of entropy, calculation of entropy using T dS relations, entropy as a coordinate.

Availability and Irreversibility: Maximum work, maximum useful work for a system and a control volume, availability of a system and a steadily flowing stream, irreversibility, second law efficiency.

UNIT IV

Pure substance: P-T and P-V diagrams, triple point and critical points, subcooled liquid, saturated liquid, mixture of saturated liquid and vapour, saturated vapour and superheated vapour states of a pure substance with water as example. Enthalpy of change of phase (Latent heat), dryness fraction, T-S and h-s diagrams, representation of various processes on these diagrams, throttling calorimeter, separating and throttling calorimeter

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. Numerical problems

UNIT V

Ideal and Real 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, internal energy and enthalpy as functions of temperature only, universal and particular gas constants, evaluation of heat, work, change in internal energy, enthalpy and entropy in various quasistatic processes, ideal gas mixture; Dalton's law of additive pressure, Amagat's law of additive volumes, evaluation of properties, analysis of various processes.

TEXT BOOKS:

1. Fundamental of Classical Thermodynamics- G J Van Wylen and R E Sonntag, Wiley Eastern. 1st edition, 2002

2. Basic and Applied Thermodynamics- P K Nag, Tata McGrawHill, 3rd edition., 2002

REFERENCE BOOKS:

1. Thermodynamics an engineering approach-Yunus A Cenegal and Michael A Boles. Tata McGraw hill Pub. 1st edition 2002
2. Engineering Thermodynamics- Rajput, Laxmi publications Pvt Ltd, 3rd Edition., 2007

Course Learning Outcomes (COs):

Students will be able to

1. **Analyze** problems on temperature scale, work and heat, understand principles of thermodynamics in engineering applications. [PO1,PO2,PO3,PO4,PO5, PO12, PSO1 & PSO2]
2. **Solve** problems associated with various thermodynamic processes and calculate properties of the thermodynamic system during execution of process or cycle. [PO1,PO2,PO3,PO4,PO5, PSO1 & PSO2]
3. **Apply** the concept of entropy principle to calculate entropy during the execution of a process or cycle and demonstrate the concept of availability and irreversibility[PO1,PO2,PO3,PO4, PSO1 & PSO2]
4. **Analyze** the behavior of working fluid in thermodynamic system during a process or cycle and solve the problems related to combustion thermodynamics, Ideal and Real gases[PO1,PO2,PO3,PO4,PO7, PO12, PSO1 & PSO2]
5. **Develop** a capability to apply principles of thermodynamics to solve numerical and design problems of engineering devices and provide useful solutions. [PO1,PO2,PO3,PO4,PO5,PO7, PO12, PSO1 & PSO2]

MECHANICS OF MATERIALS

Course Code: ME34 **Course Credits: 4:0:0**
Prerequisite: Nil **Contact Hours:** 56
Course Coordinator: Dr ARUN KUMAR P C

Course Learning Objectives

1. Introduce the basic concepts of mechanics of materials like stress, strain, material constants, thermal stresses and stresses in composite sections.
2. Impart the knowledge of compound stresses, Mohr's circle diagram and stresses in thick and thin cylinders.
3. Develop understanding of shear force and bending moment diagrams when beams are subjected to various types of loads.
4. Impart the knowledge of bending and shear stresses induced in the beams.
5. Understanding the concepts of torsion of shafts, deflection of beams, columns and struts for solving problems of practical interest.

Preamble

In the present context of mechanical engineering curriculum the course on Mechanics of Materials provides the mechanical engineer with an approach to understand behavior of various components under stress when loaded. With the advances being made in the areas of manufacturing, design and automotive engineering newer and efficient design of machinery and equipment's require an in depth knowledge of behavior of components under stressed condition within elastic limit. The various topics of practical interest give the students a deeper insight into the behavior of beams, shafts and cylinders when loaded during service.

UNIT I

Simple stress and strain: Introduction, stress, strain, mechanical properties of materials, linear elasticity, Hook's law and poisons 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, Volumetric strain, expression for volumetric strain. Stress in composite section, Elastic constants, simple shear stress, shear strain, temperature stresses (including compound bars)

UNIT II

Compound stresses: Introduction, plane stress, stresses on inclined sections, principal stresses and maximum shear stresses, Mohr's circle for plane stress.

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) (Compound cylinders not included)

UNIT III

Bending moment and shear force in beams : Introduction, 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, uniformly distributed load (UDL),uniformly varying load(UVL)and couple for different types of beams.

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, shear stresses in beams, shear stress across rectangular, I Section, T Section & circular sections.

UNIT V

Deflection of beams: Introduction, differential equation for deflection, equations for deflections, slope and moments, double integration method for cantilever and simply supported beams for point load, UDL. Macaulay's Method.

Torsion of circular shafts and elastic stability of columns: Introduction, pure torsion, assumptions, derivation of torsional equations, polar modulus, torsional rigidity / stiffness of shafts, power transmitted by solid and hollow circular shafts. Introduction to columns, Euler's theory for axially loaded elastic long columns, derivation of Euler's load for various end conditions, limitations of Euler's theory, Rankine's formula.

TEXT BOOKS:

1. Mechanics of materials, S.I units, Ferdinand Beer & Russell Johnston, TATA McGrawHill – 1st edition 2003
2. Strength of materials, W.A Nash , Schaums outline series , 4th edition – 2007

REFERENCE BOOKS:

1. Mechanics of materials, K.V. Rao, G.C. Raju, 1st edition, 2007
2. Strength of materials, Ramamrutham, 5th edition 2006.

Course Learning Outcomes (COs):

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

1) **Develop** an understanding the concepts of mechanics of materials like stress, strain, material constants, thermal stresses and stresses in composite sections. [PO1,PO2,PO3,PO4,PO5,PO12,PSO1 & PSO2]
2) **Compile** the concepts of compound stresses, Mohr's circle diagram and stresses in thick and thin cylinders. [PO1,PO2,PO3,PO4,PO5,PO12,PSO1 & PSO2]
3) **Develop** ability in identifying the problem and apply the fundamental concepts of shear force and bending moment diagrams when beams are subjected to various types of loads. [PO1,PO2,PO3,PO4,PO5,PO12,PSO1 & PSO2]
4) **Develop** competence in understanding the concepts of bending and shear stresses induced in the beams for solving engineering problems. [PO1,PO2,PO3,PO4,PO5,PO12,PSO1 & PSO2]
5) **Demonstrate** the ability to have the competence in understanding the concepts of torsion of shafts, columns and struts for solving practical problems[PO1,PO2,PO3,PO4,PO5,PO12,PSO1 & PSO2]

MANUFACTURING PROCESS – I

Course Code: ME 35 **Course Credits: 4:0:0**
Prerequisite : Nil **Contact Hours: 56**
Course Coordinator: Mr BHARATH M R

Preamble
The present course on manufacturing process-I, provide the mechanical engineer with an approach to understand different methods of transforming raw material to finished goods. Various methods include – Foundry, welding, machining, forming processes etc. In this course, foundry and welding processes are being studied. With the advances being made in the areas of manufacturing engineering newer and efficient methods and equipment are developed. The different topics of practical interest give the students a better insight into the advances in the field of manufacturing.

Course Learning Objectives

1. Moulding methods, types of moulds, Cores, core making, Gating Systems, types of Casting, Melting furnaces, defects in Casting and Inspection methods
2. Forging methods, forging analysis, Concept of friction hill, Material flow lines, drawing process, types of drawing process and defects in forging and drawing process and sheet metal.
3. Extrusion and Rolling process, defects in extrusion, Rolling and sheet metal.
4. Welding processes, Classification and Special Welding processes like EWB, EBM, thermit, Friction and Laser welding.
5. Structure and solidification of weld, welding characteristics of different materials, Non-destructive Inspection methods.

UNIT- I

Casting Process:
Introduction to Casting- Casting, Steps involved in casting, Advantages and limitations of casting.
Pattern Making- Types of pattern, allowance, materials and BIS color code. Types of Molding sands, ingredients of molding sands and its properties. Core sand ingredients and properties. Core Making, Core blowing Machine, Core baking, Dielectric baking of cores.
Gating System – definition, elements of gating system, functions and gating ratio
Molding Methods- Green molding, hand and machine molding. Jolt and Jolt-Squeeze Machine and Sand slingers. No bake sand Molding: Ingredients and properties, CO_2 Silicate Molding, Shell Molding and investment casting.
Melting Furnaces- Classification of Furnaces, Oil fired furnaces, Electric furnaces Arc, resistance and Induction furnaces. Cupola construction, preparation and operation of conventional Cupola
Cleaning and Inspection- Casting and fettling operations, Defects in Casting, Causes and remedies.

UNIT- II

Forming Process:
Introduction to forming- Forming, classification, Characteristics of wrought products, Advantages, limitations and applications.

Forging- Classification of forging processes, forging machines & equipment, Concepts of friction hill and factors affecting it, Die-design parameters, Material flow lines in forging, Forging defects.
Drawing- Steps involved in wire drawing, drawing die details, Types of tube drawing processes,Frictionless drawing of cylindrical rod.

UNIT- III

Extrusion- Types of extrusion processes, Variables involved in extrusion process, Relation between variables in extrusion, Special type of extrusion processes, Metal flow pattern in extrusion, Defects in extruded products.
Rolling- Classification of rolling processes. Types of rolling mills, Metal flow pattern in rolling, friction hill, Defects in rolled products, Rolling variables.
Sheet metal forming- Definition of sheet metal, Material used for sheet metal, Sheet metal operations, Classification of power presses.

UNIT - IV

Fabrication Process:

Welding- Introduction, classification – preparation of base metal and joint, Fluxes need and types. Principles, applications and parameters in practice of Gas, TIG, MIG, SAW, FCAW, Electro slag welding, Atomic Hydrogen welding.

Other Welding Processes- Principle and applications of resistance welding, Spot, Seam, Projection Welding, Thermit Welding, Friction welding, Explosive Welding, Ultrasonic welding, Electron Beam Welding, Laser Welding.

UNIT- V

Metallurgical aspects of Welding- Solidification and structure of welds, Heat affected Zone, Residual stress, weldability and weldability testing, welding characteristics of ferrous and nonferrous metals, welding defects.
NDT for Casting, Forming and Welding processes- Nondestructive Testing, X –Ray radiography, dye penetrant test, Ultrasonic test, Magnetic particle Inspection, Eddy Current testing, Holography methods of Inspection.

TEXT BOOKS:

1. Manufacturing Technology : Foundry Forming and Welding, P.N.Rao 2nd Edition TMH,2003
2. Manufacturing Technology", Serope Kalpakjain, Steuen.R.Sechmid, Pearson Education Asia, 5th Ed. 2006..
3. Mechanical metallurgy by George E. Dieter Tata McGraw - Hill publication. 3rd edition 2013.
4. Manufacturing Processes for Engineering materials by Serope kalpakajiam and Steven R Schimid, Pearson education, 4th edition 2007.
5. Manufacturing Process-III, By Dr.Radha Krishna, Sudha Publications.2010.

REFERENCE BOOKS:

1) Materials and Process of Manufacture, Roy A Lindberg, PHI Publications, 2nd edition 2006.
2) Principal of Metal Casting, Heine, Loper, Philip Rosenthal, TMH. 1st edition2005.
3) Materials & Processes in Manufacturing *by* Paul Degarmo E, Jt Black, Ronald A Kohser. Prentice -hall of India, 8th edition 2006
4) Manufacturing Science, by AsokKumarMallik &Amitabha Ghosh – Affiliated East-west Press Pvt Ltd, 2nd edition 2012.
5) Fundamentals of Metal forming processes, B.L.Juneja, First edition New age International, 2007.
6) Theory of Plasticity and Metal forming Processes, Dr.Ssadhu singh, Khanna Publishers, 3rd edition 2003
7) Metal Forming processes, by G.R Nagpal, Khanna Publishers,Second edition, 2005.

Course Learning Outcomes

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

1. **Identify** the steps in making of casting, selection of melting furnace: analyze the defects and suggest remedies[PO1, PO3,PO6,PO7, PO12, PSO1 & PSO2]
2. **Select** suitable forging and drawing methods for different materials to get defect free products[PO1, PO3,PO6,PO7, PO12, PSO1 & PSO2]
3. **Select** different extrusion and rolling process for different materials for various types of engineering products[PO1, PO3,PO6,PO7, PO12, PSO1 & PSO2]
4. **Select** safe, economical ecofriendly, hazard free welding process for sustainable product development**.** [PO1, PO3,PO6,PO7, PO12, PSO1 & PSO2]
5. **Summarize** welding defects and welding characteristics and apply NDT techniques for quality assurance of cast and welded components. [PO1,PO2, PO3,PO4, PO6,PO7, PO12, PSO1 & PSO2]

ENERGY ENGINEERING

Course Code: ME36 **Course Credits: 3:0:0**
Prerequisite: Nil **Contact Hours:42**
Course Coordinator: Dr VEERANA B NASI

Preamble

Energy is an important sector and knowledge in power plant technologies and non-conventional energy sources is essential for the students of mechanical engineering. Energy engineering deals with the construction and working of steam power plants, Diesel engine power plants, hydroelectric power plants and nuclear power plants. In view of present trends towards adopting renewable and green energy, sources such as solar, wind, bio-mass, ocean, geothermal, fuel cells and hydrogen have been included. Overall, this course provides students the basic understanding of the various commonly used conventional and non-conventional power generation technologies.

Course Learning Objectives

1. To Study the construction and working of steam power plants, Diesel power plants, hydro electric power plants and nuclear power plants.
2. To Study solar thermal and photo voltaic energy conversion.
3. To Study wind energy, biomass, ocean and geothermal energy conversion technologies.
4. To Study fuel cells and hydrogen energy conversion.
5. To Study the importance and applications of various renewable and green energy technologies.

UNIT I

Steam Power Plant: Different types of fuels used for steam generation, equipment for burning coal in lump form, different types of stockers, oil burners, advantages and disadvantages of using pulverized fuel, equipment for preparation and burning of pulverized coal, unit system and bin system. pulverized fuel furnaces, cyclone furnace, coal and ash handling, generation of steam using forced circulation, high and supercritical pressures, brief account of Benson, Velox, Schmidt steam generators. chimneys: natural, forced, induced and balanced draft, calculations involving height of chimney to produce a given draft. cooling towers and Ponds. Accessories for steam generators such as super-heaters, de-superheaters, economizers, air pre-heaters and re-heaters.

UNIT II

Diesel Engine Power Plant- Applications of diesel engines, layout of diesel power plant, methods of starting diesel engines, cooling and lubrication system for the diesel engine, filters, centrifuges, oil heaters, intake and exhaust system.

Hydro-Electric Plants: Storage and pondage, flow duration and mass curves, hydrographs, general layout of hydro-electric power plant, low, medium and high head plants, pumped storage plants, penstock, water hammer, surge tanks, gates and valves, power house.

UNIT III

Nuclear Power Plant: Elements of the nuclear reactor, brief description of reactors of the following types - pressurized water reactor, boiling water reactor, sodium graphite reactor, fast breeder reactor, homogeneous graphite reactor and gas cooled reactor, radiation hazards, shielding, radioactive waste disposal.

Geothermal Energy Conversion: Principle of working, types of geothermal stations with schematic diagrams, problems associated with geothermal conversion, scope of geothermal energy.

UNIT IV

Solar Energy – Solar radiation outside the earth's atmosphere, solar radiation at the earth surface, solar radiation measurement, working principles of solar flat plate collectors, solar air heaters, thermal energy storage, solar pond and photovoltaic conversion.

Wind Energy: Properties of wind, wind velocity and power from wind, major problems associated with wind power, types of wind machines and their characteristics, horizontal and vertical axis wind mills.

Fuel cells: Principles of working, advantages, disadvantages and applications.

UNIT V

Energy from Ocean: Tides and waves as energy suppliers and their mechanics, fundamental characteristics of tidal power, harnessing tidal energy, limitations. ocean thermal energy conversion: principle of working, problems associated with OTEC.

Energy from Bio-mass: Bio gas production from organic wastes by anaerobic fermentation, description of bio gas plants, transportation of bio-gas, problems involved with bio-gas production, applications of bio-gas.

Hydrogen energy: Production, storage, safety, advantages, disadvantages, applications.

TEXT BOOKS:

1. Power Plant Engineering, P.K.Nag Tata McGraw Hill 2nd edition 2001.
2. Non conventional resources: B H Khan Tata McGraw Hill 1st edition– 2007

REFERENCE BOOKS:

1. Power Plant Engineering by R.K.Rajput, Laxmi publication, New Delhi.
2. Principles of Energy conversion, A.W.Culp Jr., McGraw Hill. 1996
3. Power Plant Engineering by Domakundawar, Dhanpath Rai sons. 2003
4. Non conventional Energy sources by G D Rai Khanna Publishers.

Course Learning Outcomes (COs):
At the end of the course, the students will be able to

1. **Understand** the concept of construction & working of conventional & non conventional energy resource based power plants[PO1,PO2,PO6,PO7, PO12,PSO1 &PSO2]
2. **Describe** recent advancements in conventional & non conventional energy resources and their effective utilization for power generation. [PO1,PO2,PO7, PO12,PSO1 &PSO2]

3. **Analyze** aspects related to harnessing energy from non-conventional energy sources. [PO1,PO2,PO6,PO7, PO11, PO12,PSO1 &PSO2]

4. **Evaluate** the present state of technologies, dealing non conventional energy sources as cost-effective power generation alternatives. [PO1,PO2,PO6,PO7, PO11, PO12,PSO1 &PSO2]

5. **Develop** concept of model, analyze and design of solar, wind and biomass energy systems. [PO1,PO2, PO7, PO12,PSO1 &PSO2]

MATERIALS TESTING LABORATORY

Course Code: MEL 37 **Course Credits: 0:0:1**
Prerequisite:Nil **Contact Hours:14**
Course Coordinator: Mr P N GIRISH BABU L

Preamble
This laboratory course provides an integrated approach to materials science and engineering. The laboratory examines the important relationships between microstructure and the properties of materials. The course provides an introduction to basic characterization techniques for materials, such as microscopy and testing such as tension test, compression test, bending, shear, hardness test, torsion test, impact test etc.

Course Learning Objectives

1. Find the various mechanical properties of the specimens, when they are subjected to compression, tension, bending, impact, torsion.
2. Examine the specimens by conducting hardness and wear tests.
3. Investigate the microstructure of different specimens using metallurgical microscope

PART - A.

Conduct the following experiments

1.Rockwell Hardness Test
2.Brinell Hardness Test
3.Vickers Hardness Test(Demo)
4.Charpy Impact Test
5. Izod impact test
6.Study of Metallurgical Microscope – Calibration of eyepiece reticle
7. Microstructure Examination

PART - B.

Conduct the following experiments

1.Tensile Test
2.Compression Test
3.Shear Test
4.Bending Test
5.Torsion Test
6.Wear Test
7.Fatigue Test(Demo)

TEXT BOOKS:

1 Mechanics of materials James M. Gere, Barry J. Goodno Publication CL Engineering; 8 edition, 2012. [PO1,PO3,PO7,PO8,PO10, PO12,PSO1 &PSO2]
2 Materials Science & Engineering- An Introduction, William D.Callister Jr. Publication Wiley, 9 edition , 2013[PO1,PO3,PO7,PO8,PO10, PO12,PSO1 &PSO2]
3 Materials testing laboratory manual , Department of Mechanical Engineering, MSRIT[PO1,PO3,PO7,PO8,PO10, PO12,PSO1 &PSO2]

Course Learning Outcomes (COs):

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

1. Demonstrate the knowledge and the skills required with respect to the procedure conduction and analysing the results with respect to Tensile, Shear and Compression, Torsion Test, Bending Test etc.
2. **Knowledge** of various heat treatment processes, hardness test, and wear test.
3. Microstructures examination and identification of metals.

Scheme of Examination

1. Students should have obtained not less than 85% attendance and 20 CIE Marks to become eligible for appearing the examination.
2. Student has to conduct two experiments (One group experiment and One individual experiment)

Max Marks:	**50**
Group Experiment:	**25**
Individual Experiment:	**15**
Viva-voce:	**10**
---	---
TOTAL:	**50**

COMPUTER AIDED MACHINE DRAWING

Course Code: MEL 38 **Course Credits: 0:0:1**
Prerequisite:CAED **Contact Hours:14**
Course Coordinator: Dr C M RAMESHA

Preamble
Drawing is the language of engineers. Especially it is true for Mechanical Engineers. Mechanical Engineers have an important task of converting concepts into reality. The job of a mechanical engineer becomes easy if he can clearly understand the drawing released by the design department. The basic objective of Machine drawing is to create and release the drawings which are unambiguous, crisp and clear to the personnel on the shop floor.

Course Learning Objectives:

1. **Draw** the sectional views of the solid and develop its lateral surface.
2. **Construct / create** three dimensional part models from the orthographic / sectional views of simple machine parts (required for assembly) using a CAD tool.
3. **Assemble** the 3-D part models using a CAD tool and **draw** the sectional view, orthographic views and Isometric view of the assembly including the bill of materials, section plane representation and ballooning.

PART A

Systems of dimensioning: Aligned dimensioning systems, chain dimensioning, unidirectional dimensioning, concepts of Limits Fits and Tolerance.

Sections of Solids: Sections of pyramids, Prisms, cubes, Tetrahedron, cones and cylinders resting only on their bases. (No problems on axis inclinations, spheres and hollow solids). True shape of sections.

Screw thread forms, Bolt, Nuts and screws

Developments of surfaces: Development of pyramids, Prisms, cubes, Tetrahedron, cones and cylinders and their frustums. Truncated solids.

3D Modeling: Create 3D Models from pictorial views of a simple machine components and convert them to orthographic views using 3D Modeling tool (Sketch Work – Show orthographic views)

PART B

Assembly Drawings: (Part Drawings should be given)
SCREW JACK.

Assembly Drawings: (Part Drawings should be given)
Plummer Block. (Pedestal Bearing)

TEXT BOOKS:

1. Computer Aided Machine Drawing K.R. Gopalkrishna, Subhash Publications, 2nd edition 2012.
2. Computer Aided Machine Drawing, Tryambaka Murthy.

REFERENCE BOOKS:

1. **Machine Drawing,** N.D. Bhatt & V.M. Panchal. 5th edition 2005
2. **Machine Drawing,** N. Siddeshwar, P.Kannaiah, V.V.S.Sastry, Tata Mc GrawHill, 2nd edition 2012
3. **Machine Drawing, Gupta**. 2nd edition 2006
4. **Machine Drawing,** Jones & Jones, 1st edition 2006

Course Learning Outcomes (COs):

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

1. **Draw** the sectional views of the solid and **develop** its lateral surface.[PO1,PO3,PO5,PO9,PO12,PSO1 &PSO2]
2. **Construct / Create** three dimensional part models from the orthographic / sectional views of simple machine parts (required for assembly) using a CAD tool. [PO1,PO3,PO5,PO9,PO12,PSO1 &PSO2]
3. **Assemble** the 3-D part models using a CAD tool and **Draw** the sectional view, orthographic views and Isometric view of the assembly including the bill of materials, section plane representation and ballooning. [PO1,PO3,PO5,PO9,PO12,PSO1 &PSO2]

Scheme of Examinations:

1. Students should have obtained not less than 85% attendance and 20 CIE Marks to become eligible for appearing End semester examination.
2. Students should complete the sketches before start to work on the computer.
3. Proportionate free hand sketch carries 40% marks and computer aided solutions with Print out carries 60% Marks
4. Students have to answer any two full questions out of Three questions; from PART A for 40 Marks (each question carry 20 Marks) and One full question from PART B for 60 Mark (each question carry 60 Marks)

Max Marks: 50 Marks

Question No: 1, 2, 3 each (10 Marks) PART A answer any TWO (20 Marks)
Question No: 4 and 5 each (30 Marks) PART B answer any ONE (30 Marks)

IV SEMESTER B.E. MECHANICAL ENGINEERING SYLLABUS

ENGINEERING MATHEMATICS-IV

Course Code: ME41 **Course Credits: 3:1:0**

Prerequisite:Calculus & Probability **Contact Hours:42 L+14T = 56**

Course Coordinators: Dr. G. NEERAJA & Mr. VIJAYA KUMAR

Course Learning Objectives:

The students will

1. Learn the concepts of finite differences, interpolation and their applications.
2. Learn the concepts of Fourier and Z transforms.
3. Understand the concept of PDE and its applications to engineering and concepts of random variables.
4. Learn the different probability distributions for discrete and continuous random variables and joint probability distribution.
5. Determine whether there is enough statistical evidence in favor of the hypothesis about the population parameter

UNIT I

Finite Differences and Interpolation: Forward, Backward differences, Interpolation, Newton-Gregory Forward and Backward Interpolation formulae, Lagrange's interpolation formula and Newton's divided difference interpolation formula (no proof).

Numerical Differentiation and Numerical Integration: Derivatives using Newton-Gregory forward and backward interpolation formulae, Newton-Cotes quadrature formula, Trapezoidal rule, Simpson's 1/3rd rule, Simpson's 3/8th rule (no proof).

UNIT II

Fourier Transforms: Infinite Fourier transform, Infinite Fourier sine and cosine transforms, Properties, Inverse transforms, Convolution theorem, Parseval's identities (statements only).

Z-Transforms: Definition, Standard Z-transforms, Single sided and double sided, Linearity property, Damping rule, Shifting property, Initial value and final value theorems, Inverse Z-transforms, Application of Z-transforms to solve difference equations.

UNIT III

Partial Differential Equations-: Classification of second order PDE, Numerical solution of one dimensional heat equation using implicit and explicit finite difference methods. Numerical solution of one dimensional wave equation, Two - dimensional Laplace and Poisson equations.

Random Variables: Random variables (discrete and continuous), Probability density function, Cumulative density function, Mean, Variance, Moment generating function.

UNIT IV

Probability Distributions: Binomial distribution, Poisson distribution, Uniform distribution, Exponential distribution, Gamma distribution, Normal distribution, Joint probability distribution (both discrete and continuous), Conditional probability, Conditional expectation.

UNIT-V

Sampling and Statistical Inference: Sampling, Sampling distributions, Standard error, Central limit theorem (no proof), Basics of parametric estimation, Test of hypothesis for means, Confidence limits for means, Z-test, Student's t-distribution, F-distribution, Chi-Square distribution as a test of goodness of fit.

TEXT BOOKS:

1. R.E. Walpole, R. H. Myers, R. S. L. Myers and K. Ye – Probability and Statistics for Engineers and Scientists – Pearson Education – Delhi – 9th edition – 2012.
2. B.S.Grewal-Higher Engineering Mathematics-Khanna Publishers-44th edition-2017.

REFERENCE BOOKS:

1. Erwin Kreyszig –Advanced Engineering Mathematics – Wiley publication – 10th edition-2015.
2. Kishor S. Trivedi – Probability & Statistics with reliability, Queuing and Computer Science Applications – John Wiley & Sons – 2nd edition – 2008.

Course Learning Outcomes (COs):

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

1. Find functional values, derivatives, areas and volumes numerically from a given data.[PO1,PO2,PSO1 & PSO2]
2. Evaluate Fourier transforms and use Z-transforms to solve difference equations. [PO1,PO2,PSO1 & PSO2]
3. Solve PDE's numerically and compute various moments of random variables. [PO1,PO2,PSO1 & PSO2]
4. Apply the concept of probability distributions to solve engineering problems. [PO1,PO2,PSO1 & PSO2]
5. Use sampling theory to make decision about the hypothesis.[PO1,PO2,PSO1 & PSO2]

MANUFACTURING PROCESSES-II

Course Code: ME42 **Course Credits: 4:0:0**
Prerequisite:Nil **Contact Hours: 56**
Course Coordinator: Dr SIDARAJU C

Preamble:
The main focus is to impart the knowledge of the fundamentals of the machining processes to understand the metal cutting phenomenon. The manufacturing /production with advent of various machines like lathe, drilling machine, milling machine and grinding machines. Improvements were made in these machines to make it semi-automatic or completely automatic. The discussion on the basics of the machine tool is very much needed to know the design aspects.

Course Learning Objectives

1. The fundamentals of metal cutting like various cutting forces, tool materials, tool life and machinability.
2. The working of Capstan and Turret lathes, drilling machine, reaming machine, milling machine and grinding machines.
3. The understanding the design aspects of different machine tools, jigs and fixture and the recent advancement in the areas of machining in terms of numerically controlled machine tool.
4. To know the preparation of powders, mixing, compaction and sintering of various components using powders metallurgy techniques.
5. To understand the manufacturing technology in terms of the machining and newer techniques adopted in industries to solve the real world problems in production.

UNIT-I

Fundamentals of machining:
Introduction, Basic elements of machining, Orthogonal and oblique cutting, Classification of cutting tools, Principal angles of single point cutting tools, Tool signature, Chip formation, Types of chips, Chip thickness ratio, Chip control and chip breakers, Velocity relationships, Force relationship in orthogonal cutting, Forces on a single point tool in turning, Stress and strain in chip, Work done in cutting, Horse power calculation, Popular metal cutting theories, Sources of heat in metal cutting.
Tool failure, Mechanism of wear, Tool life, Factors affecting tool life, Effect of cutting speed, Feed and depth of cut, Tool geometry, Tool material, Work material, Nature of cutting, Rigidity of machine tool and work, Use of cutting fluids, Characteristics of cutting tool materials, Machineability, Machineability index.
.

UNIT-II

Turret & Capstan lathes and Automatic machines:
Introduction, Turret & capstan lathe compared with center lathe, Main parts of a Turret & capstan lathe, Differences between Turret & capstan lathe, Classification of Turret lathe, Turret & capstan lathe size and specification, Primary and secondary motions, Bar feed mechanism, Turret index and stop drum mechanisms. Tool layouts on Turret, capstan and automatic lathe.
Drilling and Reaming:
Introduction, Classification of drills, Twist drills parts and terminology, Drill size and specification, Carbide tipped drills, Types of drilling machines, Machine size, Drilling operations, Tool and work holding devices, Problems on estimating machining time.

UNIT-III

Milling:
Introduction, Working principle in milling, Size and specifications, Types of milling machines, Milling machines attachments, Milling cutters, Milling operations, Indexing or dividing head, Indexing methods.

Grinding:
Introduction, Common forms of abrasive tools, Wheel material, Symbolic representation of bonds, Grain, Grade, Structure, Common wheel shapes, Built up wheels, Mounted wheels and points, Diamond wheels, Loading and glazing of grinding wheels, Trueing and dressing, Wheel balancing, Use of coolants, Types of grinding machines, Sizes and specification of the grinder.

UNIT-IV

Fundamentals of machine tool design:
Introduction, Basic elements of machine tools, Machine tool structures, Considerations in design of machine tool structures, Machine tool beds, Slides and Slideways, Materials for slideways, Machine tool spindles, Spindle bearings, Kinematic drives of machine tools.

Jigs and Fixtures:
Introduction, Differences between jigs and fixtures, Importance consideration in jigs and fixture design, Main principles of design of jigs and fixture, Main elements of jigs and fixtures, Locating devices and methods, Support pins and jack pins, Locating pins, Diamond pin locators, Vee Locators, External pin location, Bush location, Clamping, Basic requirements of clamping devices, Types of clamps, Types of jigs, Jig bushes, Types of fixtures, Jigs and fixtures construction.

UNIT –V

Numerical Control of machine tools:
Introduction, Procedure for manufacturing through NC, NC machine tool system, Machine control unit, Machine tool, Drive units and servo controls, Principle axes of motions, Specifying the origin of coordinate system, Tool position systems, Motion, control systems, Point to point system, Straight line system, Contouring path system, Interpolations, Feedback devices, Transducers, Sensors and convertors, Servo control systems, Classification of NC system, Application of numerical control, Advantages and disadvantages of using NC machines, NC tooling, Types of numerical controls, Adaptive control, Machining centers, Principle parts of a machining center, Turning centres.

Powder metallurgy:
Basic steps in Powder metallurgy, Production of metal powders, Blending of metal powders, Compaction, Sintering and Finishing, Application, advantages and limitations of powder metallurgy.

TEXT BOOKS:

1. A Course in Workshop Technology, Volume II (Machine Tools), B.S. Raghuwanshi, Dhanpat Rai Publication, 2012
2. Processes and Materials of Manufacture, 4th Edition, Roy A. Lindberg, PHI Learning Publication, 2008

REFERENCE BOOKS:

1. Fundamentals of Metal Machining and Machine Tools, 3rd Edition, Winston A. Knight, Geoffrey Boothroyd, Taylor and Francis Publication, 2005
2. Production Technology, Volume I, O.P.Khanna, Dhanpat Rai Publication, 2015.

Course Learning Outcomes (COs):

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

1. **Recognize** the various cutting forces acting in metal cutting on cutting tool materials and their tool life [PO1,PO2,PO3 & PSO1]
2. **Understand** the working of Capstan and Turret lathes, drilling machine, reaming machine, milling machine and grinding machines. [PO1,PO2 & PSO1]
3. **Apply** the design aspects of jigs and fixture and the recent advancement in the areas of machining in terms of numerically controlled machine tool. [PO1,PO2,PO3 & PSO1]
4. **Comprehend** the preparation of powders, mixing, compaction and sintering of various components using powders metallurgy techniques. [PO1,PO2,PO6, PO7 & PSO1]
5. **Demonstrate** the knowledge in machining and newer techniques adopted in industries to solve the real-world problems in production. [PO1,PO2,PO6, PO7 & PSO1]

APPLIED THERMODYNAMICS

Course Code: ME 43 **Course Credits: 3:1:0**
Prerequisite: ME 33 **Contact Hours:42 L+14T = 56**
Course Coordinator: Dr. P.B.NAGARAJ

Preamble
Applied Thermodynamics is the study of science of energy, entropy, and the properties that are related to heat and work. Applied Thermodynamics is relevant to the study of thermodynamic processes involving energy conversion including chemical reactions and the processes that occur in equipment such as power plants, compressors, turbines or rocket engines, IC engines, refrigeration systems, etc.
As the world is running short of fossil fuels and the ever increasing price of petroleum resources coupled with increasing demand for clean energy, applied thermodynamics continues to be a fundamental topic of current interest and research. A student should gain knowledge to apply the laws of thermodynamics and energy conversion to seek solutions to several practical applications. The laboratory sessions are included to train the student in designing and conducting experiments, making measurement of test parameters and analysis the test data. The course helps the student to further the knowledge and concepts of thermodynamics as applied to theoretical and practical aspects at an advanced level.

Course Learning Objectives:

1. To prepare students understand and apply concepts of thermodynamics to various energy conversion processes and systems and make them aware of current advancement.
2. To study combustion aspects, testing and performance parameters of I C engines
3. To study the various aspects of energy conversion in the gas and vapor power cycles, reciprocating compressors, gas turbines, jet propulsion systems, steam nozzles and refrigeration systems.
4. To study various psychrometric processes and understand the working of air conditioning systems.
5. To prepare students to apply various concepts in thermodynamics to solve numerical and design problems of various thermodynamic processes and systems and provide useful solution.

UNIT I

Combustion in SI and CI engines: Ignition limits, stages of combustion in SI engine, Effect of engine variables on Ignition lag, abnormal combustion, Detonation or knocking and its effect, SI engine combustion chamber design principles, stages of combustion in CI engines, Delay period in CI engines and variables affecting the delay period, diesel knock and methods of controlling the diesel knock, Octane number, Cetane number, CI engine combustion chambers. Testing and Performance of Single Cylinder and Multi cylinder Engines, measurement of performance parameters, heat balance sheet. Numerical problems

UNIT II

Gas power cycles: Air standard cycles, Otto, Diesel, Dual , Stirling and Ericsson cycles, p v and T s diagrams, description, efficiencies and mean effective pressures, comparision of otto, diesel and dual combustion cycles

Gas turbines and Jet propulsion: Classification of gas turbines, analysis of open cycle gas turbine cycle, methods to improve thermal efficiency (no numericals on this topic), Jet propulsion and Rocket propulsion

UNIT III

Steam Nozzles: Introduction, types of nozzles and diffusers, steady flow energy equation in nozzles, entropy changes with friction, nozzle efficiency, diffuser efficiency, mass discharge through nozzle, throat pressure for maximum discharge, critical pressure ratio for adiabatic and frictionless expansion from a given initial velocity, effect of friction on critical pressure ratio, numerical problems

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 cycles. Effects of pressure and temperature on Rankine cycle performance. Actual vapour power cycles, Ideal and practical regenerative rankine cycles, open and closed feed water heaters, reheat rankine cycle (no numericals on regenerative and reheat cycles)

UNIT IV

Reciprocating 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.

Refrigeration: Principle, methods of refrigeration, units of refrigeration, COP, air cycle refrigeration, Vapour compression refrigeration (VCR) system; description, analysis, refrigerating effect, capacity, power required, Thermodynamic analysis of VCR cycle, operating parameters affecting the COP of VCR cycle, Vapour absorption refrigeration system (no numerical on this topic), Steam jet refrigeration.

UNIT V

Psychrometrics: Atmospheric air and psychrometric properties: DBT,WBT, DPT, partial pressures, specific and relative humidity and relation between the two 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. Summer and winter air conditioning.

TEXT BOOKS:

1. Basic and Applied thermodynamics by P K Nag, Tata McGraw Hill pub co., 2nd edition 2002
2. Thermodynamics- An Engineering Approach-Yunus, A Cenegal and Michael A Boles, Tata McGraw Hill Publications.,1st edition 2002

REFERENCE BOOKS:

1. Internal combustion engines- M L Mathur and R P Sharma, Dhanpat Rai Publications.,3rd edition 2007
2. Thermal Engineering- R K Rajput, Laxmi Publications,3rd edition 2003

Course Learning Outcomes (COs):

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

1. Analyze the combustion phenomenon and solve the practical problems associated with the performance parameters of the Internal combustion engine and create awareness of current advancement in I C engines[PO1,PO2,PO3,PO4,PO7,PO12,PSO1 & PSO2]
2. Apply the knowledge of thermodynamics in the analysis of air standard and gas turbine cycles and determine cycle efficiency, work output and heat supply. [PO1,PO2,PO3,PO4,PO7,PO12,PSO1 & PSO2]
3. Solve practical problems on steam nozzles, gas turbines and make modifications to improve Rankine cycle efficiency[PO1,PO2,PO3,PO4,PO7,PO12,PSO1 & PSO2]
4. Evaluate the performance parameters of single and multistage air compressors and analyze the different types of refrigeration systems for given comfort conditions. [PO1,PO2,PO3,PO4,PO7,PO12,PSO1 & PSO2]
5. Solve the problems on design of air conditioning systems with the use of psychrometric chart and develop ability to apply the concept of air conditioning systems to solve design problems of real systems.[PO1,PO2,PO3,PO4,PO7,PO12,PSO1 & PSO2].

KINEMATICS OF MACHINES

Course Code: ME 44 **Course Credits: 4:0:0**
Prerequisite: Nil **Contact Hours: 56**
Course Coordinator: Mr PRADEEP KUMAR K V

Preamble
The main objective of the kinematics of machine is to give the overall basic principles and theoretical aspects related to theory of machines. i.e construction of any machine from basic such as linkages, kinematic pairs, kinematic chain with constrained motion and formation of mechanism and their inversions to have different kind of motions. The subject also gives overall view of how velocity and acceleration of linkages changes with the position with reference to change position of points by different methods The subject also gives the knowledge about construction and working of very important mechanism to transform one form of motion to another form and transmit motions from one point to another point.
The subject enriches the knowledge of students about different types of gears & gear trains by their working, design, and manufacturing, selection of materials for manufacturing gears and to make gear train by using different gears combinations to execute for the different application. Also students know about different types of cams & followers by their working, design, construction of cam profile for different motion of the follower and selection of followers for different applications.

Course Learning Objective

1. To Identify and enumerate different mechanisms with basic understanding of motion and machine.
2. To Understand and Analyse velocity and acceleration by different graphical methods.
3. To Analyse and determine velocity and acceleration by analytical methods.
4. To Apply the knowledge of gears and gear trains.
5. To Formulate and draw cam profile for different types of followers and follower motion.

UNIT I

Introduction: Definitions oflink or element, kinematic pairs, degrees of freedom, Grubler's criterion (without derivation), kinematic chain, mechanism, structure, mobility of mechanism, inversion, machine, kinematic chains and inversions. Inversions of four bar chain, single slider crank chain and double slider crank chain.
Mechanisms: Quick return motion mechanisms – drag link mechanism, straight line motion mechanisms – Peaucellier's mechanism and Robert's mechanism, intermittent motion mechanisms – Geneva mechanism and ratchet and pawl mechanism, pantograph, ackerman steering gear mechanism.

UNIT II

Velocity and Acceleration Analysis of Mechanisms (Graphical Methods): Velocity and acceleration analysis of four bar mechanism, slider cranks mechanism. vector polygons.
Velocity Analysis By Instantaneous Center Method: Definition, Kennedy's theorem, determination of linear and angular velocity using instantaneous center method.
Klein's construction: Analysis of velocity and acceleration of single slider crank mechanism.

UNIT III

Velocity and Acceleration Analysis of Mechanisms: Complex algebra method only for four bar mechanism and slider crank mechanisms.

UNIT IV

Spur Gears: Gear terminology, law of gearing, characteristics of involutes action, path of contact, arc of contact, contact ratio, interference in involutes gears, methods of avoiding interference, back lash, comparison of involutes and cycloidal teeth.
Gear trains: Simple gear trains, compound gear trains for speed reduction, epicyclic gear trains, Algebraic and tabular column methods of finding velocity ratio of epicyclic gear trains. Tooth load and torque calculations in epicyclic gear trains.

UNIT V

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.

TEXT BOOKS:

1. Theory of Machines: Sadhu Singh, Pearson Education, 2nd edition, 2007
2. Theory of Machines: Thomas Bevan, CBS Publications, 2nd edition 1984

REFERENCE BOOKS:

1. Theory of Machines: Rattan, 3rd edition 2005 edition.
2. Theory of Machines and Mechanisms: Shigley,J.VandUickers, 2nd edition 2005 edition.
3. Mechanisms and Dynamics of Machinery: Bansal, 2nd edition 2006
4. Theory of Machines: Khurmi, 4th edition 2004

Course Learning Outcomes (COs):

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

1. **Identify** different mechanisms and motion [PO1,PO2,PO3,PSO1 &PSO2]
2. **Analyze** velocity and acceleration by different graphical methods. [PO1,PO2,PO3,PSO1 &PSO2]
3. **Determine** velocity and acceleration by analytical methods. [PO1,PO2,PO3,PSO1 &PSO2]
4. **Demonstrate** the knowledge of gears and gear trains. [PO1,PO2,PO3,PSO1 &PSO2]
5. **Draw** cam profile for different types of followers.[PO1,PO2,PO3,PSO1 &PSO2]

FLUID MECHANICS

Course Code: ME45 **Course Credits: 4:0:0**

Prerequisite: Nil **Contact Hours: 56**

Course Coordinator: Ms BIJAYA LAKSHMI DAS

Preamble

Fluid mechanics is an important field of study in mechanical engineering and involves the study of motion of fluids and the forces generated by interaction with the solid boundaries. It is an active field of research with many unsolved or partly solved problems. Fluid mechanics involves both experimental and theoretical approaches. Problems in fluid mechanics can be solved by numerical methods using computers. The basic ideas taught in this course have significant applications in various areas branches of engineering including mechanical, civil, chemical, and automotive and aerospace engineering.

Course Learning Objectives

1. The basic concepts of fluid statics, pressure measurement, buoyancy, kinematics and dynamics of fluid flow.
2. The basic concepts of fluid flow measuring equipment such as venturimeter, orifices, notches and losses in laminar flow through pipes.
3. The head losses in turbulent flow through pipes and fluid flow problems with concepts of dimensional analysis, similitude and model analysis.
4. The compressible flows and flow around immersed bodies.

UNIT I

Properties of fluids-Introduction to fluid mechanics & its applications, properties of fluids, viscosity, thermodynamic properties, surface tension, capillarity, vapor pressure and cavitation.

Fluid Statics: Fluid pressure at a point, Pascal's law, pressure variation in a static fluid, absolute, gauge, atmosphere and vacuum pressure. Manometers, simple and differential manometers, total pressure and location of center of pressure on horizontal/vertical/inclined plane surfaces and curved surfaces submerged in a liquid.

UNIT II

Buoyancy: Buoyancy, center of buoyancy, meta-center and meta-center height, conditions of equilibrium of floating and submerged bodies.

Fluid Kinematics: Types of fluid flow-introduction, continuity equation in three dimensions (Cartesian co-ordinate system only), velocity and acceleration, velocity potential function and stream function and flow nets.

UNIT III

Fluid Dynamics: Introduction, equations of motion, Euler's equation of motion, Bernoulli's equation from Euler's equation, limitation of Bernoulli's equation, fluid flow measurements**:** venturi-meter, vertical orifice & orifice meter, Pitot tube, v-notch and rectangular notch, rotometer.

Flow through pipes: Frictional loss in pipe flow, Darcy's-equation and Chezy's equation for loss of head due to friction in pipes, hydraulic gradient line and total energy line.

UNIT IV

Laminar flow and viscous effects: Reynolds number, laminar and turbulent flows, critical Reynolds number, turbulence intensity, laminar flow through circular pipe-Hagen Poiseulle's equation, laminar flow between parallel plates.
Dimensional Analysis: Introduction, derived quantities, dimensions of physical quantities, dimensional homogeneity, Rayleigh's method, Buckingham's π theorem dimensionless numbers and their significance, similitude and model studies.

UNIT V

Introduction to compressible flow: Velocity of sound in a fluid and its expression for isothermal and adiabatic flow. Mach number, propagation of pressure waves in a compressible fluid, mach cone and mach angle, isentropic flow relationships, flow in nozzles and diffusers, Mach number – area relationships.
Flow past immersed bodies: Drag, lift, expression for lift and drag, pressure drag and friction drag,flow over airfoils, effect of angle of incidence, boundary layer concept, displacement thickness, momentum thickness and energy thickness, flow separation.

TEXT BOOKS:

1. Fluid Mechanics by Dr. Bansal. R.K, Lakshmi Publications, 4th edition 2011.
2. Fluid Mechanics and Hydraulics, by Dr. Jagadishlal; Metropolitan Book Co-Ltd 4thedition 2004.

REFERENCE BOOKS:

1. Fluid Mechanics by Modi & Seth, 5th edition2004
2. Fluid Mechanics by Stecter, 1st edition 2005.
3. Fluid Mechanics and Fluid Power Engineering by Kumar.D.S, Kataria& Sons., 2nd edition 2004.

Course Learning Outcomes (COs):
At the end of the course, the student will be able to

1) **Demonstrate** the basic principles of fluid mechanics, properties and concepts of fluid statics. .[PO1,PO2,PO12,PSO1 & PSO2]
2) **Apply** the knowledge of buoyancy and the concepts of fluid kinematic. .[PO1,PO2,PO3,PO12,PSO1 & PSO2]
3) **Analyze** the dynamics of fluid flow, its applications. .[PO1,PO2,PO3,PO5,PO7,PO12,PSO1 & PSO2]
4) **Describe** the laminar flow, significance of non-dimensional parameters in fluid flow. .[PO1,PO2,PO3,PO5,PO7,PO12,PSO1 & PSO2]
5) **Identify** the principles of the compressible flow, application of boundary layer concepts.[PO1,PO2,PO3,PO5,PO7,PO12,PSO1 & PSO2]

MECHANICAL MEASUREMENTS & METROLOGY

Course Code : ME46 **Course Credits: 3:0:0**
Prerequisite: Nil **Contact Hours:42**
Course Coordinator: Dr NAGESH S N

Preamble

In industries, the main focus is on manufacturing/production with advent of various machines like lathe, drilling machine, milling machine, shaping machine, grinding machine. These machines are used in production. Improvements were made in these machines to make it semi-automatic or automatic. These are conventional or traditional machining processes.
Later in non-traditional machining processes like EDM, ECM came into existence. Here in this course a study of these conventional and non-conventional processes are made by the students. Simultaneously in the lab session, students learn practical skills.

Course Learning Objectives

1. Introduce students to the definition, objectives and various aspects of Metrology and Measurements as applied to Mechanical engineering**.**
2. Impart the knowledge of fits, Tolerances, Gauging and comparators.
3. Define the fundamental concepts and derive the relations for the design of gauges, types of gauges, concepts involved in comparators, angular measurements, screw thread and gear measurements.
4. Define the fundamental methods of measurement, concept of transducer and intermediate modifying and terminating devices. Clear exposure to the errors, classification and remedies.
5. To expose the students to various aspects of measurement of Force, Torque, Strain, Pressure and Temperature along with the introduction to design ,types and applications of Coordinate measuring machines.

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, transfer from line standard to end standard, calibration of end bars (Numerical), Slip gauges, wringing phenomena, Indian Standards (M-81,M-112), Numerical Examples on building of slip gauges.
System of limits, Definition of tolerance, Specification in assembly, Principle of inter changeability and selective assembly limits of size, Indian Standards, concept of limits of size and tolerances, compound tolerances, accumulation of tolerances.

UNIT II

Fits, Tolerances and gauging & Comparators: Definition of fits, types of fits and their designation (IS 919-1963), geometrical tolerance, positional – tolerances, hole basis system, shaft basis system, classification of gauges, brief concept of design of gauges (principles), Wear allowance on gauges, Types of gauges – Plain plug gauge, ring Gauge, snap gauge, limit gauge and gauge materials.
Introduction to Comparators, Characteristics, classification of comparators, mechanical comparators – Johnson Mikrokator, Sigma Comparators, dial indicator, Optical comparators – principles, Zeiss ultra Optimeter, Electric and Electronic comparators – principles, LVDT, Pneumatic comparators, back pressure Gauges, Solex comparators.

UNIT III

Angular measurement, Interferometer and Screw thread gear measurement: Angular measurements, Bevel Protractor, Sine Principle and use of Sine bars, Sine center, use of angle gauges, (numericals on building of angles) Clinometers. Interferometer Principle of interferometery, autocollimator. Optical flats. 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. Toolmakers microscope, gear terminology, use of gear tooth Vernier caliper and gear tooth micrometer.

UNIT IV

Measurements and Measurement systems, Intermediate modifying and terminatingdevices: Definition, Significance of measurement, generalized measurement system, definitions and concept of accuracy, precision, calibration, threshold, sensitivity, hysteresis, repeatability, linearity, loading effect, system response-times delay. Errors in Measurements, classification of errors. Transducers, Transfer efficiency, Primary and Secondary transducers, Electrical, Mechanical, Electronic transducers, advantages of each type transducers. Mechanical systems, inherent problems, Electrical intermediate modifying devices, Input circuitry, Ballast, Ballast circuit, Electronic amplifiers and telemetry. Terminating devices, Mechanical, Cathode Ray Oscilloscope, Oscillographs, X-Y Plotters.

UNIT V

Measurement of Force and Torque, Pressure Temperature and Strain Measurement: Principle, Analytical balance, platform balance, Proving ring, Torque measurement, Prony brake, Hydraulic dynamometer. Pressure Measurements, Principle, use of elastic members, Bridgeman gauge, McLeod gauge, Pirani Gauge. Temperature and Strain Measurement: Resistance thermometers, thermocouple, law of thermocouple, materials used for construction, Pyrometer, Optical Pyrometer. Strain Measurements, Strain gauge, preparation and mounting of strain gauges, gauge factor, methods of strain measurement.
Coordinate measuring machine: Introduction, design, types and its applications.

TEXT BOOKS:

1. Mechanical measurements, by Beckwith Marangoni and Lienhard, Pearson Education, 6thEd., 2006.
2. Engineering Metrology, by R.K.Jain, Khanna Publishers,5th edition 2006.

REFERENCE BOOKS:

1. Engineering Metrology, by I.C.Gupts, Dhanpat Rai Publications, Delhi. 2nd edition 2006 edition.
2. Industrial Instrumentation, Alsutko, Jerry.D.Faulk, Thompson Asia Pvt. Ltd.1st edition 2002.
3. Measurements Systems Applications and Design, by Ernest O. Doblin, McGraw Hill Book Co. 2nd edition. 2006

Course Learning Outcomes (COs):

1. Explain the concept of measurements in engineering [PO1,PO2,PO4,PO7,PO8,PSO1,PSO2]

2. Examine the applications of Limits, Fits, Tolerances and Analyse comparators for different engineering applications. [PO1,PO2,PO4,PO6,PO7,PO8,PSO1,PSO2]

3. Identify the uses of Gauges for Angular measurement, Screw thread and Gear Measurement. [PO1,PO2,PO3,PO4,PO6,PO12,PSO1,PSO2]

4. Understand the significance of measurement system, Errors, Transducers, Intermediate modifying and terminating devices. [PO1,PO2,PO3,PO4,PO6,PO7,PO8,PSO1,PSO2]
5. Apply the techniques for force, torque, pressure, temperature and strain measurement systems[PO1,PO2,PO3,PO4,PO6,PO7,PO8,PO12,PSO1,PSO2]

APPLIED THERMODYNAMICS LABORATORY

Course Code : MEL47 **Course Credits: 0:0:1**
Prerequisite: Nil **Contact Hours:14**
Course Coordinator: Dr P B NAGARAJ

Preamble
Applied Thermodynamics is relevant to the study of thermodynamic processes involving energy conversion including chemical reactions and the processes that occur in equipment such as power plants, compressors, turbines or rocket engines, IC engines, etc.

Course Learning Objectives:
1. Students should apply the knowledge and conduct the experiments of Flash and Fire points, Viscosity and calorific value of a solid, liquid and gaseous fuel.
2. Conduct the tests on two and four stroke petrol and diesel engines.
3. Conduct the Morse Test on a four cylinder petrol engine.
4. Conduct the test on air compressor and centrifugal blower

Tests conducted are listed below
A. Conduct the following Experiments.
1. Determination of Flash and Fire point of Light, medium and heavy oils.
2. Determination of solid fuel calorific value using Lewis Thomson Calorimeter
3. Determination of an oil using Redwood and Torsion Viscometer
4. Determination of liquid and gaseous fuel calorific value using Boy's gas Calorimeter
5. Valve timing diagram for I C Engine.
6. Measurement of an irregular area using Planimeter.

B. Conduct the performance test on the following experiments.
1. Two stroke Petrol engine
2. Four stroke Petrol engine with computerised I C engine test rig
3. Two stroke Diesel engine
4. Four stroke diesel engine with computerised I C engine test rig (heat balance sheet)
5. Multi cylinder petrol engine – Morse Test
6. Performance testing of a 2 stage recoprocating Air Compressor
7. Performance testing of Centrifugal Blower

TEXT BOOK:

1. Applied Thermodynamics Manual, Department of Mechanical Engineering, MSRIT

REFERENCE BOOKS:

1. Basic and Applied Thermodynamics by P K Nag, Tata-Mc-Graw Hill publications, 2008
2. Applied thermodynamics, Kestoor praveen, SUGGi Publishing, 2014

Course Learning Outcomes (COs):

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

1. **Determine** properties such as flash and fire point, viscosity and calorific value of various types of fuels. [PO1,PO2,PO4,PO6,PO7,PO10,PO12,PSO1,PSO2]
2. **Demonstrate** the use of Valve timing diagram of I C Engines and use of Planimeter[PO1,PO2,PO3,PO4,PO10,PO12,PSO1,PSO2]
3. **Conduct** experiments on I C Engines, Blowers and Air compressors to determine performance parameters
   [PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO10,PO11,PO12,PSO1,PSO2]

Scheme of Examinations:

1. Students should have obtained not less than 85% attendance and 20 CIE Marks to become eligible for appearing the examination

2. Students has to conduct two experimenets (one group experment and one individual experiment)

Max Marks	50
Group experiment:	**25**
Individual Experiment:	**15**
Viva-voce:	**10**

MANUFACTURING PROCESS LABORATORY – I

Course Code : MEL48 **Course Credits: 0:0:1**
Prerequisite: Nil **Contact Hours:14**
Course Coordinator: Dr ANIL KUMAR T

Preamble
Foundry is a place where castings are produced on a large scale. The students will be conducting experiments in the laboratory pertaining to testing of molding sand, preparation of moulds using cope and drag with patterns or without pattern, and forming the metals using forging process.

Course Learning Objectives:

Students apply the knowledge and conduct the experiments in the testing of moulding sand, preparation of moulds using cope and drag with patterns or without pattern and also forging models.

Tests conducted are listed below

1.**Testing of Moulding sand and core sand:** Properties of sand specimens and conduction of the following tests.

a. Compression, Shear and Tensile tests on Universal Sand Testing Machine.
b. Permeability Test
c. Core Hardness and Mould Hardness Test
d. Grain Fineness Number Test (Sieve Analysis Test)
e. Clay Content test
f. Moisture Content test

2.**Foundry Practice:**

a. Preparation of Moulds using Two Moulding Boxes using Patterns or without patterns.
b. Preparation of casting (Non ferrous metals - Demonstration only)

3.**Forging Operations**:

Preparation of forged Models involving Upsetting, Drawing and Bending operations.

TEXT BOOKS:

1. Manufacturing Process – I laboratory manual, Department of Mechanical Engineering, MSRIT.
2. Mechanical Metallurgy by George E Dieter, McGraw hill publication.
3. Principal of Metal casting by Richard W. Heine, Carl R. Loper, Philip C. Rosenthal, Tata McGraw-Hill

Course Learning Outcomes (COs):

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

1. **Evaluate** the properties of molding sand. [PO1,PO2,PO4,PO9,PO12,PSO1,PSO2]
2. **Prepare** the moulds using patterns or without patterns.
   [PO1,PO2,PO4,PO9,PO12,PSO1,PSO2]
3. **Prepare** the forging models related to different forging
   operation[PO1,PO2,PO4,PO9,PO12,PSO1,PSO2]

Scheme of Examination

1. Students should have obtained not less than 85% attendance and 20 CIE Marks to become eligible for appearing the examination.
2. Student has to conduct two experiments (One group experiment and one individual experiment)

Max Marks:	**50**
Group Experiment:	**25**
Individual Experiment:	**15**
Viva-voce:	**10**
----------	**----------**
TOTAL:	**50**