DEPARTMENT OF MECHANICAL ENGINEERING

SCHEME OF INSTRUCTIONS AND SYLLABUS FOR UNDERGRADUATE STUDIES

B.Tech. IN MECHANICAL ENGINEERING

Visvesvaraya National Institute of Technology, Nagpur

February 2016

MISSION AND VISION
OF
VISVESVARAYA NATIONAL INSTITUTE OF TECHNOLOGY, NAGPUR

MISSION

The Mission of VNIT is to achieve high standards of excellence in generating and propagating knowledge in engineering and allied disciplines. V.N.I.T. is committed to providing an education that combines rigorous academics with joy of discovery. The Institute encourages its community to engage in a dialogue with society to be able to effectively contribute for the betterment of humankind.

VISION

To contribute effectively to the national endeavour of producing quality human resource of world class standard by developing a sustainable technical education system to meet the changing technological needs of the Country, incorporating relevant social concerns and to build an environment to create and propagate innovative technologies for the economic development of the Nation.

MISSION AND VISION
OF
DEPARTMENT OF MECHANICAL ENGINEERING, V. N. I. T. Nagpur

VISION

The vision of the department is to produce quality human resources of high standard in mechanical engineering who can contribute favorably to the technological and socio economic development of the nation.

MISSION

Mission of the Department of Mechanical Engineering is

1. **To develop state of the art facilities related to mechanical engineering**
2. **To attract highly qualified faculty to the department**
3. **To promote participation of industries in academics, research and consultancy**
4. **To undertake research at regional and national level**

Department of Mechanical Engineering offers B. Tech program in Mechanical Engineering. This is an eight semester course. First two semesters are common for all branches and students have to complete 43 credits. The remaining six semesters are attended by the student in the department, wherein student has to complete certain number of credits as indicated in Table 1. Each subject (or course) has certain number of credits. There are two types of subjects: Core and elective. Core courses are compulsory and some courses from electives are to be taken to complete the required credits.

TABLE 1. CREDIT REQUIREMENTS FOR B.TECH. MECHANICAL ENGINEERING

Postgraduate Core (PC)		**Postgraduate Elective (PE)**	
Category	Credit	Category	Credit
Departmental Core (DC)	82	Departmental Electives (DE) and Other Courses (OC)	45
Basic Science (BS)	43		
Total	125	Total	45
Grand Total PC + PE			170

The number of credits attached to a subject depends on number of classes in a week. For example a subject with 3-1-0 (L-T-P) means it has 3 Lectures, 1 Tutorial and 0 Practical in a week. This subject will have eight credits (3x1 + 1x1 + 0x1 = 4). If a student is declared pass in a subject, then he/she gets the credits associated with that subject. Depending on marks scored in a subject, student is given a Grade. Each grade has got certain grade points as follows:

Grades	AA	AB	BB	BC	CC	CD	DD	FF
Grade Points	10	09	08	07	06	05	04	Fail

The performance of a student will be evaluated in terms of two indices, viz. the Semester Grade Point Average (SGPA) which is the Grade Point Average for a semester and Cumulative Grade Point Average (CGPA) which is the Grade Point Average for all the completed semesters at any point in time. SGPA & CGPA are:

$$\boldsymbol{SGPA} = \frac{\sum_{semester}(Course\ credits\ X\ Grade\ points)\ for\ all\ courses\ except\ audit}{\sum_{semester}(Course\ credits\ )\ for\ all\ courses\ except\ audit}$$

$$\boldsymbol{CGPA} = \frac{\sum_{All\ semester}(Course\ credits\ X\ Grade\ points)\ for\ all\ courses\ with\ pass\ grade\ except\ audit}{\sum_{All\ semester}(Course\ credits\ )\ for\ all\ courses\ except\ audit}$$

Students can Audit a few subjects. i.e., they can attend the classes and do home work and give exam also, but they will not get any credit for that subject. Audit subjects are for self enhancement of students.

Details about Faculty members teaching to B.TECH. MECHANICAL ENGINEERING

Name of Faculty Member	Designation	Qualifications	Areas of specialization
P.M. Padole	Professor	Ph.D.	Machine design, FEM, Mechanisms and Stress analysis
Animesh Chatterrjee	Professor	Ph.D.	Mechanical vibrations, Composites, Control Systems
S.B.Thombre	Professor	Ph.D.	Heat and Mass Transfer
A.M. Kuthe	Professor	Ph.D.	Layered Manufacturing, Bio-Medical Engineering
V.R. Kalamkar	Associate Professor	Ph.D.	CFD, Advanced turbo machinery
A.B.Andhare	Associate Professor	Ph.D.	Machine Condition Monitoring, Manufacturing Processes
Y.M. Puri	Associate Professor	Ph.D.	Unconventional manufacturing, Computer aided and integrated manufacturing
J.G. Suryawanshi	Associate Professor	Ph.D.	I.C. Engines
D.B. Zodpe	Associate Professor	Ph.D.	Refrigeration and Cryogenics
R.V. Uddanwadiker	Assistant Professor	Ph.D.	Bio-Mechanics
A.S. Dhoble	Assistant Professor	Ph.D.	Power plant engineering
S.S. Chiddarwar	Assistant Professor	Ph.D.	Robotics, Artificial Intelligence, Machine Vision and Automation
H.P.Jawale	Assistant Professor	Ph.D.	Measurements and Design
A.K.Singh	Assistant Professor	Ph.D.	Contact and friction mechanics, Tribology,
M.S. Kotambkar	Assistant Professor	Ph.D.	Vibrations, FEM and Machine Design
A.A. Thakre	Assistant Professor	M.Tech.	Tribology, Optimization
D.A. Jolhe	Assistant Professor	M.Tech.	Methods Engineering and Optimization
P.V. Kane	Assistant Professor	M.Tech.	CIM, Reliability
K.M.Ashtankar	Assistant Professor	Ph.D.	Industrial engineering and Management
T.V.K. Gupta	Assistant Professor	Ph.D.	Manufacturing Engineering
D. Ravikumar	Assistant Professor	Ph.D.	Surface Engineering
Gaurav Tiwari	Assistant Professor	Ph.D.	Fracture Mechanics
T.B. Gohil	Assistant Professor	Ph.D.	Advanced CFD

Scheme of Instructions for M. Tech. in CAD-CAM Engineering

III Semester				IV Semester			
CORE				**CORE**			
Code	**Course**	**L-T-P**	**Cr**	**Code**	**Course**	**L-T-P**	**Cr**
MEL203	Engineering Thermodynamics	3-1-0	4	MEL202	Fluid Mechanics	3-1-0	4
MEL204	Engineering Metallurgy	3-0-0	3	MEP202	Fluid Mechanics Lab	0-0-2	1
MEP204	Engineering Metallurgy Lab	0-0-2	1	MEL201	Theory of Machines – I	3-1-0	4
MAL201	Integral Transforms & PDE	3-1-0	4	MEL304	Machine Design – I	3-1-0	4
MEL206	Solid Mechanics	3-1-0	4	MEL305	Manufacturing Processes – II	3-0-0	3
MEL207	Manufacturing Processes- I	3-0-0	3	MEP305	Manufacturing Processes – II Lab	0-0-2	1
MEP207	Manufacturing Processes- I Lab	0-0-2	1	MEL303	Energy Conversion – I	3-1-0	4
				MEL306	Machine Drawing	2-0-0	2
				MEP306	Machine Drawing Practice	0-0-2	1
		20				24	
V Semester				**VI Semester**			
CORE				**CORE**			
Code	**Course**	**L-T-P**	**Cr**	**Code**	**Course**	**L-T-P**	**Cr**
MEL302	Heat Transfer	3-1-0	4	MEL312	Mechanical Measurements and Metrology	3-0-0	4
MEL308	Energy Conversion – II	3-0-0	3	MEP312	Mechanical Measurements and Metrology Lab	0-0-2	1
MEL301	Theory of Machines – II	0-0-2	1	MEL309	Machine Design –II	3-1-0	4
MEL307	Fluid Machines	3-1-0	4	MEL310	Manufacturing Process Automation	3-0-0	3
MEP307	Fluid Machines Lab	3-1-0	4	MEP310	Manufacturing Process Automation Lab	0-0-2	1
MEP301	Theory of Machines Lab	3-0-0	3	MEP309	Design Lab	0-0-2	1
MEP302	Thermal Lab	0-0-2	1	**ELECTIVES (ANY ONE FORM GROUP)**			
ELECTIVES (ANY ONE)							
MEL416	Industrial Robotics	3-0-0	3	MEL432 MEL422	1. Computer Graphics and Solid Modeling 2. Automobile Engineering	3-0-0	3
MEL421	Computational Methods in Engg	3-0-0	3	MEP432 MEP422	1. Computer Graphics and Solid Modeling Lab 2. Automobile Engineering Lab	0-0-2	1
	OC/HM type of courses available	3-0-0	3	**ELECTIVES (ANY TWO FORM GROUP)**			
				MEL429 MEL418 MEL401 MEL405 MEL427	1. Renewable Energy Sources 2. Advanced Stress Analysis 3. Control Systems 4. Optimization 5. Quality Engineering & Management 6. OC/HM type of courses available*	3-0-0	3
						3*2=6	
		22				23	

VII Semester				VIII Semester			
CORE				CORE			
Code	**Course**	**L-T-P**	**Cr**	**Code**	**Course**	**L-T-P**	**Cr**
MED401	Project Phase I	2-0-0	2	MED402	Project Phase II	4-0-0	4
ELECTIVES (ANY ONE)				**ELECTIVES (ANY ONE)**			
MEL435 MEL420	1.Computational Fluid Dynamics 2. Finite Element Method	3-0-0	3	MEL426 MEL430	1. Ref and Cryogenics 2. Advanced IC Engines	3-0-0	3
MEP435 MEP420	1.Computational Fluid Dynamics Lab 2. Finite Element Method Lab	0-0-2	1	MEP426 MEP430	1. Ref and Cryogenics Lab 2. Advanced IC Engines Lab	0-0-2	1
ELECTIVES (ANY FOUR FROM THE GROUP)				**ELECTIVES (ANY FOUR FROM THE GROUP)**			
MEL407 MEL414 MEL433 MEL412 MEL431 MEL437 MEL408 MEL425 MEL440 MEL450 MEL417 MEL402	1. Biomechanics 2. Tribology 3. Design for manufacturing and assembly 4. Air Conditioning 5. Advanced Mechanisms 6. Composite Materials 7. Supply Chain Management 8. Reliability & Maintenance Engg 9. M/C Vision & Its Application 10. Advanced Machining Processes 11. Power Plant Engineering 12. Surface Engineering 13. OC/HM type of courses available*	3-0-0	3	MEL443 MEL449 MEL415 MEL424 MEL428 MEL403 MEL448 MEL413	1. Air Pollution Control 2. Adv. Turbo Machinery 3. Mechanical Vibration 4. Industrial Engineering Management 5. Machine Tool Design 6. Operations Research 7. AI in Manufacturing 8. Fracture Mechanics 9. OC/HM type of courses available*	3-0-0	3
		3*4 = 12				3*4=12	
		18				20	

Year/ Semester	Credits
First Year	43
Third Semester	20
Fourth Semester	24
Fifth Semester	22
Sixth Semester	23
Seventh Semester	18
Eighth Semester	20
Total Credits	170

Sr. No.	Type	III Sem.	IV Sem.	V Sem.	VI Sem.	VII Sem.	VIII Sem.	Total
01	DC	20	24	19	13	2	4	82
02	DE	-----	-----	3	10	16	16	45

Programme Educational Objectives of B.Tech. Mechanical Engineering

1. To impart to the students knowledge of contemporary science and mechanical engineering related subjects
2. To enhance analytical skills of the students for decision making.
3. To provide opportunity to the students to expand their horizon beyond mechanical engineering.
4. To prepare the students to take-up career in different industries or to pursue higher studies in mechanical and interdisciplinary programs
5. To create awareness amongst the students towards social, environmental and energy related issues.
6. To introduce the students to the professionalism and effective communication skills

Programme Outcomes of B.Tech. Mechanical Engineering

1. The graduates will be able to apply knowledge of basic sciences (math, physics, chemistry etc.) and engineering (core and elective subjects) in getting solutions to mechanical engineering related problems
2. The graduates will be able to design and conduct experiments as well as analyze and interpret data.
3. The graduates will be able to design a system or a component of a system for a specific task within realistic constraints
4. The graduates will be able to undertake multi disciplinary courses and tasks.
5. The graduates will be able to formulate and apply the knowledge of mathematical techniques in solving the governing equations of a system under consideration.
6. The graduates will be able to develop industrial and professional ethics and managerial skills.
7. The graduates will be able to communicate effectively their point of views
8. The graduates will be able to study the impact of mechanical systems on the global, economic, environmental and societal context.
9. The graduates will acquire attitude for life- long learning
10. The graduate will be able to use modern tools, softwares, equipments etc. to analyze and obtain solution to the problems.

    The graduates will be able to participate in competitive examinations for success.

COURSE SYLLABUS FOR B.TECH. MECHANICAL (THIRD SEMESTER)

Course Name: MEL203-ENGINEERING THERMODYNAMICS

Course Pre-requisites: NIL

Offered in: III Semester (Odd Semester)

Scheme and Credit: [(3-1-0); Credits: 4]

Type of Course: Core

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. Concept of various forms of energy specially (heat and work)

2. First and second law of Thermodynamics.

3. Understanding of various systems / processes for ideal gas / two phase mixtures.

4. Related Thermodynamic cycles for various applications.

Syllabus:

Basic Concepts

Introduction to Thermodynamics Basic concept of thermodynamics, Closed and open systems, Forms of energy, Properties of system, State and equilibrium, processes and cycles, Temperatures and Zeroth law of thermodynamics. Introduction to First law of Thermodynamics (Law of conservation of Energy), Heat and work, Mechanical forms of work, non-mechanical forms of work (Electrical, Magnetic etc.) ,Ideal gas equation of states, Difference between Gas and vapor, compressibility Factor, Internal energy and specific heats of gases, Universal Gas constant.

First Law of Thermodynamics

First Law of thermodynamics, Closed system (control mass system), work done, change in Internal energy, heat transferred during various thermodynamic processes, P-V diagrams. Open system (control mass system), Thermodynamic analysis of control volume Conservation of energy principle, flow work and enthalpy The steady flow process applied to (i) Nozzles and Diffuser (ii) Turbines and Compressor, (iii) Throttle valve Unsteady flow process (Simple system like Charging & Discharging of tanks).

Second Law of Thermodynamics

Second law of Thermodynamics Introduction (Law of degradation of Energy) Thermal Energy reservoir, Kelvin-Plank & Clausius Statement, Heat engine, Refrigerator and Heat pump, Perpetual motion machines, Reversible and Irreversible processes, Carnot cycle, Thermodynamic temperature scale. Entropy: The Clausius inequality, Entropy Principle of increase of entropy, Change in entropy for Closed and steady flow open systems. Second law analysis of engineering system, Availability, reversible work and Irreversibility.

Properties of Steam

Critical state, sensible heat, Latent heat, Super Heat, Wet Steam, Dryness fraction, Internal energy of steam External work dine during evaporation, T-S diagram Mollier Chart. Work and heat transfer during various thermodynamic processes with steam as working fluid Determination of dryness fraction using various calorimeters.

Air Standard Cycle

Air standard cycle: Otto cycle Sterling and Ericsson cycle, Brayton cycle Vapor cycle: Simple and Modified Rankine cycle with reheat & regeneration.

I.C. Engines and Compressors

Introduction to Internal combustion engine e.g. Two stroke, Four stroke cycle, engine components, their comparison,Wankel engine, and their efficiencies, Introduction to Single stage reciprocating compressor and its efficiencies.

REFERENCES

1. Nag P.K. "Engineering Thermodynamics", Tata McGraw- Hill, 3rd Edition, 2002.
2. Reyner Joel. "Engineering Thermodynamics", Addison Wesley, 5th Edition, 1999.
3. Arora C.P. "Thermodynamics", Tata McGraw- Hill, 1st Edition, 2001.
4. Thombre S.B. "A data book on Thermal Engineering", Green Brains Publication, 1st Edition, 2003.

Course Outcomes: On completion of this course, students will be

1. Able to understand the fundamental of the first and second laws of thermodynamics and their application to a wide range of systems.

2. Able to analyze the work and heat interactions associated with a prescribed process path, and to perform a first law analysis of a flow system.

3. Able to evaluate entropy changes in a wide range of processes and determine the reversibility or irreversibility of a process from such calculations.

4. Familiar with the construction and principles governing the form of simple and complex one-component pressure-temperature diagrams and the use of volume-temperature and pressure-volume phase diagrams and the steam tables in the analysis of engineering devices and systems.

5. Familiar with the fundamental of the air standard cycles and their applications.

Course Name: MEL204- ENGINEERING METALLURGY

Course Pre-requisites: NIL

Offered in: III Semester (Odd Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Core

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

Students will be able to understand the fundamentals and do structure property co-relation.

Syllabus:

Classification of materials, Properties and applications of materials crystalline nature of materials, especially microscopic examinations of metals. Alloys and solid solutions, types and their formations, modified Gibb's Phase rule, Lever rule for phase mixtures and their application in system.

Study of equilibrium diagram and invariant reactions, Iron-Iron carbide equilibrium diagram, critical temperatures, microstructure of slowly cooled steels, Estimation of carbon from microstructures, structure property relationship. Classification and application of steels, Effect of alloying elements, Specification of some commonly used steels for Engineering applications (e.g. En. AISI, ASTM, IS etc.) with examples.

Classification and application of plain carbon steels. Examples of alloy steels such as high manganese steel, Ball bearing steels, maraging steels, spring steels, etc.

Tool steels-classification, composition, application and commercial heat treatment practice for HSS, secondary hardening. Stainless steels- classification, composition, application and general heat treatment practice for stainless steels.

Heat Treatment and its importance, annealing, Normalizing, Hardening, Quench Cracks, Hardenability test TTT Diagram and its construction and related Heat Treatment Processes such as Austempering, Martempering, patenting etc. Retention of austenite, Effects and elimination of retained austenite, Tempering case/ Surface hardening treatments such as carbonizing, Nitriding, Cyaniding, Carbonitriding. Flame and Induction hardening.

Cast Iron- Classification, White Cast Iron, Gray Cast Iron, Nodular Cast Iron, Malleable Cast Iron, and Chilled and alloy Cast iron. (Production route, Composition, Microstructure and applications) Effects of various parameters on structure and properties of Cast Iron, Alloy Cast Iron such as Ni resist Ni hard.

Non-Ferrous Alloys: Study of non-ferrous alloys such as brasses (Cu-Zn diagram), bronzes (Cu-Zn diagram), Aluminum alloys (e.g. Al-Si and Al-Cu diagram), bearing materials.

Tension Test: Engineering and True stress strain curve, conversion relationship, evaluation of properties, numerical based on tension and compression test, Types of engineering stress strain curves, compression test.Hardness test- Brinell, Vickers, And Rockwell.

Introduction to Charpy and Izod Impact Test, Introduction to Non Destructive Testing.

REFERENCES

1. Avner S. “Introduction to Physical Metallurgy”, Tata McGraw Hill, 2nd Edition, 2001.

2. Lakhtin Y. “Physical Metallurgy & Heat Treatment”, Mir Publishers, 6th Edition, 1998.

3. Rollason E.C, "Introduction to Engineering Metallurgy", Edward Arnold publications, 1959.

4. Agrawal B.K. "Introduction to Engineering Materials", Tata McGraw Hill, 1st Edition, 2007.

Course Outcomes: On completion of this course, students will be
1. Able to describe the basic elements of material science and its application to engineering fields.
2. Able to establish their understanding for crystal structure, phase diagrams and their applications, principles of solidification of metal.
3. Able to explain the concept of phase diagrams, solidification principles and engineering of ferrous and non-ferrous materials.

Course Name: MEP204- ENGINEERING METALLURGY LAB

Course Pre-requisites: NIL

Offered in: III Semester (Odd Semester)

Scheme and Credit: [(0-0-2); Credits: 1]

Type of Course: Core

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

Students will be able to learn and practice preparation, identification of micro structure and understand basic mechanical tests.

Syllabus:
A set of 10 Experiments from following list
1. Study of Metallurgical Microscope.
2. Preparation of specimen for metallographic examinations.
3. Preparation of Mounted sample with the help mounting press/ cold setting resins.
4. Study and drawing of microstructures of steels.
5. Study and drawing of microstructures of cast iron.
6. Study and drawing of microstructures of non-ferrous metals.
7. Study of the effect of annealing and normalizing on the properties of steel.
8. Determination of hardenability of steels by Jominy End Quench Test.
9. Tensile Test on mild steel and aluminum test specimen.
10. Measurement of Hardness of ferrous and non-ferrous materials with the help of
    Brinell
    Vickers
11. Rockwell Testing machine.
12. Study the heat treatment of High Speed Steels.
13. Study the heat treatment of Stainless Steels.
14. Study of effect of Alloying element on Properties of Steels.
15. Study of Macroscopic examination.
16. Study of Mechanisms of Quenching.
17. Study of Pack carburizing of steel samples.
18. Impact Test.

Course Name: MAL201- INTEGRAL TRANSFORMS & PDE

Course Pre-requisites: NIL

Offered in: III Semester (Odd Semester)

Scheme and Credit: [(3-1-0); Credits: 4]

Type of Course: Core

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

The course will enable students in handling systems using differential equations. Use tools like Laplace transforms, Fourier transforms and Fourier series in formulating and solving problems.

Syllabus:

Differential Equation :Solution of Ordinary differential equation of higher order, Frobenius method, Legendre equation, Bessel equation, Legendre Polynomials, Bessel function of first and second kind.

Laplace Transform: Definition & its properties, transform of derivatives and integrals, evaluation of integrals by Laplace Transform. Inverse Laplace Transform, convolution theorem, Laplace transform of periodic function and unit step function and dirac delta function, application of Laplace transform to solve ordinary differential equation and partial differential equation-One-dimensional wave and heat equation.

Partial Differential Equation: Partial differential equation of first order. Linear homogeneous partial differential equation of nth order with constant coefficient, Method of separation of variables, application to simple problem of vibration of strings and beam, to simple of vibration of rectangular membrane and one dimensional heat equation.

Fourier Series: Introduction, the Fourier theorem, Evaluation of Fourier coefficients, Half Range series, considerations of symmetry, Exponential form of Fourier series, Fourier integral theorem, Fourier transform, Elementary concept of double Fourier Series.

Complex Variable :Analytical function, Cauchy-Riemann conditions, conjugate functions, singularities, Couchy's integral theorem and integral formula, Taylor's and Laurent's theorem, Residue theorem, Evolution of integral by residue theorem, Conformal mapping, mapping by Linear and Inverse transformation.

REFERENCES

1. Speigel M. R. "Advanced Mathematics For Engineers and Scientists", McGraw Hill, 2nd Edition, 1992.
2. Chandrika Prasad. "Mathematics for Engineers", Prasad Mudranalaya, 12th Edition, 1981.
3. Kreyszig E. "Advanced Engineering Mathematics", John Wiley & Sons, 7th Edition, 1993.

Course Outcomes: On completion of this course, students will be

1. Able to apply knowledge of mathematics, science and engineering in the solution of Mechanical Engineering problems.
2. Able to demonstrate an ability to identify, formulate, analyze and solve Mechanical Engineering problems.
3. Able to demonstrate ability to design mechanical systems, conduct experiments, analyze and interpret the resulting data.
4. Able to demonstrate an ability to design a system, component to meet desired needs within the context of Mechanical Engineering and considering realistic constraints.

Course Name: MEL206 - SOLID MECHANICS

Course Pre-requisites: NIL

Offered in: III Semester (Odd Semester)

Scheme and Credit: [(3-1-0); Credits: 4]

Type of Course: Core

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

By learning the subject, students will understand the behaviour of Mechanical systems under various loading conditions. This will laid down the fundamentals required for design and analysis of the mechanical components.

Syllabus:

Introduction, stress, strain, types of stresses, stress strain diagram, hooke's law, analysis of composite section, thermal stresses and strain, thermal stresses, longitudinal stress and strains, lateral stress and strain, poisons ratio, volumetric stresses and strain with uni-axial, bi-axial and tri-axial loading, bulk modulus, relation between Young's modulus, and modulus of rigidity, poison's ratio and bulk modulus.

Principal stress and strain: - Analytical method, Mohr's circle for representation of stresses, derivation of maximum and minimum principal stresses and maximum shear stresses when member is subjected to different types of stresses simultaneously (i.e. combined stress).

Types of beam (cantilever, simply supported, overhang beam etc.), types of load (concentrated and UDL), shear force and bending moment diagram for different types of beams subjected to different types of loads.

Stresses in beam: pure bending, theory of simple bending with assumption and expression for bending stresses, derivation of bending equation, bending stresses in symmetrical sections, section modulus for various shapes of beam sections.

Shear stresses in beams: Derivation of differential equation of elastic curve with the assumptions made in it, deflection and slopes of cantilever, simply supported, overhang beams subjected to concentrated load, UDL, relation between slope deflection and radius of curvature, Macaulay's method, Area-Moment method to determine deflection of beam.

Derivation of torsion equation with the assumptions made in it, torsion shear stress induced in the shaft when it is subjected to torque, strength and rigidity criteria for design of shaft, torque transmitted for solid and hollow circular shaft, derivation of maximum, minimum principal stresses and maximum shear stress induced in shaft when it is subjected to bending moment torque and axial load.

Column and struts: Failure of long and short columns, slenderness ratio, assumptions made in Euler's column theory, end conditions for column, expressions for crippling load for various end conditions of column, effective length of column, limitations of Euler's formula, Johnson's parabolic formula

Definition of strain energy stored in a body when it is subjected to gradually applied load, suddenly applied load sand impact loads, strain energy stored in bending and torsion.

Factor of safety, statistical method of determining factor of safety, theories of failure, modes of failure, Compound stresses, eccentric axial loading, variable stresses in machine parts stress

concentration and stress raiser, notch sensitivity, stress concentration factor, methods of reducing stress concentration, Goodman's criteria, soderberg's criteria, Garber's criteria, fatigue design for finite and infinite life of parts subjected to variable loads.

1. Two problems on principal stresses.

2. Two problems on Mohr's circle.

3. Two problems on thermal stresses with heat flow.

4. Two problems on SF and BM diagram.

5. Two problems on stresses in beam bending

6. Two problems on shear stresses.

7. Two problems on Macaulay's method.

8. Two problems on Area –Moment method.

9. Two problems on shafts.

10. Two problems on columns and struts.

11. Two problems on compound loading.

12. Two problems on fatigue and variable loads.

REFERENCES

1. Shames I.H. "Introduction to Solid Mechanics", PHI Publication, 3rd Edition, 2002.

2. Ragab A.R. "Engineering Solid Mechanics", CRC Press, 2nd Edition, 1998.

3. Beer F.P., Johnston E.R. "Mechanics of Materials", TaTa McGraw Hill Publication, 3rd Edition, 2004.

Course Outcomes: On completion of this course, students will be

1. Able to understand the theory of elasticity including strain/displacement and Hooke's law relationships.

2. Able to analyze solid mechanics problems using classical methods and energy methods;

3. Able to analyze the stresses and deflections of beams under various loading conditions.

4. Able to solve torsion problems in bars and thin walled members.

5. Able to obtain solutions to column buckling and plate problems.

6. Able to apply various failure criteria for general stress states at points.

Course Name: MEL207 - MANUFACTURING PROCESSES- I

Course Pre-requisites: NIL

Offered in: III Semester (Odd Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Core

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. To understand different manufacturing process and select the best one out of the available methods.

2. To understand the design for manufacturability.

Syllabus:

Pattern Making : Casting Processes, Pattern making, pattern materials, Types of pattern, Removable and disposable pattern, pattern allowances, color codes of pattern. Moulding Sands: Types of Moulding sands, properties of moulding sand. Moulding: Types of Moulds, Tools used in moulding, Procedure for making moulds, Moulding process, Types of moulding operations. Cores: Properties of cores, types of cores, core making, chaplets.

Casting : Elements of gating system, Types of gating, risering, Melting and pouring of metals,Melting Furnaces: Electric arc furnace, Cupola furnace, Induction furnace, oil fired tilting furnace. Defects in sand casting: blowholes, shrinkage defect, hot tears. Mis-runs, cold shut, and pour short, Inclusions. Special casting processes: Plaster mould casting processes, shell moulding casting processes, permanent mould casting processes, die casting processes, continues casting processes, centrifugal casting processes, Advantages and limitations of casting processes, selection of casting process. CO2 moulding, Investment casting.

Mechanical Working of Metals:

Mechanical Working of Metals: Hot rolling, hot spinning, wire drawing. Metal Forming Process: Rolling Processes, rolling operation, terminology used in rolling, rolling mills, thread rolling, Extrusion Process: Types of extrusion, extrusion pressure in direct and indirect extrusion.

Forging Processes: Forging materials, classification of forging operations, types of forging operations. Power forging, Impression die forging, press forging, roll-die forging, and defects in forging, Rotary swaging. Defects in forging. Surface Coating of Metals: Cleaning methods of metals, buffing, and electroplating, anodizing, plastic coating.

Sheet Metal Working: Introduction, Punches and dies, sheet metal working operations: piercing and punching, blanking, notching, beading, flanging, hemming, seaming, perforating, slitting, lancing, mechanism of blanking, drawing, coining, embossing, wire drawing, metal spinning.

Powder Metallurgy and Processing of Plastics: Introduction, Methods of manufacturing powders, production of metal powder, mixing of powders, compaction, sintering, secondary operation, advantages and limitation of powder metallurgy. Processing of Plastic: Introduction, general properties and applications, types of plastic, thermosetting plastic, thermo-plastic plastics. Forms of raw plastic material: Powder form, laminated sheets and rods, fibers, resins, Methods of processing plastics: compression molding, injection molding, extrusion, Calendaring, wire drawing.

Welding: Metal joining processes: Introduction, classification of joining processes. Welding process: Types of welding processes, pre-welding requirements, and welding, welding technique, types of

welding joints, edge preparation for welding, welding techniques. Arc welding: electron theory of arc columns, arc-welding process, weld penetration, Gas welding: Gas welding process, Types of flames, fluxes, filler material. Resistance Welding: Spot welding, seam welding, tungsten inert gas (TIG) welding, Metal Inert gas welding (MIG). Soldering and brazing, Thermit welding.

Mechanical Fasteners: Threaded fasteners, non-threaded fasteners.

REFERENCES

1. Rao P.N. "Manufacturing Technology: Metal cutting & Machine Tools", McGraw Hill Publication, 3rd Edition 2013.

2. Ghosh A., Malik A.K. "Manufacturing Science", Affiliated East-West Press Ltd, 1st Edition, 2001.

3. Hajra Choudhari. "Workshop Technology", Media Promoters & Publishers, 13th Edition, 2010.

4. Kalpakjian S., Schmid S.R. "Manufacturing Engineering & Technology", Pearson Edu Asia, 4th Edition, 2000.

5. Krar, Oswald. "Technology of machine Tools", McGraw Hill New York, 1st Edition, 1976.

6. Begman M. "Manufacturing Processes", Texas Publication, 1st Edition, 1956.

7. HMT. "Production Technology", Tata Mcgraw Hill Publication, 1st Edition, 1980.

8. Bawa H. S. "Workshop Technology", Tata McGraw Hill Publication, 1st Edition, 2001.

Course Outcomes: On completion of this course, students will be

1. Able to understand the behavior and properties of materials as they are affected by manufacturing processes.

2. Able to apply knowledge of manufacturing processes and the skills to develop and manipulate the operating parameters for a given process.

3. Able to examine the principles associated with basic operations involving the forming and welding of engineering materials.

4. Able to analyze the basic processes used in mechanical working of metals and welding operations on engineering materials.

Course Name: MEP207- MANUFACTURING PROCESSES- I LAB

Course Pre-requisites: NIL

Offered in: III Semester (Odd Semester)

Scheme and Credit: [(0-0-2); Credits: 1]

Type of Course: Core

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. To understand different manufacturing process and select the best one out of the available methods.

2. To understand the design for manufacturability

Syllabus:

Pattern Making Shop:

1. Study of various joints used in pattern making.

2. Study of different wood working machines.

3. Study of various tools used in pattern making.

4. Study of various pattern allowances

5. Practice of making a pattern.

Foundry Shop:

1. Study of different furnaces (i.e. Cupola, Electric arc, Induction, Tilting etc.)

2. Study of different types of pattern.

3. Study of different types of Foundry tools.

4. Study of different types of sands and their properties.

5. Practice of making green sand mould.

Welding Shop:

1. Electric Arc Welding.

2. Resistance welding.

3. Gas welding.

4. Gas cutting.

Sheet Metal Working.

COURSE SYLLABUS FOR B.Tech. Mechanical (FOURTH SEMESTER)

Course Name: MEL202- FLUID MECHANICS

Course Pre-requisites: NIL

Offered in: IV Semester (Even Semester)

Scheme and Credit: [(3-1-0); Credits: 4]

Type of Course: Core

Course Assessment Method: Sessional I (15%), Sessional II (15%), Teachers Assessment (10%), End Semester exam (60%).

Course Objectives:

1. To understand the basic concepts regarding the behaviour of fluid.
2. To learn various methods for estimation of forces due to fluid / fluid pressure measurement and flow measurements.
3. Develops skill to analyze various fluid systems.

Syllabus:

Introduction : Properties of fluids, viscosity, capillarity and surface tension, Fluid pressure and its measurement Pressure variation in compressible and incompressible fluids, Hydrostatics: Forces on plane and curved surfaces, Buoyancy, Stability of floating and submerged bodies, Relative equilibrium pressure distribution in liquid subjected to acceleration and rotation.

Flow Kinematics: Types of flows; steady and unsteady, rotational and irrotational, laminar and turbulent, etc Streamlines, potential lines, flow net, vortex motion, Velocity and acceleration at a point, stream function, potential function, continuity equation, Bernoulli's equation and its applications.

Measurement of Fluid Flow: Through ducts: Orifice meter, venturi meter, rotameter, etc., Through open channels: Triangular notch, Rectangular notch, trapezoidal notch, etc., Through reservoirs: Orifice, mouthpiece, etc.

Viscous Flow : Through pipes and parallel plates (Hagen poiseuille and plane poiseuille flow)

Boundary layer concept, boundary layer thickness, wall shear, displacement thickness, momentum thickness and energy thickness, integral equation,Boundary layer separation.

Flow Through Pipes: Major and minor losses, friction chart, Pipes in series and parallel, Siphon, Power transmission Hydraulic Gradient Line and Total Energy Line

Compressible Flows: Introduction to compressible flows, speed of sound wave, Mach number, Mach cone, one dimensional isentropic flows, stagnation properties, flow through nozzles, normal shock

Tutorials: (minimum 5)

1. Dimensional analysis and similitude
2. Error analysis
3. Drag and lift on immersed bodies
4. Kinetic energy and momentum correction factors
5. Water hammer
6. Pipe networks

Other assignments based on the theory syllabus

REFERENCES

5. White F.M "Fluid mechanics; Ed", McGraw Hil, 2nd1986.
6. Massey B.S. "Mechanics of fluids", ELBS-Chapman & Hall, 6th Ed1994.
7. Streeter V.L, Wylie E.B "Fluid mechanics, 7th Ed;,", McGraw Hill, 1983.
8. Thombre S.B. "A data book on Thermal Engineering", Green Brains Publication, 1st 2003.

Course Outcomes:

Students successfully completing this course will demonstrate the following outcomes by homework and exams:

1. An understanding of fluid mechanics fundamentals, including concepts of mass and momentum conservation.
2. An ability to apply the Bernoulli equation to solve problems in fluid mechanics.
3. An ability to apply control volume analysis to problems in fluid mechanics.
4. An ability to use potential flow theory to solve problems in fluid mechanics.
5. An ability to perform dimensional analysis for problems in fluid mechanics.
6. A knowledge of laminar and turbulent boundary layer fundamentals.

Course Name: MEP202- FLUID MECHANICS LAB

Course Pre-requisites: NIL

Offered in: IV Semester (Even Semester)

Scheme and Credit: [(0-0-2); Credits: 1]

Type of Course: Core

Course Assessment Method: Sessional I (15%), Sessional II (15%), Teachers Assessment (10%), End Semester exam (60%).

Course Objectives:

1. To understand the basic concepts regarding the behaviour of fluid.
2. To learn various methods for estimation of forces due to fluid / fluid pressure measurement and flow measurements.
3. Develops skill to analyze various fluid systems.

Syllabus:

1. Determination of viscosity of a fluid by falling sphere method
2. Study of manometers
3. Study of pressure variation along the depth in an incompressible fluid
4. Study of vortex motion
5. Determination of metacentric height of a ship model
6. Tracing of stream lines
7. Verification of Bernoulli's equation
8. Determination of drag and lift coefficients
9. Determination of coefficient of discharge of a venturi/ orifice meter
10. Determination of coefficient of discharge of an orifice/ mouthpiece
11. Determination of coefficient of discharge of different notches
12. Study of Hagen Poiseuille flow
13. Reynolds experiment

Other experiments based on the theory syllabus.

Course Name: MEL201-THEORY OF MACHINES – I

Course Pre-requisites: NIL

Offered in: IV Semester (Even Semester)

Scheme and Credit: [(3-1-0); Credits: 4]

Type of Course: Core

Course Assessment Method: Sessional I (15%), Sessional II (15%), Teachers Assessment (10%), End Semester exam (60%).

Course Objectives:

To understand the theory and fundamentals of working of machines to understand different types of assemblies and linkages used in machine parts.

Syllabus:

Basic Concept of Mechanism : Basic concept of mechanisms, links, kinematic pairs, kinematic chain, mechanisms, machine, Types of mechanisms, Degree of freedom of link and planer mechanism, Classification of four-bar chain (Class I and Class II) Inversion of four bar chain, Slider crank chain and double slider crank chain. Analysis and Synthesis of Mechanism : Velocity, acceleration analysis of planer mechanism by graphical method using relative velocity/ acceleration. Concept of velocity and acceleration image, Coriollis component of acceleration, Instantaneous centre of velocity method. Synthesis of four-bar/ slider crank mechanism for gross motion. Input/ Output coordination and quick return ratio. Transmission angle.Cam Mechanisms : Types of cams, follower and applications. Synthesis of cam for different types of follower motion like constant velocity, parabolic SHM, cycloidal etc. Construction of eccentric cam, tangent cam and circular arc cam. Analysis of follower motion for cams with specified contours like eccentric cam, tangent cam and circular arc cam. Transmission : Belt Drive: Ratio of belt tension, initial tension for flat and V belts. Power Screw: Theory of Friction, Efficiency and torque required to raise and lower load Brakes: Types of brakes and braking torque relations Clutches: Types of clutches and relations for torque transmitted Gears : Types of gears, Gear tooth terminologies. Concept of conjugate action, law of conjugate action, kinematics of involute gear tooth pairs during the contact, number of pairs of teeth in contact, path of approach and path of recess Interference, undercutting for involute profile teeth. Introduction to cycloidal profile. Types of gear trains. Kinematic analysis of ear trains including simple epicyclic and double epicyclic gear trains.
Force Analysis : Static force analysis: free body diagram, condition of equilibrium. Analysis of all links of given linkages, cams, gears mechanism and their combinations without friction. Force analysis of four bar chain with friction, Force analysis of gear trains. Concept of inertial load. Dynamic force analysis of four link mechanisms. Dynamic force analysis of cam follower mechanism.

REFERENCES

1. Shigley J.E., Uiker J.J "Theory of Mechanisms & Machines", McGraw Hill Int., 1985.
2. Thomos Beven "Theory of Mechanisms & Machinesrs", CBS Publisher
3. Rao J.S., Dukki Patti R.V "Mechanisms & Machines Theory,", New age Int, 2nd 1998.
4. Ghosh A, Mallik A "Theory of Mechanisms & Machines, Ed", Aff. East-West Press, 3rd 1998.
5. Rattan "Theory of Machine", Tata McGraw Hill, 1995.
6. Sandor G.N., Erdman A.G "Theory of Machines", Prentice Hall Publications, 1984 .

Course Outcomes: On completion of this course, students will be able to

1. Draw inversions and determine velocity and acceleration of different mechanisms.
2. Construct different types of cam profile for a given data.

Course Name: MEL304-MACHINE DESIGN – I

Course Pre-requisites: NIL

Offered in: IV Semester (Even Semester)

Scheme and Credit: [(3-1-0); Credits: 4]

Type of Course: Core

Course Assessment Method: Sessional I (15%), Sessional II (15%), Teachers Assessment (10%), End Semester exam (60%).

Course Objectives:

To apply knowledge of mechanics of materials for designing mechanical elements including design process, failure prevention under static & variable loadings.

Syllabus:

Design Principles : Definition of design, types of design, design process, need, defining the problem, feasibility, preliminary design alternatives, final design selection, preliminary and final plans and drawings. Failure criterion & manufacturing considerations in design, basis of good design, theories of failure and factor of safety, wear, corrosion, manufacturing methods, machining tolerance, surface finish, cost design consideration in casting & forging. Material Selection: Mechanical properties, Applications and designations as per ISI and their equivalence with other standards of engineering materials, selection of material, temperature effects on material properties of ferrous and non-ferrous materials, plastics, composites & their applications.

Joints : Design of Joints : Design of cotter and knuckle joint, shrink and press fit joints. Riveted Joint: Riveted joints for boilers, structural works (uniform strength joint), and eccentric loaded joint. Welded Joint: Design of single transverse, double transverse, parallel fillet, combination fillets butt joint, eccentrically loaded welded joints. Bolted Joint: Design of bolted fasteners, bolts of uniform strength, bolted joints under eccentric loading. Design of lever and pin joints: Hand lever, Foot lever, and Bell Crank lever.

Design of Springs , Design of Power screws : Forms of threads; square, Acme & Trapezoidal threads, efficiency of various threads form. Design of screw jack and compounded screws.

Design of Springs, Expression for deflection and shear stress in helical spring, design of helical spring, design of leaf spring. Design of brakes & clutches: Kinematics of friction drives such as brakes, clutches design of friction clutch, single plate, double plate, cone, centrifugal clutch, design of brake, shoe brake, band brake, internal expanding brake. Design of pressure vessels: Classification of thin & thick cylindrical pressure vessel, stresses in thin & thick cylindrical pressure vessel when it is subjected to internal pressure, expression for circumferential & longitudinal stresses, designs of pressure vessel, heads & cover plate Design of shafts: Design of Transmission shafts on the basis of strength, rigidity & critical speed, ASME code for shaft design. Design of stepped shaft, axle, splined-shaft, keys.

REFERENCES

1. Maleev V.L, Hartman J.B “Mechanical Design of Machine”, CBS Pub. & distributors., 1983.
2. Black P.H., Adams O.E “Machine Design Tata Mc Graw Hill, 1968.
3. Shigley J.E “Mechanical Engg. Design”, Tata Mc Graw Hill International, 8th Edition.
4. Shiwalkar B.D “Design of Machine Elements, Ed”, Central Techno Publication, 2nd 2001.
5. Shiwalkar B.D “Design Data for Machine Elements”, Central Techno Publication.
6. PSG College of Technology “Design data”, DPV Printers, Coimbature, 2011 .
7. V. B. Bhandari “Design of Machine Elements”, Tata McGraw Hills, 3rd, 2013.

Course Outcomes:

On completion of this course, students will be able to

1. Identify various failures and calculate resisting areas of machine elements.
2. Use preferred numbers and standardization to select element/element dimension.
3. Design machine element subjected to direct, bending, twisting and combined stress.
4. Solve problems on power transmission.
5. Design of thin and thick cylinder pressure vessel.
6. Select appropriate bearing for given situation and Calculate important bearing characteristics.

Course Name: MEL305-MANUFACTURING PROCESSES – II

Course Pre-requisites: NIL

Offered in: IV Semester (Even Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Core

Course Assessment Method: Sessional I (15%), Sessional II (15%), Teachers Assessment (10%), End Semester exam (60%).

Course Objectives:

The students will achieve sufficient knowledge & studies to :

1. understand and analyze basic machining operation
2. understand the theory of metal cutting & apply it to various operations,
3. Learn different non conventional machining processes, their features & controlling parameters.

Syllabus:

Theory of Metal Cutting

Introduction, orthogonal and oblique cutting, mechanics of metal cutting, shear plane stress, strain and cutting forces, cheap formation. Cutting force calculation, determination of torque and power requirement for turning, drilling and milling. Influence of tool angle, cutting fluids, cutting tool materials, cutting speed, feed and depth of cut, effect on power requirement, tool life.

Lathes

Introduction, construction, types, work holding devices, operating conditions, operations on lathe. Turrets, capstan and automats. Introduction, construction, classification, tool attachments of turret and capstan lathe, bar feed mechanism, indexing mechanism. General operation mechanism, classification advantages of automatic lathe machines. Drilling, Shaping, planning, slotting, milling Machines

Drilling: Introduction, operating conditions, material removal rate. Boring, reaming, tapping, shaping, planning and slotting, Introduction, types, operating conditions, machining time, material removal rate. Milling: Introduction, types, milling process, operating conditions, material removal rate, types of milling operations. Indexing, Introduction to Jigs and fixtures, types, applications.

Finishing Processes

Grinding wheel, grinding machines, fine finishing operations such as lapping, honing, polishing buffing

Non-conventional Machining Processes

Introduction, classification, water jet machining, chemical machining, electro chemical machining, electrical discharge machining, non-conventional forming processes.

REFERENCES

1. Sharma P.C “Text Book of Production Engineering”, S Chand & Co., 10 th 2002.
2. Parashar B.S., Mittal R.K “Element of Manufact. Processes,.Ed", Eastern Eco, 2003.
3. Ghosh A., Mallik A.K “Manufacturing Science”, Affiliated East-West Press Pvt. Ltd, 2001.
4. Pandya, Shah “Modern Machining Processes”, Tata McGraw Hill, New Delhi, 12th 1998.
5. Hajra Choudhary S.K., Bose S.K, HajraChoudary A.K., Roy H “Elements of Workshop Tech. Ed”, Media Promoters & Pub, Vol.I & II, 19th.

Course Outcomes: On completion of this course, students will be able to
1. Explain mechanics of cutting.
2. Classify and explain working of basic machine tools with kinematics
3. Observe and conclude the effect of varying tool materials, cutting parameters and work piece materials 4. Interpret and select tool and tool holder designation system.
5. Identify the machine tool and select cutting parameters for given job.

Course Name: MEP305-MANUFACTURING PROCESSES – II LAB

Course Pre-requisites: NIL

Offered in: IV Semester (Even Semester)

Scheme and Credit: [(0-0-2); Credits: 1]

Type of Course: Core

Course Assessment Method: Sessional I (15%), Sessional II (15%), Teachers Assessment (10%), End Semester exam (60%).

List of Experiments:
Experiment based on syllabus of Manufacturing Processes – II

Course Name: MEL303-ENERGY CONVERSION – I

Course Pre-requisites: NIL

Offered in: IV Semester (Even Semester)

Scheme and Credit: [(3-1-0); Credits: 4]

Type of Course: Core

Course Assessment Method: Sessional I (15%), Sessional II (15%), Teachers Assessment (10%), End Semester exam (60%).

Course Objectives:

Basically uses all the applications of steam & its measurements leading to Thermal Power Plant using any fuel.

Syllabus:

Steam Generators

Principles of steam generation, Classification of Steam Generators, Fire tubes and Water tubes Steam Generators, High Pressure and Super critical Steam Generators, Boiler Mountings and Accessories.

Draught

Draught and its classification, Chimney height, Chimney Efficiency, Condition for maximum discharge. Performance of Steam Generators, Evaporative Capacity, Equivalent Evaporation, Factor of Evaporation, Boiler Efficiency, Energy balance.

Fluidized Bed Boilers

Fluidized Bed Boilers: Bubbling Fluidized Bed Boiler, Circulating Fluidized Bed Boiler, Introduction to Cogeneration and Combined Cycles, Power Plants.

Steam Nozzles & Steam Turbines

Steam Nozzles: Adiabatic expansion in nozzles, Maximum Discharge, Critical Pressure Ratio and effects of Friction, Calculation of throats and exit area, Super Saturated flow, Wilson's line.

Steam Turbines: Principles of Working of Steam Turbines, Classifications of Steam Turbine, Comparison of Impulse and Reaction Turbines, Simple and Compound Steam Turbines.

Steam Turbines and Engines

Energy losses in Steam Turbines, Flow of steam through Turbine blading, Actual Reheat factor, Velocity diagrams, Graphical and analytical Methods, Work done, Thrust and Power, Dimensions and Proportioning of the Blades, Steam Turbine, Efficiencies, Condition for Maximum Efficiency, Reheat and Regenerative cycles, Governing of Steam Turbine. Introduction to Simple Steam Engine. Modified Rankine Cycle.

Steam Condensers and Cooling Towers

Steam Condensers and Cooling Towers: Types of Condensers, Classification of Condenser, Quantity of cooling water Required, Design Calculations for Surface Condenser, Daltons Law of Partial Pressures, Sources of Air Leakage and Air Removal. Wet and Dry Pumps, Air Ejectors, Cooling Towers, Cooling Ponds.

Tutorials:

1. High pressure boilers
2. Meta-stable flow in steam nozzles
3. Governing of steam turbines

4. Blade design in steam turbines
5. Cooling Towers and cooling ponds
6. Design aspects of steam condenser.

REFERENCES

1. Domkundwar, K'raman, Khajuria "Thermal Engineering", Dhanpatrai & sons, 4th1996.
2. Ballaney P.L "Thermal Engineering ", Khanna Publishers, 24th2003.
3. Rogers, Mayhew "Engineering Thermo: Work and Heat Transfer", Longman, London, 1992.
4. Kearton V.J "Steam Turbines", The English Language Book Society, London, 1961.
5. Thombre S.B, Roy H "A data book on Thermal Engineering", Green Brains Publication, 1st2003.

Course Outcomes:

On completion of this course, students will be able to

1. Classify boilers and prepare heat balance for the boiler performances.
2. Apply change cycles for thermal power plants.
3. Analyze the performance of air compressors.
4. Describe the performances for steam nozzles, steam condensers and cooling towers.

Course Name: MEL306-MACHINE DRAWING

Course Pre-requisites: NIL

Offered in: IV Semester (Even Semester)

Scheme and Credit: [(2-0-0); Credits: 2]

Type of Course: Core

Course Assessment Method: Sessional I (15%), Sessional II (15%), Teachers Assessment (10%), End Semester exam (60%).

Course Objectives:

This course will teach the practice followed for graphical interpretation of mechanical comments designed by design section, so that the actual manufacturing

Syllabus:

Drawing Standards for following:

Drawing Sheets, Name Blocks, Lines, Sections, Dimensioning, Dimensioning of Tolerances Standard Components, Standard Features, Machining Symbols, Welding Symbols, Surface Finish Symbols, Heat Treatment, Manufacturing Instructions, Allowances, Materials.

Orthographic Projections of Elements

Orthographic Projections, Sectional Views, Multiple Views, Missing Views, Profiles, Cross sections, References, Alignments, Dimensioning.

Study, qualitative selection of type / size (excluding design calculations) and standard practices for the following elements

Threads, Bolts, Nuts, Washers, Rivets, Welds, Keys & Keyways, Splines, Couplings.

Assembly and Dismantling Techniques, Principles of Assembly:

Fits and Tolerances (Standard, types, application and selection) Tolerance Charting Surface Finish requirement for assembly, Manufacturing Method, Geometrics suitable for assembly, Assembly/Dismantling Tools, Bearing Assemblies, Assemblies by fastening.

Assembly Drawings (Principles, techniques and standards of drawing of following)

Component, Subassembly, Full assembly, Exploded Views, Various frames / brackets / housings / casings, Study of some standard assemblies.

Production Drawing:

Name Plates, Part List, Revisions, etc., Essential Parts/Formats required for production drawing, Process Sheet

REFERENCES

1. Naryana K.L., Kannaiah R., Venkata Reddy K “Machine Drawing”, New Age Int.Pub, 1st.
2. Naryana K.L., Kannaiah R., Venkata Reddy K “Production Drawing ", New Age Int.Pub, 1st.
3. N.D.Bhatt “Machine Drawing; Ed”, Charotar Publishing House, 33rd 2000.
4. PSG College of Technology “Design data”, DPV Printers, Coimbature, 1st Ed.; , 2002.
5. “Engg. Drawing practice for schools & colleges”, Bureau of Indian Standards, 1st1998.

Course Outcomes: On completion of this course, students will be able to

1. Understand and apply the knowledge of machine drawing as a system of Communication in which ideas are expressed clearly and all information fully conveyed.

2. To understand the design a system, component or process to meet desired needs within, realistic constraints such as manufacturability ,economic ,environmental, safety & sustainability etc.., to represent a part drawing and assembly drawings.

3. To identify, formulates, analyzes and solve Engineering Problems in Optimum time.

Course Name: MEP306- MACHINE DRAWING PRACTICE

Course Pre-requisites: NIL

Offered in: IV Semester (Even Semester)

Scheme and Credit: [(0-0-2); Credits: 1]

Type of Course: Core

Course Assessment Method: Sessional I (15%), Sessional II (15%), Teachers Assessment (10%), End Semester exam (60%).

Course Objectives:

This course will teach the practice followed for graphical interpretation of mechanical comments designed by design section, so that the actual manufacturing

Syllabus:

1. Pencil Drawings of some standard components: Two sheets.
2. Pencil Drawings of standard assemblies with components: 2 sheets (2 different assemblies)
3. Pencil Drawings of Exploded View of a small assembly: One sheet.
4. Computer printout of a small assembly with components: One Assembly.
5. Computer printout of a large assembly with component drawings, subassembly drawings and assembly drawings using all standard formats: One Assembly.
6. Computers print out of Production Drawing and Process sheets for two components.

COURSE SYLLABUS FOR B.TECH. MECHANICAL (FIFTH SEMESTER)

Course Name: MEL302 - HEAT TRANSFER

Course Pre-requisites: NIL

Offered in: V Semester (Odd Semester)

Scheme and Credit: [(3-1-0); Credits: 4]

Type of Course: Core

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. To introduce students different modes of heat transfer like conduction, convection & Radiation,
2. Estimation of heat transfer through composite walls & transient temperature state HT to sudden change
3. Prediction of hic for different g

Syllabus:

Basic modes of Heat Transfer & their mechanisms : Introduction, Conduction: Fourier law of heat conduction, Thermal conductivity, General conduction equation, thermal diffusivity, One Dimensional, steady-state, without heat generation heat transfer, Concept of thermal resistance and electrical analogy, Conduction through composite slab/cylinders/spheres, Contact resistance/ Fouling Factor, Overall heat transfer coefficient, Critical thickness of Insulation, Analysis of extended surfaces: Rectangular profile longitudinal fins/ spines, Lumped heat capacitance method of unsteady analysis.

Forced Convection : Flow over flat plate, Hydrodynamic & thermal boundary layer, Prandtl Number, Nusselt Number, Reynolds Number, Local and average heat transfer coefficient, Empirical relations for external flows, Flow through ducts.

Natural Convection: Natural Convection from vertical plate, Grashoff's Number, Empirical relations for natural convection from various bodies.

Condensation: Filmwise and Dropwise condensation, Nusselt theory for filmwise condensation on vertical plates, Pool Boiling Curve.

Radiation : Laws of Radiation, Black body, Grey body & Coloured body, Emissivity, Black body radiation, Shape factor & its properties, Radiation exchange between two gray surfaces.

Heat Exchanger : Classification of heat exchangers, LMTD Approach for parallel & Counter flow heat exchangers, NTU approach for parallel/ Counter flow heat exchangers, Design aspects of heat exchangers.

REFERENCES

1. Incropera, F.P., Dewitt, D. P., "Funda. of Heat & Mass Transfer", John Wiley & Sons ,4th 1996.
2. Holman, J. P., "Heat Transfer", McGraw Hill, 8th Edition, 2003 .
3. Sukhatme, S. P., "A Textbook on Heat Transfer", Orient Longman Ltd Bombay, 1985 .
4.T hombre, S.B., "A data book on Thermal Engg, Ed ", Green Brains Publication, 1st Edition, 2003 .

Course Outcomes: On completion of this course, students will be

1. Understand the basic laws of heat transfer.
2. Account for the consequence of heat transfer in thermal analyses of engineering systems.
3. Obtain numerical solutions for conduction and radiation heat transfer problems.
4. Evaluate heat transfer coefficients for natural convection and forced convection.
5. Analyze heat exchanger performance by using the method of heat exchanger effectiveness.

Course Name: MEL308 - ENERGY CONVERSION – II

Course Pre-requisites: NIL

Offered in: V Semester (Odd Semester)

Scheme and Credit: [(3-1-0); Credits: 4]

Type of Course: Core

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. To give an overview of Internal Combustion Engines, their classification, applications, operation and processes.

2. To carry out thermodynamic analysis of various cycles of operation.

3. To give complete knowledge of type of fuels used in IC engines and the fuel supply systems

4. To describe combustion phenomena in IC engines

5. To explain the Gas Turbine and Jet Propulsion systems.

Syllabus:

I.C. Engines : Air standard and fuel air cycles, parts of I.C. engines, two stroke and four stroke I.C. engines, SI and CI engines, combustion in SI and CI engines, detonation, carburetion and diesel injection. Measurement of power: indicated, friction and brake power, fuel and air consumption, indicated, brake, volumetric and mechanical efficiency, percentage of excess air, heat balance sheet, performance characteristics & factors influencing the performance of I.C. engines.

Gas Turbines & Jet Propulsion : Ideal cycles, small stage efficiency, pressure losses, intercooling, reheat & regeneration, fuel-air ratio, combustion efficiency, performance calculations, open cycle and closed cycle gas turbines. Working of turbojet, turboprop, ramjet & pulsejet, performance.

Reciprocating Compressors :Parts, operations, work done during isothermal, polytropic & adiabatic compression process, PV diagram, isothermal, volumetric and mechanical efficiency, effect of clearance, multistage compressor, condition for minimum work input, capacity control, actual indicator diagram.

Refrigeration And Air Conditioning : Vapor compression refrigeration system, analysis, actual refrigerating cycle, effect of subcooling & superheating, C.O.P., performance calculation, psychometric chart and processes such as heating cooling, humidification & dehumidification.

REFERENCES

1. Ballaney P.L. “Thermal engineering, Ed;, ”,Khanna Publishers ,24th 2003.
2. Holman J. P.,"IC engines",McGraw Hill,2nd 2004 .
3. Arora C.P."Steam and Gas Turbines; ",Tata McGraw Hill,2nd 2001 .
4. Yadav R.."Steam and Gas Turbines;"Central Publishing house Allahbad,,2001 .

Course Outcomes: On completion of this course, students will be

1. Classify various types of I.C. Engines and Cycles of operation.
2. Express the effect of various operating variables on engine performance
3. Discuss fuel metering and fuel supply systems for different types of engines
4. Distinguish normal and abnormal combustion phenomena in SI and CI engines
5. Justify the suitability of conventional and non-conventional fuels for IC engines
6. Solve the performance of Gas Turbine and Jet engines

Course Name: MEL301 - THEORY OF MACHINES – II

Course Pre-requisites: NIL

Offered in: V Semester (Odd Semester)

Scheme and Credit: [(3-1-0); Credits: 4]

Type of Course: Core

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

The course aims to make the students competent for analysis of dynamic forces and vibration in mechanical systems. The students are expected to be competent to do the following:

1) Analyze dynamic forces in reciprocating engine, mechanisms and other planer mechanisms.
2) Design flywheel,
3) Represent mechanical systems in terms of mathematical model for vibration analysis,
4) Find natural frequency of single degree freedom systems
5) Analyze free and forced vibration

Syllabus:

Machine Dynamics : Concepts in machine element dynamics. D'Alembert principle and inertia forces. Unbalance forces and moments in rotor-disc assembly. Static and dynamic balancing by analytical as well as graphical method. Field balancing by vector diagram and by influence coefficient method.

Balancing of reciprocating masses : Dynamic force analysis of reciprocating mechanism by analytical method. Primary and secondary inertia forces. Balancing of inertia forces in reciprocating mechanism. T-ç□diagram for single- cylinder and multi-cylinder engines and other reciprocating machines such as punching press. Selection of Flywheel inertia parameters. Balancing of inertia forces and couples in multi-cylinder engines. Selection of firing order and crank diagram. Radial engines and V-twin engines. Gyroscopic effect in machines such as ship, vehicles, grinding mills.

Vibration : Basic methods of mathematical modeling of discrete vibratory systems. Free body diagram, Rayleigh energy method and Langrange equation. Laplace transform and transfer function derivation. Free vibration of single DOF systems. Estimation of Damping. Forced vibration under harmonic excitation. Impulse and step response. Modeling of two DOF systems. Torsional vibrations of rotors. Whirling of shaft and critical speed. Modeling of multi-degree of freedom system mode orthogonality property. Natural frequency and mode shape calculation by matrix iteration method. Modal analysis. Free and forced vibration.

REFERENCES

1. Ghosh & Malik. "Theory of Mechanism and Machine, ",Aff. East-West Press, Anand ,3rd.

2. Ratan ,"Theory of Machine,; ",Tata McGraw Hill, 12th Reprint Edition .

3. Rao,Gupta"Theory and Practice of Mechanical Vibration,",New Age International,2nd Ed.

4. Meirovitch L."Elements of Vibration Analysis,"McGraw Hill Publications,2nd Ed .

Course Outcomes: On completion of this course, students will be

1. Students will have an understanding of static force relationships and inertia forces and their effect that exist in machines
2. Students will demonstrate the dynamics of flywheel and their motion
3. Students will be able to perform balancing, vibration and critical speeds with respect to Machine dynamics

Course Name: MEL307 - FLUID MACHINES

Course Pre-requisites: NIL

Offered in: V Semester (Odd Semester)

Scheme and Credit: [(3-1-0); Credits: 4]

Type of Course: Core

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

(1) To learn and understand principles of fluid mechanics and power with applications. Topics include: fluid properties, conservation of energy, momentum, incompressible flow in pipes, standard symbols, components and control of hydraulic and pneumatic systems.

(2) To provide the student the necessary analytical skills to solve and analyze a variety of fluid mechanics and fluid power related problems.

Syllabus:

Roto dynamic machinery

Operation, performance and similarity laws of roto dynamic machineries

Pumps

Types of pumps, fans, blower, and compressors, cavitation in pump

Hydraulic design of centrifugal type pump and blower.

Hydraulic design of Positive displacement type and jet pump type machinery.

Turbines

Impulse and reaction type hydro turbines; operation, performance, similarity laws,

Hydraulic design of impulse type and radial flow type hydro turbines.

REFERENCES

1.Vasandani V.P. “Hydraulic Machines”,Khanna Publishers,1984.

2.Kumar D.S,"Fluid Mechanics and Fluid Machines; ",S.K.Kataria & Sons,4th Ed 1992 .

3.Bansal R.K,"Fluid Mechanics and Fluid Machines,;, ",Laxmi Publications,7th Ed 2002.

4.Lal Jagdish"Hydraulic Machines"Metropolitan Book Co. Ltd,,7th Ed 1984.

5.Rajput R.K. “Hydraulic Machines,; S.Chand &Co.”,Metropolitan Book Co. Ltd,,1st Ed..

6.Church A.H., Lal J"Centrifugal Pumps and blowers",Metropolitan Book,6th Ed 1973 .

7.Massey B.S"Turbines, Fans and Compressors;, ",Van Nostrand Reinhold Co.,6th Ed 1989.

8.Yahya S.M."Turbines, Fans and Compressors;"Tata McGraw Hill,,1999.

Course Outcomes: On learning this subject students will be able

1. To select a turbine or a pump etc. depending upon the availability of resources and requirement of the project in hand.
2. To calculate various parameters like efficiency, specific speed etc. To some extent the students will get expertise about the design methodologies of Fluid Machinery.

Course Name: MEP307- FLUID MACHINES LAB

Course Pre-requisites: NIL

Offered in: V Semester (Odd Semester)

Scheme and Credit: [(0-0-2); Credits: 2]

Type of Course: Core

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. To understand the basic concepts regarding the behavior of fluid.
2. To learn various methods for estimation of forces due to fluid / fluid pressure measurement and flow measurements.
3. Develops skill to analyze various fluid systems.

Syllabus:

1. Determination of viscosity of a fluid by falling sphere method
2. Study of manometers
3. Study of pressure variation along the depth in an incompressible fluid
4. Study of vortex motion
5. Determination of metacentric height of a ship model
6. Tracing of stream lines
7. Verification of Bernoulli's equation
8. Determination of drag and lift coefficients
9. Determination of coefficient of discharge of a venturi/ orifice meter
10. Determination of coefficient of discharge of an orifice/ mouthpiece
11. Determination of coefficient of discharge of different notches
12. Study of Hagen Poiseuille flow
13. Reynolds experiment

Other experiments based on the theory syllabus

Course Outcomes: On completion of this course, students will be

1. Design piping system and its components.

2. Evaluate and compare different flow meters.

3. Predict losses in various fluid dynamical systems.

4. Explain the role of pressure as a driving force.

5. Calibration of flow meters.

Course Name: MEP301- THEORY OF MACHINES LAB

Offered in: V Semester (Odd Semester)

Scheme and Credit: [(0-0-2); Credits: 2]

Type of Course: Core

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:
To understand the theory and fundamentals of working of machines
To understand different types of assemblies and linkages used in machine parts.

Syllabus:
- Determination of jump-of speed of a typical cam-follower system.
- Dynamic balancing of rotating masses.
- Balancing of reciprocating mechanism.
- Critical speed of shafts.
- Gyroscope
- Free vibration of single DOF and two DOF spring mass system.
- Natural frequency determination of cantilever beam.
- Damping determination through free vibration logarithmic decay of simple damped system.
- Natural frequency determination of two & three rotor system.
- Torsional vibration of bifilar or trifilar pendulum.
- Transmissibility of single DOF system.
- Dynamic vibration absorber.
- Dynamic force analysis of four bar mechanisms.
- Dynamic force analysis of slider crank mechanism.
- Flywheel selection and parameter design for a typical multi cylinder engine.

Performance characteristics of governors.

Course Outcomes: On completion of this course, students will be

1. Students will have an understanding of static force relationships and inertia forces and

their effect that exist in machines

2. Students will demonstrate the dynamics of flywheel and their motion

3. Students will be able to perform balancing, vibration and critical speeds with respect to

Machine dynamics

Course Name: MEP302- THERMAL LAB

Offered in: V Semester (Odd Semester)

Scheme and Credit: [(0-0-2); Credits: 2]

Type of Course: Core

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

Objective is to make the students understand:

(1) how the thermal conductivities of different materials are estimated
(2) how hTc on various surfaces can be calculated
(3) different boiling regimes and critical heat flux values
(4) Error involved in the estimation of different parameters.

Syllabus:

1) Thermal conductivity of insulating powder. To compare theoretical & practically observed temperature distribution (pin fin) experiment in a pin fin when subjected to forced and convection.
2) To compare performance of HX in parallel & counter flow mode.
3) To determine heat transfer coefficient over a cylindrical body under transient conditions.
4) To determine thermal efficiency of solar collector under natural and forced convection of operation.
5) To determine thermal conductivity of metal rods.
6) To determine heat transfer coefficient under filmwise / dropwise condensation.
7) To observe the different boiling regimes on a cylindrical rod.
8) To determine critical heat flux
9) To determine htc for flow through pipes
10) To determine htc for flow through pipes forced convection from a vertical / horizontal / inclined plates.

Course Outcomes: On completion of this course, students will be

1. Ability to measure the thermal conductivity of different common metallic materials.

2. Ability to measure the quantity of heat transfer between fluids and solid boundaries.

3. Ability to measure the amount of heat exchanged between fluids flowing within heat exchangers

4. Ability to carry out simple experimental work in irradiative heat transfer

Course Name: MEL416- INDUSTRIAL ROBOTICS

Offered in: V Semester (Odd Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Elective

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1) To gain fundamental skills underlying the mechanism and control of manipulators
2) To obtain knowledge and understand basic concepts of industrial robotics, in terms of classification, kinematics, in terms of classification, kinematics, sensors and actuators, dynamics and motion planning for typical application.
3) To implement robots for various applications in industry, service, society and surveillance

Syllabus:

Introduction

Construction of manipulators, advantages and disadvantages of various kinematic structures.

Actuators

Pneumatic, hydraulic and electric. Characteristics and control. Nonservo robots, motion planning. Feed back systems, encoders, servo control PTP and CP.

Introduction to Kinematics

Homogeneous coordinates, solution of the inverse kinematics problem, multiple solutions, jacobian, work envelopes.

Trajectory planning

Manipulator dynamics and force control.

Sensors

Vision, ranging, laser, acoustic, tactile. Developments in sensor technology, sensory control.

Programming Language: VAL, RAIL, AML. Mobile robots, walking devices. Robot reasoning and Robot applications

REFERENCES

1.Fu K.S, Gonzalez R.C., Lee C.S.G., “Fundamental of Robotics”, McGraw Hill, 1987.

2.Koren Y., "Robotics for Engineers", McGraw Hil, 1985 .

3.Craig J.J,"Robotics”, Addison Wesley, 1986.

Course Outcomes: On completion of this course, students will be

1. Analyze the manipulator design including actuator, drive and sensor issue
2. Calculate the forward kinematics, inverse kinematics and Jacobian for serial and parallel robots
3. Identify different types of end effectors and sensors required for specific applications
4. Develop programming principles and languages for a robot control system
5. Discuss various applications of industrial robot systems.

Course Name: MEL421- COMPUTATIONAL METHODS IN ENGINEERING

Course Pre-requisites: NIL

Offered in: V Semester (Odd Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Elective

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. To apply knowledge of numerical methods in the solution of mechanical and related engineering problems.
2. To demonstrate an ability to identify, formulate, analyze and solve mechanical engineering problems numerically under realistic constraints.

Syllabus:

Overview and practical significance of course in engineering problem, Mathematical modeling, interpolation and extrapolation, Definition of Differential equation and its type, initial value problem, boundary value problem, Accuracy, precision, Error and its type, Tolerance, Significant figure and its rule, Taylor series, Maclaurin series and expansion of some useful function. Newton-Raphson's, Bisection, Regula-falsi, and Secant method. Rate of convergence: Defination &its properties, convergence of Bisection, Secant, Regula-falsi, & Newton's Rapson's method. System of non-linear equation: Gauss Jacobin, Gauss- Elimination, Gauss-Jordan, LU decomposition, Choleski decomposition method. Iterative method: Gauss- Jacobi, Gauss-Seidal method, Interpolation: Lagrange interpolation(linear and quadratic), Derive the Error of interpolation equation, Rolls theorem. Newton divided difference interpolation: divided difference & divided difference, finite difference operator, Newton forward and backward difference interpolation, Spline interpolation: Linear, quadratic and cubic spline interpolation and its significance. Least square approximation: linear and quadratic. Eigen value definition &its significance, phase form, stability analysis, Eigen value by direct and power method, Numerical integration method: Trapezoidal rule, Simpson's 1/3 and 3/8 rule, Gauss Legendre. Numerical solution of ODE(IVP) using Euler, Predictor-corrector, mid- point, Runge-Kutta 2nd , Runge-Kutta 4th order method .Numerical solution of ODE(BVP) using finite difference method and central difference method . Type of boundary condition: Neumann, Dirichlet, Cauchy &Robin boundary condition. Definition &type of PDE, finite difference approximation to derivative: forward, backward and central for 1st &2nd order, the Laplace equation, Bender-Schmidt recurrence relation& Crank-Nicolson's condition, Overview on FEM,FDM&FVM& its significances in engineering problem, weighted residual and Galerkin method with numerical problem

REFERENCES

1. Kreyszig, E. "Advanced Engineering Mathematics", John Wiley & Sons, 7th Edition, 1993.
2. Chandrika Prasad. "Mathematics for Engineers", Prasad Mudranalaya, 12th Edition, 1981.
3. Chandrika Prasad "Advanced Mathematics for Engineers", Prasad Mudranalaya, 7th Edition, 1972
4. Speigel, M.R. "Advanced Mathematics For Engineers and Scientists", McGraw Hill., 1992.

Course Outcomes: On completion of this course, students will be

1. Able to demonstrate an ability to identify, formulate, analyze and solve mechanical engineering problems numerically under realistic constraints.
2. Trained with computer programming language such as MATLAB and Excel softwares.
3. Trained for higher studies and research.

COURSE SYLLABUS FOR B.TECH. MECHANICAL (SIXTH SEMESTER)

Course Name: MEL312- MECHANICAL MEASUREMENTS AND METROLOGY

Course Pre-requisites: NIL

Offered in: VI Semester (Even Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Core

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. To educate students on different measurement systems and on common types of errors
2. To introduce different types of sensors, transducers and strain gauges used for measurement.
3. To educate students on different measurement systems for metrology purpose
4. To introduce concepts of linear, angular, roughness thread, gear measurements, limits, fits and tolerances

Syllabus:

General Principles, Purpose and performance of measurement systems, Structure and Examples of measurement systems, Block diagram symbols , Systematic characteristics, Generalised model of a system element, Statistical characteristics, Identification of static characteristics – calibration
Measurement error of a system of ideal elements, the error probability density function of a system of non-ideal elements, Error reduction techniques, Theory of Experimentation,
Elements of Measurement Systems :Classification, Principle, Construction, Range and working of following instruments (Analytical Treatment Not included) Displacement, force, speed, torque, Flow, Level, Pressure, Sound and Light
Signal Processing :Sensing elements, Types of Signals, Signal Processing and Conditioning elements, Data Acquisition Digital Techniques in Mechanical Measurements, Readouts and Data Processing, analysis and Data Presentation elements.
Metrology Measurements, Errors, Standards, Various precision measuring instruments, Straightness, Flatness, Squareness, Roundness measurement, Angular measurement. Calibration of all measuring instruments. Principles of gauge design - Types of gauges, Taylor's principle of gauge design, Limits, Fits, Tolerances. Comparators - Types and working principle of Mechanical, Pneumatic, Electronic, Optical, Electrical comparators and their applications. Interferometer - Principles, Sources of light, Optical flat, Fringe patterns, Calibration of optical flat and It's applications, Tool maker's microscope, Profile projector. Surface finish measurement - Surface texture terminology measurements of surface roughness and instruments. Machine tool metrology - Alignment test, Performance test of Lathe, Milling and Drilling machine. Metrology of screw thread - Screw thread terminology, Thread gauges, Measurement of thread elements - Floating carriage micrometer.
Gear metrology - Gear terminology and its measurement, Measurements of tooth thickness by gear tooth vernier caliper base tangent method, Constant chord method, Span micrometer method, Roller method.

REFERENCES

1. Gupta, I. C., “Engineering Metrology”, Dhanpat Rai, 2000
2. Jain, R. K., “Engineering Metrology”, Khanna Publisher, 20th Edition 2013
3. Bentley, John P. , “Principles of Measurement Systems”, Pearson Education Limited
4. Nakara Choudhari, “ Instrumentation Measurement and Analysis,” TMH Publications
5. Doeblin O.E, “Measurement Systems”, McGraw Hill Publications

Course Outcomes: On completion of this course, students will be
1. aware of different measurement systems and on common types of errors
2. aware of different types of sensors, transducers and strain gauges used for measurement.
3. aware of different measurement systems for metrology purpose
4. aware of concepts of linear, angular, roughness thread, gear measurements, limits, fits and tolerances

Course Name: MEP312- MECHANICAL MEASUREMENTS AND METROLOGY

Course Pre-requisites: NIL

Offered in: VI Semester (Even Semester)

Scheme and Credit: [(0-0-2); Credits: 1]

Type of Course: Core

Course Assessment Method: Continuous assessment

List of Experiments:

1. Calibration of Vernier / Micrometer / Dial Gauge
2. Checking Dimensions of part using slip gauges
3. Measurements of Gear Tooth Dimensions
4. Measurement of Angle using sine bar / sine center / tool makers microscope
5. Measurement of straightness and flatness
6. Measurement of thread parameters
7. Setting up of comparators for inspection (Mechanical / Pneumatic / Electrical)
8. Measurement of Temperature using Thermocouple / Pyrometer
9. Measurement of Displacement
10. Measurement of Force
11. Measurement of Torque
12. Measurement of Vibration
13. Measurement of SPL and light intensity

Course Name: MEL309 - MACHINE DESIGN –II

Course Pre-requisites: NIL

Offered in: VI Semester (Even Semester)

Scheme and Credit: [(3-1-0); Credits: 4]

Type of Course: Core

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. To develop the skill to understand the basics of design aspects of mechanical systems.
2. Design of Mechanical Components and assemblies for industrial & domestic applications.
3. Development of foundation for advanced machine design.

Syllabus:

Bearings and Design for rotating bodies :Surface finish, frictions wear, lubrication, oil seals, design of journal bearings for radial and thrust loads, selection of ball and roller bearing for radial and thrust loads. Failures of antifriction bearing, design of hydrostatic pocket type thrust bearing such as circular step thrust bearing, bearing housing.

Coupling :Types of shaft coupling, design of flange coupling, flexible bush coupling. Flywheel: Coefficient of fluctuation of energy and Coefficient of fluctuation of speed, energy store in flywheel, stresses in flywheel, design of flywheel.

Friction and chain drive :Types of belts & belt material, analysis of belt tension, condition for transmitting maximum power, design of flat belt, flat belt pulley. V belt drive: Types of V-belt, analysis of V-belt tension, design of V belt pulley, Roller change drive: Velocity ratio and length of chain, design of chain, dimensions of tooth profile, sprocket.

Spur, Helical and Bevel Gear :Review of Kinematics of gears & terminology, interference, tooth profiles, formative number of teeth etc. Buckingham equation, design of spur gear drive, helical gear drive. Bevel gear drive: Types of bevel gear proportions of bevel gear, force analysis of bevel gear drive design of bevel gear drive.

Worm Gear and Hoisting Systems :Worm gear drive: Types and proportion of worm and worm gear, force analysis, beam strength of worm gear teeth, dynamic tooth load, wear load, thermal rating of worm gear, design of worm and worm gear. Introduction to haulage system, design of wire rope, sheave and drums, Electric motor rating, types of motor like AC, DC, their Characteristics, controls, selection motors.

REFERENCES

1. Maleev V.L., Hartman J.B, “Mechanical Design of Machine”, CBS Pub. & Distributors, 1983
2. Black P.H., Adams O.E, “ Machine Design”, Mc Graw Hill,1968
3. Shigley J.E, “ Mechanical Engineering Design”, Mc Graw Hill International, 1986

Course Outcomes: On completion of this course, students will be

1.To develop the skill to understand the basics of design aspects of mechanical systems.
2. Design of Mechanical Components and assemblies for industrial & domestic applications.
3. Develop of foundation for advanced machine design.

Course Name: MEP309- DESIGN LAB

Course Pre-requisites: NIL

Offered in: VI Semester (Even Semester)

Scheme and Credit: [(0-0-2); Credits: 1]

Type of Course: Core

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. To expose the students to the practical aspects of assembly design.
2. Exposure to advanced software's for Machine Design

Syllabus:

1. Practical based on the above syllabus of Machine Design -II

Course Name: MEL310 - MANUFACTURING PROCESS AUTOMATION

Course Pre-requisites: NIL

Offered in: VI Semester (Even Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Core

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. To learn the concept of automated production lines, system configuration, transfer line, part handling system, storage system.
2. To understand programming of CNC machines, robots, AGV's
3. To learn manufacturing of gear and plastic processing
4. To introduce fundamental concepts and elements of CAD, CAM.

Syllabus:

Gear Manufacturing :Gear casting gear milling, gear shaping, gear bobbing for spur helical and bevel gear. Tooling and selection of cutting parameters, Process accuracy and quality of gears. Gear stamping. Process, gear drawing. Processes, Rolling process, gear finishing gear shaving, gear lapping, gear honing. Processing of plastics: Plastic molding methods, thermoforming, coding, laminate forming, machining of plastic, reinforced plastics Press working : Die cutting operation, classification, types of presses, press terminology, introduction to shaping operations, bending forming & drawing, Introduction of Jigs and Fixtures : Difference between jigs and fixtures, uses, principles of jigs and fixture design. Materials, principles of location, methods of location, Clamping requirements, types of clamps, jig bushes, drilling jigs, milling fixtures, classification of fixtures. Automated Machines :NC, Basic components, co-ordinate system, types, NC part programming, DNC, types, advantages, limitations, CNC, AC, CIM, FMS. Robotics: Robot anatomy, configurations, types of control, accuracy & repeatability of robot, end effectors, sensors, robot programming, robot applications. Automated material handling and Inspection :Types of automation, reasons for automation, automated guided vehicle, types, applications, traffic control and safety. ASRS, types, basic components, applications, carosel storage system. CAQC, CAPP, G.T.

REFERENCES

1. Sharma P.C, "Production Technology", S. Chand & Co. Ltd, 10th Ed 2003
2. Groover, M. P., " Automation production systems and CIMS", Prentice Hall of India, 9th Ed 2002
3. Koren Yoram, "Computer Control of Manufacturing Systems", McGraw Hill, 3rd Ed, 1986

Course Outcomes: On completion of this course, students will be

1. Demonstrate a thorough understanding of the principles and theoretical bases of modern manufacturing techniques, automation, and production processes.
2. Identify appropriate manufacturing systems for different production requirements, and describe their performance using appropriate analytical and modeling methods.
3. Apply appropriate technology, quality tools and manufacturing methodology to design, re-design and continuously improve the manufacturing operations of engineering companies.

Course Name: MEP310 - MANUFACTURING PROCESS AUTOMATION LAB

Course Pre-requisites: NIL

Offered in: VI Semester (Even Semester)

Scheme and Credit: [(0-0-2); Credits: 1]

Type of Course: Core

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. To learn operation and programming software's for CNC machines.
2. To design a FMS and carry out its techno-economic analysis
3. To learn programming and operation of material handling systems like conveyors, AGVs, Robots, ASRS.

List of Experiment

1. Performance, Simulation on CNC lathe (at least two Complex Geometries)
2. Performance, Simulation on CNC milling (at least two Complex Geometries)
3. Case Study on FMS design for an industry
4. IRB120 and SCORBOT ER-4U robot programming
5. Designing a Jig and Fixture for the given part
6. Part Coding and Group Technology
7. Simulation using Automation studio software

Course Name: MEL432 - COMPUTER GRAPHICS AND SOLID MODELING

Course Pre-requisites: NIL

Offered in: VI Semester (Even Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Elective

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. To understand the concept of graphics
2. To expertise the modelling technique
3. To simulate all the engineering parts.

Syllabus:

Introduction to Computer Graphics, Application of Graphics, Graphic devices, display systems, refresh CRT, Raster scan and random scan, color monitors, VGA, flat panel display, LED and LCD, input and output devices.

Graphical User Interface, Introduction, Types of GUI, widgets, components, Design of GUI, User centered design, Event driven programming, Principles of good GUI design.

Scan conversion and output primitives, DDA algorithm, Bresenham line drawing algorithm, Bresenhem's midpoint circle and ellipse algorithm, polygon filling.

Windows and clipping, windows and Viewport, clipping, point clipping, line clipping, Sutherland cohen subdivision line clipping algorithm, Midpoint subdivision algorithm.

2D and 3D transformations, geometric transformation using homogenous matrix method, translation, rotation, scaling, reflection, and shearing. Successive transformation and composite transformation.

Solid Modeling vs. surface modeling, Types of representation, spatial enumeration, cell decomposition, boundary representation, sweep representation, primitive instancing, constructive solid geometry, Advanced modeling techniques, procedural modeling, Multi-particle rendering, Volume rendering, Grammar based system. Curves, curves representation, parametric and non parametric form, properties of curve representation, interpolation and approximation, Blending functions, 3d Space curves, Spline, cubic Spline, B-spline, Bezier curves, properties of Bezier curves, Hermite curves, comparison of curves, 3D surfaces, Super-quadric surfaces, blobby objects.

REFERENCES

1. Edward Angel, "Interactive Computer Graphics"
2. Hearn and Baker, "Computer Graphics C version "
3. ISRD Group, "Computer Graphics", McGraw Hill Companies

Course Outcomes: On completion of this course, students will be able to

1. Understand and manipulate coordinate systems, views, and transformations
2. Describe a use the main curve representations and determine their differential properties
3. Describe a use the main surface representations and determine their differential properties
4. Construct sketches and place geometric and topologic constraints on them
5. Construct parametric and feature models solid models
6. Perform construction, analysis, and interrogation of CAD models
7. Build assembly models and fits

Course Name: MEP432- COMPUTER GRAPHICS AND SOLID MODELING LAB

Course Pre-requisites: NIL

Offered in: VI Semester (Even Semester)

Scheme and Credit: [(0-0-2); Credits: 1]

Type of Course: Elective

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. To impart practical knowledge in the field of solid modelling
2. To understand various algorithms used in GUI

List of Experiments:

1. Based on syllabus Computer Graphics & Solid Modeling Lab.

Course Name: MEL422 -AUTOMOBILE ENGINEERING

Course Pre-requisites: NIL

Offered in: VI Semester (Even Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Elective

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. To understand various systems in vehicle,
2. To gain knowledge regarding maintenance and testing of vehicle.

Syllabus:

Introduction: Automobile history and development Present scenario of automobiles in India and Abroad. Chassis, articulated and rigid vehicles and vehicles layout. Prime movers. I. C. Engines, Gas turbines, Wankel engine, Engine construction - Structural components and materials Review of fuel, cooling and lubrication systems Filters, water pumps, radiators, Thermostats, ant freezing Compounds. Steering & Suspension Systems: Steering systems, principle of steering, center point steering, Steering linkages, steering geometry and wheel alignment, power Steering, special steering systems. Tyres, tyres specification, factors affecting tyre performance, Special tyres, wheel balancing, suspension system- Function of Spring and shock absorber, conventional and Independent suspension System, Telescopic shock absorber, linked suspension systems,

Transmission Systems :Clutch - Necessity, requirements of a clutch system. Types of Clutches, size of clutch, centrifugal clutch, wet clutch, fluid Clutch. Transmission, Necessity of transmission, principle, types of transmission, Sliding mesh, constant mesh, synchromesh, Transfer gear box, Gear Selector mechanism, lubrication and control. Overdrive, Torque Converter, Automatic Transmission.

Propeller shaft, Universal joint, constant velocity joint, Hotchkiss drive, and torque tube drive. Differential - Need and types Rear Axles and Front Axles. Brakes: Need, types Mechanical, hydraulic, Pneumatic brakes, Electrical Brakes, Engine Exhaust brakes, Drum and Disc brakes, Comparison. Details of components, Brake adjustment. Electrical systems: Construction. Operation and maintenance of Lead acid batteries, battery charging system, Principles and Operation of cutout and regulators, Starter motor, Battery Ignition and magneto ignition systems ignition timing. Lighting and electrical accessories Automobile air- conditioning, Panel board instruments.

Maintenance & Testing: Maintenance, Trouble shooting and service, procedures, Overhauling, Engine tune up, Tools and equipment for repair and Overhaul. Testing equipments. Inspection, laboratory and road testing of automobiles. Safety Considerations in automobiles, Tractors, Trailers, Fun mobiles, Hybrid vehicles racing cars. Recent Advances in automobiles such as ABS, Electronic Power Steering, and Steer by wire, Traction control, Active suspension, Collision avoidance, Intelligent lighting, Navigational aids and Intelligent vehicle highway system.

REFERENCES

1. Singh, K., “Automobile Engineering-Vol. Vol. II”, Standard pub. & Distributors, 9th Ed 2003
2. Ramalingum K.K, “Automobile Engineering”, Scitech Publications, 2001
3. Srinivasan S., “Automotive Engines”, Tata Mc Graw Hill, 1985
4. Crouse W.H, “Automotive Mechanics”, Tata Mc Graw Hill, 2002

Course Outcomes: On completion of this course, students will be

1. Able to understand various systems in vehicle
2. Gain knowledge regarding maintenance and testing of vehicle.

Course Name: MEP422- AUTOMOBILE ENGINEERING LAB

Course Pre-requisites: NIL

Offered in: VI Semester (Even Semester)

Scheme and Credit: [(0-0-2); Credits: 1]

Type of Course: Elective

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. To understand various systems in vehicle,
2. To gain knowledge regarding maintenance and testing of vehicle.

Syllabus: List of experiments

1. Study of Carburetors
2. Study of Fuel Injection Systems
3. Study of Engine Components
4. Performance Characteristics of C.I. Engine
5. Performance Characteristics of C.I. Engine
6. Experiment on Air Pollution

Course Name: MEL429 -RENEWABLE ENERGY SOURCES

Course Pre-requisites: NIL

Offered in: VI Semester (Even Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Elective

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. To explain concepts and mathematical treatment related to solar energy utilization.
2. To explain concepts related to solar collectors, solar air heaters, their types, solar radiation measurements, storage and applications.
3. To explain energy extraction systems, advantages, limitations of unconventional energy sources like wind energy, ocean energy (OTEC / Tidal / Wave) geothermal energy, magneto hydrodynamic power generator, biogas and biomass.

Syllabus:

Renewable energy sources: Need for alternative sources of energy, various options available, principles of energy conversion using solar energy, wind energy, Ocean energy, Geothermal energy and MHD power generation. Solar Energy: Introduction, Spectral distribution of solar radiation, beam and diffused radiations, measurement of solar radiation, pyranometer, pyrhelio meter, sunshine recorder. Solar radiation geometry, radiation on tilted surface, tilt factors.Solar flat plate collectors: Liquid flat plate collector & their analysis, collector efficiency factor and heat removal factor, collector efficiency, Concept of selective surfaces, some novel designs of solar collectors, Solar air heaters and their analysis.

Concentrating Collectors: Cylindrical parabolic collectors, compound parabolic collectors, parabolied collectors, their construction and principle of operation, advantages and drawbacks, tracking systems Solar energy storage. Applications of solar energy: Water heating, space heating, drying, refrigeration, distillation, cooking, PV systems. Bio-Gas: Introduction to biogas generation, fixed dome & floating drum biogas plants, their constructional details, factors affecting generation of biogas, utilization of biogas.

Biomass: Introduction, methods of obtaining energy from biomass, inceneration, thermal gasification. Up draft and down draft gasifiers, their constructional details, Applications of producer gas. Wind & Ocean Energy: Power in wind, basic principles of wind energy conversion, , basic components of WEC Systems, Savonius and Darrieus rotors, application of wind energy. Ocean energy: Introduction, Ocean Thermal Electric Conversion (OTEC), open and closed cycle of OTEC, hybrid cycle, energy from tides, generation components of tidal power plants, single and double basin design arrangement, estimation of tidal power and energy.

REFERENCES

1. Sukhatme, S.P., “Solar energy”, Tata Mc Graw Hill, 2nd Ed 2003
2. Duffie, Beckman, “Solar energy”, John Wiley & Sons, 1974
3. Rai, G.D., “Non Conventional energy sources”, Khanna Publishers, 3rd Ed 1995
4. Garg H. P.,Prakash J., “Solar Energy – Fundamentals & Applications”, Tata McGraw Hill, 1997
5. Khandelwal K., Mahdi, S., “Biogas Techno.-A practical Handbook,” TMH, 1st Ed, 1988
6. Thombre S.B., “Book on Thermal Engg,” Green Brains Publication, 1st Ed, 2003

Course Outcomes: On completion of this course, students will be

1. Able to provide a general overview on current energy resources and their sufficiency and usage.
2. Able to understanding the total energy usage and, especially, in energy used in power production.
3. Have a general view and understanding on the role of electrical energy technologies as a part of energy technologies and on their future potential and role.
4. Clearly separate renewable and non-renewable energy technologies, understand their role and potential for present and future societies.
5. Able to explain and argue plausibly on the role of different renewable energy resources and their usage in power production in the near future.

Course Name: MEL418- ADVANCED STRESS ANALYSIS

Pre-requisites: Nil

Offered in: II Semester (Even Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Core

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).

Course Objectives:

The objective of this course is to provide students the tools required for design and analysis of complex problems in mechanics of materials.

Syllabus:

Fundamentals of stress and strain, stress strain relationship, Elastic constant, plane stress, plane strain.

Stress analysis for two-dimensional problems in Cartesian coordinate system, differential equations of equilibrium. Boundary conditions, compatibility equation, Airy's stress function.

Two dimensional problems in polar coordinate systems, general equations in polar coordinate systems, general equations in polar coordinates, stress distribution about systematic axis. Pure bending of curved beams, effect of hole on stress distribution in plates.

Thermal stress, circular disc, thin plate, long cylinder.

Photo elasticity Introduction, polarized light, wave plates, plane and circular poloriscope, Isochromatic & isoclinic fringes, compensation techniques, separation techniques, analysis of fringe patterns. Introduction to 3-D photo elasticity.

Strain Gauge techniques, strain gauge circuit, recording instruments, analysis of data, strain rosette. Brittle coating technique, coating stress, failure theories, crack patterns, crack detection, Moire fringe techniques.

Reference Books / Material:

1. Timoshnko, Goodiar, "Theory of Elasticity", McGraw Hill Book Co., 3rd Edition, 1970
2. Dalley, Rille, "Experimental Stress Analysis", McGraw Hill Book Co., 3rd Edition, 1991
3. Dove, Adams, "Experimental Stress Analysis," Prentice Hall of India, 1965

Course Outcomes: After completion of this course, student will be able to

i. Explain the concept of elasticity, and the difference between stress and strain
ii. Explain the terms: isotropic, orthotropic and anisotropic, as applied to materials
iii. Explain the terms: plane stress and plane strain
iv. Use the concepts of principal stress and principal strains
v. Use the basic tensor notations, the stress, strain and inertia tensors, and their reduction to principal axes
vi. Apply the analytical procedures involved in strain gauge measurements, in particular the transformation equations
vii. Solve basic problems in two-dimensional elasticity using Airy's stress function

Course Name: MEL401- CONTROL SYSTEMS

Course Pre-requisites: NIL

Offered in: VI Semester (Even Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Elective

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. To teach the fundamental concepts of Control Systems and mathematical modelling of the system,
2. To study the concept of time response and frequency response of the system,
3. To teach the basics of stability analysis of the system.

Syllabus:

Principal of feedback control: Types of control system and error constants. Performance characterization of second and higher order systems through transient response. Effect of additional zero and pole. Introduction to design and compensation.

Compensator design: Compensator design using root locus plot. Cascade lag compensation, cascade lead compensation. Lag-lead compensation. Root locus of system with dead time and sensitivity analysis. Compensator design using Bode plots.

Controllers : PID controllers Pneumatic valves, actuator and controllers. Hydraulic actuators and servo mechanisms. DC Servo motor and stepper motors. Control through operational amplifiers.

Control Systems :State variable, modeling of control system. Conversion of state variable model to transfer function and vice versa. Solution of state equations. State transition matrix. Concepts of controllability and observability.

Introduction to digital control systems :Sample data systems, Z transform of discrete signals. Performance of a sample data second order system. Root locus of digital control systems. Stability analysis in the Z plane.

Introduction to control system on MATLAB platform

Introduction to control system on MATLAB platform. MATLAB commands and control system toolbox. Analysis of transient response of control system through MATLAB commands. Root locus and BODE plot on MATLAB figure window. Simulation of digital control system using MATLAB.

REFERENCES

1. Nise, “Control system Engineering”, Wiley, 1995
2. Dorf, “Modern control system”, Addison Wesley, 8th Ed 199
3. Gopal, “Digital control system”, Tata McGraw Hill, New Delhi
4. Ogata, K., “Modern Control Engineering”, Prentice Hall of India, Third Edition

Course Outcomes: On completion of this course, students will be

1. Demonstrate an understanding of the fundamentals of (feedback) control systems.
2. Determine and use models of physical systems in forms suitable for use in the analysis and design of control systems.
3. Express and solve system equations in state-variable form (state variable models).
4. Determine the time and frequency-domain responses of first and second-order systems to step and sinusoidal (and to some extent, ramp) inputs.
5. Determine the (absolute) stability of a closed-loop control system
6. Apply root-locus technique to analyze and design control systems.

Course Name: MEL405 - OPTIMIZATION

Course Pre-requisites: NIL

Offered in: VI Semester (Even Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Elective

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. To understand the classical optimization techniques for getting solutions to mechanical engineering related problems.
2. To understand the various numerical methods for getting solutions of constrained and unconstrained problems of mechanical engineering.
3. To develop the skills for the formulation of mathematical models and application of software tools such as Matlab for designing a system operating within a realistic constraints.

Syllabus:

Introduction to Optimization Techniques, Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function –objective function surfaces – classification of Optimization problems, Graphical Method.

Classical Optimization Techniques. Single variable Optimization – multi variable Optimization without constraints – necessary and sufficient conditions for minimum/maximum – multivariable, Optimization with equality constraints. Solution by method of Lagrange multipliers – multivariable Optimization with inequality
constraints. Kuhn-Tucker Conditions, Constraint Qualification.

Unconstrained optimization Techniques, Introduction; Standard form of the problem and basic terminology; Direct search method- Simplex method, Random search method, Univariate and pattern search method, Indirect search method-Steepest Descent (Cauchy) method, Conjugate gradient method, Newton's method, Application to engineering problems.

Constrained Optimization Introduction; Standard form of the problem and basic terminology; Direct method; Linear Programming (Simplex) ; Sequential Linear Programming; Generalized reduced gradient method, Methods of feasible direction Indirect method: Penalty function method, Interior and exterior penalty function method, Convex programming problem, Check for Convergence. Application to engineering problems Introduction to non-traditional methods, Genetic Algorithm: Introduction, Representation of design variables, Objective function and constraints, Genetic operators and numerical results. Introduction to Neural network based optimization.

REFERENCES

1. Rao, S. S., "Engineering Optimization (Theory and Practice)", John Wiley & Sons
2. Arora, Jasbir S. , "Introduction to Optimum Design", Elsevier Academic Press
3. Deb, K., "Optimization for Engineering Design-Algorithms and Examples", PHI Learning Private Limited, New Delhi

Course Outcomes: On completion of this course,

1. Students will be able to apply knowledge of classical optimization techniques to solve the problems of mechanical systems.
2. Students will be able to apply knowledge of numerical methods for solving the constrained and unconstrained problems of mechanical engineering.
3. Students will be able formulate the mathematical model for a system operating under some constraints and be able to write own codes in matlab for the optimization of the system response.

Course Name: MEL427- QUALITY ENGINEERING & MANAGEMENT

Course Pre-requisites: NIL

Offered in: VI Semester (Even Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Elective

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. Understanding the concepts and philosophies in quality engineering and management and underlying statistical theories.
2. Developing analytical skills for investigating the quality related problems by adopting appropriate analytical/ statistical tools and techniques.
3. Developing the acumen for robust design through processes analysis and improvement.
4. Developing the aptitude for solving quality and reliability related issues through case studies, mini projects and use of appropriate software.

Syllabus:

Evolution of quality concept, Meaning and dimensions of quality, Quality philosophies, Process quality improvement methodologies, like, TQM, Quality Management System & ISO, Six Sigma, SQC, SPC, BPR, BPM, JIT, Lean, etc.

Customer's perception of quality, Kano model, Zone of tolerance, Statistical concepts in quality management, Quality improvement/management tools and techniques, Control charts, Acceptance sampling, Process capability analysis, FMEA, Use of simulation in quality, Service quality, Quality costs.

Robust design, Taguchi techniques, Loss function, Orthogonal Arrays, Design of experiments, ANOVA, System reliability and failure analysis.

Multicriteria techniques in quality management, Introduction to National & International Quality Awards.

Mini project, case studies and use of appropriate software

REFERENCES

1. Mitra, A., " Fundamentals of Quality Control and Improvement", 2008, Prentice Hall.
2. Ryan, Thomas, "Statistical Methods for Quality Improvement," 2011, John Wiley & Sons.
3. Dhillon, B. S., "Applied Reliability and Quality," 2007, Springer.
4. Phadke, M. S., " Quality Engineering using Robust Design," 1989, Prentice Hall

Course Outcomes: On completion of this course, students will be able to

1. Implement the concepts and philosophies in quality engineering and management and underlying statistical theories to engineering problems.
2. Develop analytical skills for investigating the quality related problems by adopting appropriate analytical/ statistical tools and techniques.
3. Practice Robust design through processes analysis and improvement.
4. Build an aptitude for solving quality and reliability related issues through case studies, mini projects and use of appropriate software.

COURSE SYLLABUS FOR B.TECH. MECHANICAL (SEVENTH SEMESTER)

Course Name: MEL435- COMPUTATIONAL FLUID DYNAMICS

Course Pre-requisites: Nil

Offered in: I Semester (Odd Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Elective

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).

Course Objectives:

1.To develop an understanding for the major theories, approaches and methodologies used in CFD
2.To build up the skills in the actual implementation of CFD methods (e.g. boundary conditions, turbulence modelling etc.) in using commercial CFD codes
3.To gain experience in the application of CFD analysis to real engineering designs.

Syllabus:

Equations of fluid dynamics

Basic concepts Eulerarian and Lagrangian methods of describing fluid flow motion, acceleration and deformation of fluid particle, vorticity. Laws governing fluid motion, continuity, Navier – stokes & energy equations. Boundary layer equation, Euler equations, potential flow equations, Bernoulli's equation and vorticity transport equation.Initial and boundary conditions. Classification of equation of motions – hyperbolic, parabolic, elliptic.

Mathematical Preliminaries

Numerical integration. Review of linear algebra, solution of simultanilus linear algebric equations – matrix inversion, solvers – direct methods, elimination methods, ill conditioned systems; Gauss-Sidel method, successive over relaxation method.

Grid Generation

Transformation of coordinates.General principles of grid generation – structured girids in two and three dimensions, algebric grid generation, differential equations based grid generation; Elliptic grid generation, algorithm, Grid cluistering, Grid refinement, Adaptive grids, Moving grids. Algorithms, CAD interfaces to grid generation. Techniques for complex and large problems: Multi block methods.

Finite difference discretisation

Elementary finite difference coefficients, basic aspects of finite difference equations, consistency, explicit and implicit methods, errors and stability analysis. Stability of elliptic and hyperbolic equations. Fundamentals of fluid flow modeling-conservative property, upwind scheme, transporting property, higher order upwinding. Finite difference applications in heat transfer – conduction, convection.

Finite Volume Method

Introduction, Application of FVM in diffusion and convection problems, NS equations – staggered grid, collocated grid, SIMPLE algorithm. Solution of discretised equations using TDMA.Finite volume methods for unsteady problems – explicit schemes, implicit schemes. Finite Element Method: Introduction. Weighted residual and variational formulations. Interpolation in one-dimensional and two-dimensional cases. Application of FEM to ID and 2D problems in fluid flow and heat transfer

Reference Books/Material:

1. Ferziger J. H., Springer P.M, "Computational Methods for fluid Dynamics", Verlag Berlin
2. Anderson J. D. JR, "Computational fluid Dynamics", Mc Graw Hill Inc, 1995
3. Patankar S. P, " Numerical Heat Transfer & Fluid flow"
4. Sunderarajan M.K., "Computational Fluid Flow and Heat Transfer", 2nd Ed, Narosa Publishing

Course Outcomes:
At the end of this course, the student will be able to:
1. Understand and be able to numerically solve the governing equations for fluid flow
2. Understand and apply finite difference, finite volume and finite element methods to fluid flow problems
3. Understand how grids are generated
4. Understand how to assess stability and conduct a grid-convergence assessment
5. Understand and apply turbulence models to engineering fluid flow problems
6. Understand and apply compressible flow solvers
7. Understand the issues surrounding two-phase flow modelling
8. Be able to numerically solve a heat transfer problem
9. Be able to use ANSYS CFX to an acceptable standard for a graduate engineer.

Course Name: MEP435- Computational Fluid Dynamics Lab

Pre-requisites: Nil

Offered in: VII Semester (Odd Semester)

Scheme and Credit: [(0-0-2); Credits: 2]

Type of Course: Core

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. To provide students with the necessary skills to use commercial CFD packages
2. To carry out research in the area of Computational Fluid Dynamics.
3. To solve a variety of flow situations and heat transfer tutorials.

Syllabus :

The set of tutorials designed to provide the student with the necessary tools for using sophisticated commercial Ansys fluent CFD software. A set of laboratory tasks will take the student through a series of increasingly complex flow and heat transfer simulations, requiring an understanding of the basic theory of computational fluid dynamics (CFD).

At the end of the course each student will have to complete a mini project.

Course Name: MEL420-FINITE ELEMENT METHOD

Course Pre-requisites: Nil

Offered in: VII Semester (Odd Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Elective

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. Equip the students with the Finite Element Analysis fundamentals,

2. Enable the students to formulate the design problems into FEA,

3. Enable the students to perform engineering simulations using Finite Element Analysis software (ANSYS & LSDYNA).

4. Enable the students to understand the ethical issues related to the utilization of FEA in the industry.

Syllabus:

Introduction to variational methods in boundary value problems. Rayleigh-Ritz method. Concept of finite elements. Brief introduction to finite analysis. Discretisation, approximation and assembly of finite elements, Strain-displacement and stress-strain relations for plain-stress, plain-strain and axismmetric problems. Temperature effect.

Finite element modeling of 1-D problems. Langranian and Hermitian shape functions, element stiffness matrix and load vector. Assembly of global stiffness matrix and global load vector. Boundary constraints and solution for nodal displacements. Convergence criteria and compatibility requirement. Higher order elements. Weak formulation, Gelerkin FEM and non-linear problems. Eigen value problems of 1-D models, vibration of bars. 2-D problems with constant strain triangles. Co-ordinate transformation and Jacobian. Straight sided and curved sided elements. Gauss-quadrature integration formula.

Beam flexure modeling with finite elements. Vibration of beams. Plate bending problem with triangular, rectangular, and curve sided elements. Types of curve sided elements. Triangular and rectangular isoperimetric elements. Sub parametric and super parametric elements. Finite element modeling of incompressible inviscid fluid flows and steady state heat conduction problem.

REFERENCES

1. Cook, R.D, “Concepts and application in Finite Element Analysis”, 3rd Ed, The Wiley & Sons
2. Chandragupta, Bellegundu, “Introduction to Finite Element Engineering”, 2nd Ed , Prentice Hall
3. Krishnamurthy , “Finite Element Analysis”, 2nd Ed, Tata Mc Graw Hill

Course Outcomes: Upon completing this course, the students will be able to:

1. Identify mathematical model for solution of common engineering problems.
2. Formulate simple problems into finite elements.
3. Solve structural, thermal, fluid flow problems.
4. Use professional-level finite element software to solve engineering problems in Solid mechanics, fluid mechanics and heat transfer.
4. Derive element matrix equation by different methods by applying basic laws in mechanics and integration by parts

Course Name: MEP420-Finite Element Method Lab

Pre-requisites: Nil

Offered in: VII Semester (Odd Semester)

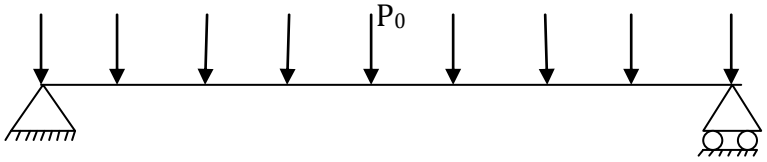
Scheme and Credit: [(0-0-2); Credits: 2]

Type of Course: Core

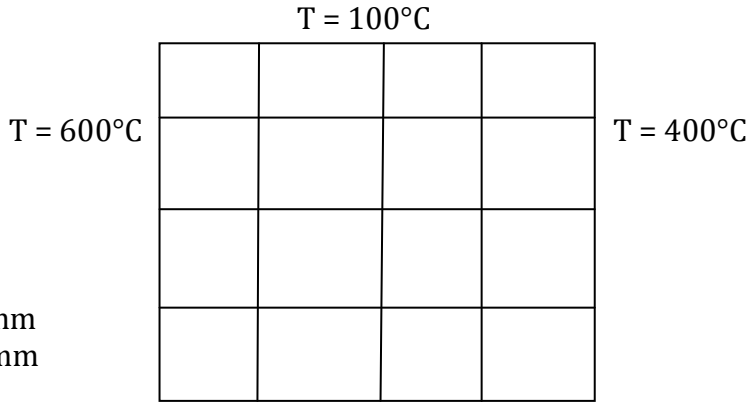
Course Assessment Method: Continuous assessment

Course Objectives:
1. Equip the students with the Finite Element Analysis fundamentals,
2. Enable the students to formulate the design problems into FEA,
3. Enable the students to perform engineering simulations using Finite Element Analysis software (ANSYS & LSDYNA).
4. Enable the students to understand the ethical issues related to the utilization of FEA in the industry

List of Experiments:
1.Write a computer program to solve the differential equation of the form $a*(d^2y/dx^2) + (b*y) + c = 0$ where a, b, c are constants which may be positive or negative.
2. Write a computer program to find the displacement by using finite displacement method.



P_0 – Load per mm (N/mm)
d – Diameter of beam (mm)
Divide the continuum in 6 parts.
3. Write a computer program to find the temperature distribution.



4. To find the Inverse matrix of Shape function for CST, Truss and Beam elements and verify it mannualy and in Ansys.
5. To write a program code for 1D bar element numerical and their comparison with manual and Ansys results.
6. To write a program code for a CST elements with force and boundary conditions to obtain displacement, strain and stress at each node and compare with manual and Anssys result
7. To write a program code for a Truss with force and boundary conditions to obtain displacement, strain and stress at each node and compare with manual and Anssys result
8. To write a program code for a 2D elements with force and boundary conditions to obtain displacement, strain and stress at each node and compare with manual and Anssys result

Course Name: MEL407-BIOMECHANICS

Course Pre-requisites: Nil

Offered in: VII Semester (Odd Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Elective

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. To understand the basic machines of human body

2. application of Engineering tools and softwares for the betterment of society

3. to understand and analyze human body as a mechanical assembly of linkages.

Syllabus:

Definition of Biomechanics, Selected Historical highlights, The Italian Renaissance, Gait century, Mechanics, Newton's laws of motion, Equation of motion for rigid Body. Biological materials, Brief Anatomy, Bone, cartilage, ligament, tendon, Muscles, their physical properties, degree of freedom of joints. Dental Biomechanics, Function of dentin, pulp, periodontal ligament. prosthodontistry, orthodontistry. Measuring techniques for force, pressure distribution, acceleration, Optical methods, strain measurement, inertial properties of human body. General considerations for modeling, types of model, validation of model, force system analysis, assumptions, free body diagrams, Simulation, Numerical solution methods, Muscle models, modeling of external forces, optimization studies, simulation as a scientific tool. Introduction Biomedical engineering, application of advanced engineering techniques to human body, case studies.

REFERENCES

1. Nigg, B.M.and Herzog, W., "BIOMECHANICS of Musculo skeleton system", John Willey & Sons, 1st Edition.
2. Saltzman, W.L., "BIOMEDICAL ENGINEERING: Bridging medicine and Technology", Cambridge Text, First Edition.
3. Winter, D., "BIOMECHANICS and Motor Control of Human Movement", WILEY Interscience Second edition

Course Outcomes:

1. Apply a broad and coherent knowledge of the underlying principles and concepts of biomechanics, particularly in the fields of kinematics and kinetics as applied to human and projectile motion.

2. Safely and effectively use biomechanics instrumentation and equipment to record and assess human and object motion.

3. Record, extract and analyse key information about teeth, muscles, bones etc.

Course Name: MEL414-TRIBOLOGY

Course Pre-requisites: Nil

Offered in: VII Semester (Odd Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Elective

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. To understand basic lubrication mechanism and various lubrication systems.
2. To understand the friction and wear phenomenon
3. To understand the concept of nano tribology and green tribology and its application for various mechanical systems or processes.

Syllabus:

Introduction to tribology. Basics of friction, wear and lubrication.
Study of lubricants, their properties and compositions.
Study of Hydrodynamic Lubrication, Principal of pressure generation between the non parallel surfaces, Derivation of Reynolds's equation, Long and short bearing approximations, Evaluation of tribological performance such as pressure distribution, load carrying capacity, lubricant flow.
Hydrostatic lubrication, working and construction details, Evaluation of tribological performance.
Squeeze film lubrication, working and construction details, Evaluation of tribological performance.
Elasthydrodynamic lubrication
Boundary/ Extreme pressure lubrication.
Surface Topography
Friction, laws of friction
Wear, Abrasive wear, Erosive wear, Adhesive wear, Fatigue wear.
Antifriction bearings

REFERENCES

1. Cameron, A. "Basic Lubrication Theory", John Wiley & Sons, Incorporated, Second Edition, 1977
2. Gwidon W. Stachowiak and Andrew W. Batchelor, "Engineering Tribology", Elsevier, Third Edition (ISBN: 978-0-7506-7836-0)
3. Majumdar, B.C. , "Introduction to Tribology of Bearings", S. Chand
4. Basu, S.K., Sengupta, S.N., Ahuja, B.B., "Fundamentals of Tribology", PHI

Course Outcomes:

By the end of the course student should:

1. Have a knowledge of surface topography and know how to model a rough engineering surface
2. Have a clear overall picture about the basics of tribology and related sciences, theoretical background about processes in tribological system, mechanisms and forms of interaction of friction surfaces
3. Understand Hertz contact and rough surface contact
4. Be familiar with adhesion theories and the effect of adhesion on friction and wear
5. Have a mastery of the friction/lubrication mechanisms and know how to apply them to the practical engineering problem

Course Name: MEL433- DESIGN FOR MANUFACTURING AND ASSEMBLY

Course Pre-requisites: Nil

Offered in: VII Semester (Odd Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Elective

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. To know characteristics of basic manufacturing processes and their capabilities

2. Select appropriate materials, processes and features for various design requirements

3. Design products which are suitable for manufacturing

4. Evaluate the design for available manufacturing alternatives

Syllabus:

Introduction – Definition, History, Advantages and Impact . Selection of materials and processes – General requirements, process capabilities, Systematic selection of processes and materials, design examples

Product design for manual assembly – General guidelines, systematic design for assembly, effect of various design features on manufacturing, design examples

Design for high speed automatic and robotic assembly – Design for high speed feeding and orientating, High speed inspection, Analysis of assembly, design examples

Design for machining – Design for single point / multi point / abrasive machining, assembly of components, accuracy and surface finish, cost estimating, design examples

Design for injection moulding – Injection moulding materials, moulding cycles, estmation of optimum number of cavities, design examples

Design for sheet metal working – Dies and Press working, Press selection, Design rules

Design for sand casting, die casting, investment casting – Materials, Basic characteristics of process and mould features, cost estimating, design rules for different castings.

Design for forging – characteristics, cost estimation and design rules

REFERENCES

1. Boothroyd, G., Dewhurst, P., Knight, W. A. “Product Design for Manufacturing and Assembly”, Third Edition, CRC Press, 2011.

2. Allen, C. W., “Simultaneous Engineering -Integrating Manufacturing and Design”, Society of Manufacturing Engineers, Nov. 1990.

3. James Bralla, “Design for Manufacturability Handbook” McGraw Hill, 2004.

4. Anderson, D.M., "Design for manufacturability & concurrent engineering: how to design for low cost, design in high quality, design for lean manufacture, and design quickly for fast production," CIM press, 2nd Edition, 2010.

Course Outcomes: Upon completing this course,

1. Student will have knowledge of basic manufacturing processes and their capabilities
2. Student will select appropriate material, process and features for a design
3. Student will design products which are easy for assembly & manufacturing
4. Student will evaluate the design for alternatives of manufacturing

Course Name: MEL412-AIR CONDITIONING

Offered in: VII Semester (Odd Semester)

Course Pre-requisites: Nil

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Elective

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1)To introduce and explain concepts topics related to Air Conditioning, Psychometrics, psychometric processes, comfort, its measurement, comfort chart, effective temperature, coding load estimation, design of summer, winter, monsoon, Air Conditioning systems, duct design and selection of air outlets.

2)To make student aware about various equipments / systems used in Air Conditioning like room air conditioners, packaged Air Conditioning like room air conditioners, packaged air conditioners, central air conditioning, filters etc.

Syllabus:

Fundamentals of Air conditioning Introduction to air conditioning, psychometrics, important terms and definitions, enthalpy of air, adiabatic saturation temperature, measurement of properties, psychometric chart, its construction and use.

Psychometric processes Mixing, mixing with condensation, sensible heating and cooling, humidification and dehumidification, bypass factor and its role, evaporative cooling, drying process, working of air-washer.

Air-conditioning systems Sensible heat factor, design of summer air conditioning system, calculation of dehumidified air quantity and apparatus dew point, ERSHF method, air-conditioning systems for monsoon and winter, air conditioning systems using all fresh air.

Comfort and Cooling load Estimation Comfort and its requirements, mechanism of body heat loss, effect of heat on body and body defense mechanism, effective temperature, comfort chart and its use, factors affecting human comfort, Cooling load estimation, components of cooling load, sensible and latent loads, ASHRAE and CARRIER methods of load estimation.

Industrial practices in Air conditioning General layout of central air conditioning Plant, Design of chilled water and condenser water piping, selection of pump. Fans, types and characteristics, filters types and selection, defrosting methods, commissioning and testing of air conditioning systems. Applications of air conditioning, working of room air-conditioning and split air-conditioning and package air-conditioning.

Air Distribution and duct design Components of air handling systems, principles of air distribution, types of supply and return air openings and related definitions, consideration s for selection and location of supply and return air openings. Duct design: General duct design, rules, principles of duct design, equivalent diameter of ducts ducting materials, friction chart and its use, methods of duct design.

REFERENCES

1. Dossat Roy J, “Principles of Refrigeration”, Pearson Education Asia Publication
2. Arora C.P., “Refrigeration and Air conditioning”, Tata Mc Graw Hill Publication, 2nd Ed.
3. Ballaney P.L., “Refrigeration and Air conditioning”, Khanna publishers
4. Prasad Manohar, “ Refrigeration and Air conditioning”, New edge Publication, 2nd Ed

Course Outcomes: On completion of this course, students will acquire enough knowledge to design the air conditioning systems for residential, commercial and industrial buildings.

Course Name: MEL431- ADVANCED MECHANISMS

Course Pre-requisites: Nil

Offered in: VII Semester (Odd Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Elective

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. Provide theoretical background for basic and advanced kinematics and synthesis of mechanisms to achieve desired motion.

2. Introduce basic and advanced computer-based tools for analysis and synthesis of mechanisms.

3. Provide an opportunity for students to use theory and application tools through a major mechanism design project

Syllabus:

Introduction to kinematics, types of mechanism, kinematics synthesis, science of relative motion, tasks of kinematic synthesis with practical applications, Degree of freedom, class-I, class-II chain, Harding's notation, Grashof criterion, Grubler's criterion. Introduction to position generation problem, concept of pole, two & three position generation synthesis, pole triangle, Relationship between moving & fixed pivots, Four position generation, opposite pole quadrilateral, center point & circle point curve, Burmester's point. Matrix method for position generation problem, rotation matrix, displacement matrix.

Introduction to function generation problem, co-ordination of input-output link motion, relative pole technique, inversion technique, overlay technique, graphical synthesis of quick return mechanisms for optimum transmission angle. Types of errors, accuracy points cheby shev's spacing and frudenstein's equation. Introduction to path generation problem, synthesis for path generation with and without prescribed timing using graphical method. Coupler curves, cognate linkages, Robert's law of cognate linkages. Complex number method for path generation problem 3 precision point. Synthesis for infinitesimally separated position, concept of polode and centrod, Euler's savery equation, inflection circle, Bobbilier and Hartman's construction. Optimal synthesis of planer mechanisms, least square method. Introduction to spatial mechanisms, D-H notations, Introduction to kinematic analysis of robot arms.

Reference Books/Material:

1. Tad D.C, "Applied linkage synthesis", Addison Wesley publication , 1964.
2. Sandor G.N., Erdman, A. G, "Advanced mechanism design", Prentice Hall Inc, 1984
3. Suh C.H., Radcliff C.W ," Kinematics and mechanisms design", John Wiley &Sons., 1978.

Course Outcomes:

1. Students gain a solid theoretical background in kinematics and in the analysis and synthesis of mechanisms.
2. Students become familiar with basic and advanced computer-based engineering tools for the analysis and design of linkages.
3. Students have the ability to apply theory and the use of practical engineering tools in a substantial mechanism design project.

Course Name: MEL437- COMPOSITE MATERIALS

Pre-requisites: Nil

Offered in: VII Semester (Odd Semester)

Scheme and Credit:[(3-0-0); Credits: 3]

Type of Course: Elective

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments/seminar/quizzes (10%), End Semester exam (60%).

Course Objectives:

1. To familiarize the students with recent advances in engineering materials and selection particularly for composites.
2. This will help for design in advanced applications, cost reduction and material optimization.
3. This is to give a sound understanding of properties and characteristics of orthotropic materials in comparison to conventional isotropic materials

Syllabus:

Introduction to composite materials, evolution and applications in engineering. Characteristics and classification of composite materials; Fibrous, laminated and particulate composites. Basic terminologies; volume fraction and weight fraction. Laminae and laminates. Different fibres, matrices and their properties. Advantages and disadvantages of polymer matrix composites, metal matrix composites and ceramic matrix composites.

Mechanical properties of unidirectional composite lamina. Longitudinal and transverse Young modulus, shear modulus, Poisson ratio. Empirical relationship of Halpin-Tsai. Longitudinal and transverse Strength. Composites under compressive loading.

Properties of angle ply lamina. Transformation of Young moduli, shear modulus. Concept of coupling coefficients. General and special orthotropic materials. Psai Pagano invariants

Strength of orthotropic lamina. Biaxial strength theories. Maximum strength, maximum strain theory. Tsia-Hill maximum work theory. Tsai Wu tensor theory. Applications to pressure vessels, composite shafts etc.

Codes and engineering representation of Laminates. Macro mechanical behavior of a laminate. Laminate stiffness for different types; symmetric, anti-symmetric, cross ply laminates. Stresses in different laminae in a laminate. Configurations and design of laminates for special properties

Strength and mechanism of failure in a composite laminate. Concept of FPF(First Ply Failure and total failure). Hygroscopic and thermal stresses.

Reference Books/Material:

1. Mallick, P. K. , “Fibre-Reinforced Composites, CRC press,” New York, 2007
2. Jones, R.M., “Mechanics of Composite Materials,” Mc Graw Hill, New Delhi
3. Broutman and Agarwal, “Analysis and Performance of Composite materials”, John Willey and Sons, New York

Course Outcomes: Upon completing this course,

1. Student would be able to understand behavior and specialties of orthotropic materials.
2. They will be able to find appropriate applications where a particular composite can be used.
3. Students will also have sound understanding of theory of elasticity and mechanics of orthotropic materials and behavior under bi-axial stress conditions.
4. Students will learn the concept of design optimization with proper material selection.

Course Name: MEL408- SUPPLY CHAIN MANAGEMENT

Pre-requisites: Nil

Offered in: VII Semester (Odd Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Elective

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. To explain the students about the basics and practical significance of the supply chain
2. To enable students to apply mathematical approaches to solve supply chain problems
3. To train students for using software such as excel/matlab for solving supply chain problems
4. To enable students for higher studies

Syllabus :

Understanding the supply chain, its performance, drivers and its metrics; Design of the supply chain network, Planning demand and supply in a supply chain, Planning and managing inventories in a supply chain, Planning and managing inventories in a supply chain, Designing and planning transportation networks, Managing cross-function drivers in a supply chain, Bullwhip effect, National and International case studies in a supply chain

Reference Books / Material:

1. Sunil Chopra and Peter Meindl , "Supply Chain Management", Pearson – Prentice Hall publication. Ist and IInd edition
2. Janat Shah, "Supply Chain Management", Pearson education Publication, Ist edition.
3. Spigel M.R , "Probability and statistics", McGraw Hill Book Co, 1980

Course Outcomes:

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

1. select and apply scientific methods and theories for collection and analysis of quantitative and qualitative data for description and complex analysis of internal and external conditions of the firm as well as theoretical issues related to these areas.
2. set up new models of analysis and solutions for problems based on the performed analyses. The graduate can communicate his/her knowledge and discuss professional and scientific issues with colleagues, management, and the surrounding society

Course Name: MEL425- RELIABILITY & MAINTENANCE ENGINEERING

Pre-requisites: Nil

Offered in: VII Semester (Odd Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Elective

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. To equip the graduate to plan, design, and execute effective maintenance strategy and maintenance practices in various types of industries and apply various RCM based tools to analyse and prioritise various defects.
2. To equip graduates with the state of the art condition monitoring technologies and instrumentation.
3. To equip graduates with the essentials reliability theory and engineering to enable them to develop and enhance reliability programs.

Syllabus:

Introduction to reliability and maintainability: Engineering reliability definition. reliability assurance. reliability through redundancy, maintainability, maintainability improvement. maintainability vis-à-vis Maintenance techniques and defect failure analysis: dismantling and assembling, inspection and adjustment, lubrication. maintenance cleaning, Welding. metal spraying, metal stitching, Defect recording and failure analysis. downtime analysis, breakdown analysis (FTA, FMEA). Maintenance types/systems and Condition monitoring: planned/unplanned maintenance, breakdown, corrective. Opportunistic, routine, preventive, predictive maintenance: condition based maintenance system, design-out maintenance, selection of maintenance system, online/offline monitoring, visual, temperature, leakage, vibration, monitoring. ferrography, spectography, cracks, corrosion, noise/sound, smell/odour monitoring. condition monitoring of lutes and hydraulic systems and cross country pipe lines. Maintenance planning and scheduling: job planning. job manuals, long term and short term plans, overhauls and renovation. corporate turn around planning Codification and cataloguing, history cards, instruction and operation manuals, maintenance work order and work permit, maintenance record and documentation benefits, procedure and steps.
Reliability based maintenance: evaluation of RBM programme, mean !allure rate. MTTF. MTBF. MTBS, MTBM. MTTR. Hazard models; weibull model, constant hazard. linearly increasing hazard. System reliability; logic diagrams, markov models, use of Boolean algebra, de Morgan's theorem.
Reliability in design and manufacture: Design analysis methods, QFD, LSA, FMECA, HAZOPS, part, materials and process (PMP) review. Production Failure Analysis and Corrective Action System (FRACAS). software reliability and analysis methods. reliability management and quality management- approaches.

Reference Books/Material:

1. Srivastava S K, “Industrial Maintenance Management”, S. Chand, 1998
2. L.S. Srinath , “Reliability Engineering”, Affilated East-West Press , 4th Edition 2005
3. Higgins L.T. , “Maintenance engineering hand book”, Mc. Graw Hill Inc, 1995

Course Outcome: Students successfully completing this course should be able :

1. To understand the relationship of key concepts in reliability engineering and application to maintenance strategies in a manufacturing environment;
2. To establish maintenance strategies according to system characteristics and design transition programs to implement these strategies;
3. Manage the manufacturing organisation with highest possible availability.

Course Name: MEL440- MACHINE VISION & ITS APPLICATION

Pre-requisites: Nil

Offered in: VII Semester (Odd Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Elective

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. To get an insight into the world of computer vision that goes beyond image processing algorithms.
2. To acquire knowledge and an understanding of artificial vision from a practical implementation perspective
3. To design vision systems for mechanical engineering applications like surface metrology, autonomous navigation and inspection, medical imaging

Syllabus:

Basics of computer vision: Nature of images, homogeneous transformations, quaternions, geometrical and optical image formation, perspective projection, camera technologies and vision systems design.

Basics of image processing : Filtering, edge detection, features detection, contours, segmentation, morphological operators.

Calibration: Camera model, intrinsic and extrinsic camera parameters, camera calibration.

Motion: Motion detection, optical flow, object tracking. Three-dimensional imaging : Epipolar geometry, stereoscopic vision, active range imaging, structured lighting.

Modeling and registration : Modeling techniques for autonomous systems, data fusion, uncertainty mapping, registration, pose estimation

Applications: Quality control, surface metrology, inspection, mapping and robot guidance, motion estimation, autonomous systems, biomedical imaging devices.

REFERENCES

1. Gonzalez, R. C. , Woods, R. E. and Eddings, S. L. Digital, “Image Processing using Matlab”, Pearson Prentice Hall, 2004
2. Tinku Acharya, Ajoy K. Ray, “Image Processing: Principles and Applications”, Wiley, 2005
3. Demant, Christian, Streicher-Abel, Bernd, Garnica, Carsten, “Industrial Image Processing: Visual Quality Control in Manufacturing”, Springer-2016

Course Outcomes: On completion of this course, students will be

1. Aware about the world of computer vision that goes beyond image processing algorithms.
2. Getting knowledge and an understanding of artificial vision from a practical implementation perspective
3. To design vision systems for mechanical engineering applications like surface metrology, autonomous navigation and inspection, medical imaging

Course Name: MEL450- ADVANCED MACHINING PROCESSES

Pre-requisites: Nil

Offered in: VII Semester (Odd Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Elective

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

The aim of the course is to enrich the fundamentals of machining processes both conventional and unconventional processes. The course elaborates the mathematical formulations of various machining processes and analyse the influence of various process parameters in each process. This also enables the student to understand the process and further the course provides an insight to choose his research career.

Syllabus :

Advanced Metal Cutting and Grinding :Modeling of cutting process: Review of cutting mechanism; Cutting force model; Oblique Cutting; Temperature analysis (Finite Difference Method); Wear model; Evaluation of surface quality; Cutting processes for producing various shapes

Gear machining: Hobbing , Modeling of grinding process: Grinding force model; Temperature analysis; Wheel life model., Introduction of finishing process: Machining mechanism in finishing: Honing, Lapping, Super finishing, etc.

Micro-Nano Precision Machining: Introduction to nano-precision mechanical manufacturing: M4 processes

Nano-precision cutting: Machine & tool; Brittle / ductile transition; Ductile mode cutting of brittle materials

Nano-precision grinding: Machine & grinding wheel; Truing & dressing; Cutting edge evaluation; Applications to extreme optics, Nano-precision polishing: Conventional polishing; Non-conventional polishing; Plane honing; Field-assisted fine finishing

Unconventional Machining Processes :Electric Discharge Machining (EDM); Electron Beam Machining (EBM); Plasma Arc Machining (PAM); Laser Beam Machining (LBM); Ultrasonic Machining (USM); Abrasive Jet Machining (AJM); Water Jet Cutting (WJC), Abrasive Water Jet Machining (AWJM); Electro-Chemical Machining (ECM); Chemical Machining (CHM)

Reference Books / Material:

1. Boothroyd, G and Knight, W A., "Fundamentals of Machining and Machine Tools", 3rd Third Edition, Saint Luice Pr, 2005.
2. G.F. Benedict, "Non-traditional Manu. Processes", Marcel Dekker, Inc. New York, 1987.
3. P.C. Pandey, and H.S. Shan, "Modern Machining Processes", Tata McGraw-Hill Publishing Co. Ltd, New Delhi, 1980.
4. J.A. McGeough, "Adv. Methods of Machining", Chapman and Hall, London, 1988.

Course Outcomes:

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

1. Illustrate advanced machining processes, cutting tools and cutting fluids for a specific material and part features.
2. Relate Generation and control of electron beam for machining, laser beam machining, comparison of thermal and non-thermal processes
3. Differentiate Thermal Metal Removal Processes, characteristics of spark eroded surface, machine tool selection and various finishing techniques.

Course Name: MEL417- Power Plant Engineering

Pre-requisites: Nil

Offered in: VII Semester (Odd Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Elective

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. To analyze different types of steam cycles and estimate efficiencies in a steam power plant
2. To describe basic working principles of gas turbine and diesel engine power plants.
3. Define terms and factors associated with power plant economics. Calculate present worth depreciation and cost of different types of power plants.
4. To Estimate the cost of producing power per kW

Syllabus:

Steam Power Plant: Reheat-regenerative cycle, binary cycle, topping and superimposed cycle.
Steam generators: Modern generators, once through and fluidized bed boilers design. Consideration of modern steam generators, furnace, fuel firing methods, fuel and ash handling systems, various accessories of steam generators, steam temperature control.
Steam Turbines: Details of construction, accessories, governing, turbine blades, power calculations, arrangement of turbines, industrial turbines.
Condensers and Cooling Towers: Performance, heat transfer design, calculations, efficiencies, detail construction, cooling water circuit, environmental aspects.
Hydro Electric Plant: Hydrology, rainfall measurement hydrographs, flow duration curves, site selection, classification of hydro stations, capacity of hydro stations, selection of prime movers, governing of water turbines, operation of different components of hydro station reservoirs, dam, spillway, canals, penstock, water hammer surge tank, Draft-tubes, specific speeds of turbines, Advantages of hydro station.
Gas Turbine Power Plant: General features and characteristics and their application power plants, Analysis of different cycles, components of gas turbine power plants, governing system of gas turbine plant, advantages of G. T. plant, Gas and steam turbines, combined cycles – Thermodynamic analysis for optimum design, advantages and performance of combined cycles, economics of combined cycle. Combined cycle with nuclear power plants, Diesel electric power plant: Thermodynamic cycle analysis, supercharge of diesel engines, different systems of diesel power plant, environmental aspects. Power Plant Economics: Fluctuating load on power plants, load curves, various performance factors of power station. Effect of variable load power plant design and operation. Economic analysis of power plants, tariffs, load division, combined operation of different power plants, heat rate, incremental heat rate, selection of power plant and station equipments.

Reference Books/ Material:

1. Stroteki, Vopat, “Power Station Engineering & Economy”, Tata Mc Graw Hill, 1977
2. Domkundawar, “Power Plant Engineering”, Dhanpat Rai & Sons,1980
3. Nagpal G. R , “Plant Engineering”, Khunna Publications, 1978

Course Outcomes: On Successful completion of this course, The student will :

1. Know the various types of power plants used in Jordan.
2. Have Knowledge of the various types of conventional and non-conventional power plants.
3. Have Knowledge of the operation, construction and design of various components of power plants.
4. Able to calculate the performance parameters of various power plants.

Course Name: MEL402- SURFACE ENGINEERING

Pre-requisites: Nil

Offered in: VII Semester (Odd Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Elective

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1.To educate students on the technologies of surface engineering for wear resistance by introducing different methods for coatings and surface treatments.
2.To introduce the concepts of surface heat treatment, thermo chemical diffusion treatment, and mechanical treatment techniques.
3.To introduce the concepts of surface alloying and surface composites by laser melting and solid state processing techniques.
4.To give various concepts of thermal spraying techniques, PVD/CVD techniques and thermal barrier coatings (TBC).

Syllabus:

Need for surface engineering, Classification of surface engineering methods and Surface Preparation. Surface Hardening without modification of surface chemistry - Induction hardening, Flame hardening, Laser beam hardening and Electron beam hardening.
Thermo Chemical Diffusion Treatments - Carburizing, nitriding and boriding techniques. Mechanical treatments - Cold working, Shot peening and SMAT processes. Laser peening, laser surface alloying, laser cladding, friction surfacing and friction stir processing techniques.
Thermal spraying techniques – Flame spraying, Oxy-fuel powder spraying, D-gun spraying, HVOF coating, Plasma spraying and Cold/kinetic spraying. Electro plating and electroless plating of pure metals and composite materials. Physical vapour deposition – PVD system, Thermal evaporation, Sputtering, Pulsed laser deposition, Electron beam deposition. Chemical Vapour Deposition (CVD) – CVD system, Hot wall and Cold wall reactors, Thermally activated and Plasma assisted CVD techniques. CVD diamond – A case study.
Protective coatings for high temperature applications – Diffusion coatings, Overlay coatings, Pack cementation. Thermal Barrier Coatings (TBC) – Coating architecture, deposition methods and applications.

Reference Books/Material:

1. Budinski ,K.G., “Surface Engineering for Wear Resistances”, Prentice Hall, Englewood Cliffs, 1988
2. Ohring, M., “ The Materials Science of Thin Films”, Academic Press Inc, 2005
3. Morton,P.H., “Surface Engineering & Heat Treatment”, Brooke field, 1991

Course Outcomes: Upon completing this course,:

1. By the end of the course, the students should be able to:
2. Demonstrate an understanding and critical awareness of the concepts of surface engineering
3. Demonstrate a sound knowledge for the systematic application of alternative technologies used to fabricate coating systems.
4. Recommend techniques used to characterize the surface and explain the principles behind their operation.
5. Demonstrate knowledge of why the surface treatment affects the bulk properties of the material.
6. Select the most suitable surface engineering techniques that would give the required properties

Course Name: MEL401- PROJECT PHASE- I

Pre-requisites:

Offered in: VII Semester (Odd Semester)

Scheme and Credit: [(2-0-0); Credits: 1]

Type of Course: Core

Course Assessment Method: Sessional I (25%), Sessional II (25%), End Semester exam (50%).

Course Objectives:

1. To define aim, objective, scope of the proposed project work
2. To design the methodology of the project
3. To carry out literature review and basic work regarding model fabrication or design of experiments or simulation

COURSE SYLLABUS FOR B. TECH. MECHANICAL (EIGHT SEMESTER)

Course Name: MEL426 - REFRIGERATION & CRYOGENICS

Pre-requisites: Nil

Offered in: VIII Semester (Even Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Elective

Course Pre-requisite: **NIL**

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. To explain and demonstrate various types of equipment's (compressors / condensers / evaporators, expansion devices) used in refrigeration.
2. To demonstrate through experimentation the performance related concepts for refrigerator, air condenser, heat pump etc.

Syllabus:

Vapor Compression Refrigeration system : Introduction to refrigeration, applications of refrigeration, development of simple saturated Vapour compression refrigeration cycle, effect of change in evaporator and condenser pressure, effect of pressure drops, polytropic compression, methods of improvement in the performance of the cycle like sub cooling, superheating, use of heat exchanger, flash chamber and flash inter-cooler.
Components of Vapor compression system: Classification, construction and application of various components like compressors, condensers, evaporators, expansion devices, controls, cooling towers etc. **Refrigerants :** Types and classification, properties and nomenclature, Azeotropes, and environment friendly refrigerants. **Other refrigeration systems :** Vapor absorption systems (NH3-H20, LiBr- H2O) steam jet refrigeration systems, thermoelectric refrigeration and vortex tube refrigeration. **Multistage Refrigeration systems :** Working and analysis of multistage systems multiple evaporator and multiple compressor systems. **Gas cycle refrigeration :** Gas cycle refrigeration, reversed Brayton /Joules/Bell Coleman cycle, aircraft refrigeration, simple cycle, boot strap cycle, reduced ambient cycle regenerative cycle, Sterling cycle refrigeration. **Cryogenics :** Introduction and applications of cryogenics, cascade refrigeration, Joules Thomson effect, methods of air liquification, Linde's and Claude's cycle, adiabatic demagnetization, cryogenic insulation.

REFERENCES

1. Randall F. Barron, "Cryogenics Systems", Second Edition Oxford Univesity Press New York, Clarendon Press, Oxford, 1985.
2. Timmerhaus, Flynn, "Cryogenics Process Engineering", Plenum Press, New York.
3. Arora C.P, "Refrigeration and Air conditioning", Tata McGraw Hill Publication, 2nd Ed.
4. Pita Edward G" Air conditioning principles and systems", Prentice Hall, 4th Ed.

Course Outcomes: On completion of this course, students will be

1. Design refrigeration systems that can produce low temperatures required in many industrial applications.
2. Acquire enough knowledge to design the air conditioning systems for residential, commercial and industrial buildings.
3. Acquire expertise and develop confidence to install and retrofit HVACR equipment.

Course Name: MEP426 - REFRIGERATION AND CRYOGENICS LAB

Pre-requisites: Nil

Offered in: VIII Semester (Even Semester)

Scheme and Credit: [(0-0-2); Credits: 1]

Type of Course: Elective

Course Pre-requisite: **NIL**

Course Assessment Method: Continuous evaluation

Course Objectives:

1. To make student understand working of various machines related to refrigeration and their energy efficiency related performance
2. To explain student working of various components of refrigeration systems

List of Experiments:

1. 1-Experiment on Determination of COP of Refrigeration trainer-CO-1
2. 2-Experiment on Determination of COP for Heat pump-CO-1
3. 3- Experiment of Determination of COP for Vapour absorption Refrigeration-CO-1
4. 4-Experiment of Determination of COP for Thermoelectric Refrigeration-CO-1
5. 5-Experiment on Determination of COP for Room air conditioner-CO-1
6. 6-Demonstration of frost free refrigerator-CO-1
7. 7-Demonstration of conventional Refrigerator-CO-1
8. 8-Study and demonstration of types of compressors-CO-2
9. 9- Study and demonstration of types of condensers-CO-2
10. 10- Study and demonstration of types of evaporators-CO-2
11. 11- Study and demonstration of types of expansion devices -CO-2

Course Outcomes:

1. Design refrigeration systems that can produce low temperatures required in many industrial applications.
2. Acquire enough knowledge to design the air conditioning systems for residential, commercial and industrial buildings.
3. Acquire expertise and develop confidence to install and retrofit HVACR equipment.

Course Name: MEL430- ADVANCED IC ENGINES

Pre-requisites: Nil

Offered in: VIII Semester (Even Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Elective

Course Pre-requisite: **NIL**

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. To get the knowledge of IC, CI engines and testing and characterization of engines.

Syllabus:

Introduction

Engines types and their operation, Introduction and Historical Perspective, Engine classifications, Engine operating cycles, Engine components, Engine friction, lubrication and cooling, lubrication systems. Frictional losses, blow by losses, pumping loss, Factors affecting mechanical friction

Fuels

Fluid, Solid, gaseous, liquid fuels, SI Engine fuels characteristics, C.I. Engine fuels, characteristics, Rating of engine fuels, I.C. engine fuels - petrol, diesel ENG, LPG, Alcohol, Vegetable oils, Combustion, Combustion stoichiometry - The first low of thermodynamics and combustion, Enthalpies of formation, Heating values combustion efficiency. The second law of thermodynamics applied to combustions. Maximum work, chemical equilibrium, theoretical flame temperature.

SI Engine

S. I. Engine fuel requirements, carburetors, factors attesting carburetion, moderns carburetors, metering systems, choke, altitude compensation, fuel injection systems, multipoint port injection, feedback systems, charge motion within the cylinder swirl, squish, combustion stages, flame propagation cyclic variations in combustion, ignition fundamentals, conventional ignition system, abnormal combustion, knock and surface ignition, knock fundamentals, turbo charging, supercharging and scavenging in engines.

C. I. Engines

Essential features of the process, combustion systems. Combustion in direct and indirect injection, fuel spray behavior. Fuel injection systems, fuel pumps, fuel injectors, atomization, combustion in C. I. Engines, ignition delay, certain number, auto ignition. Factors affecting delay. Effects of fuel properties. Abnormal combustion, supercharging and turbo charging in engines.

Pollutant formation & Control

Nature and extent of problem, Nitrogen oxides Kinetics of NO formation, formation of NO2 NO formation in S. I. Engines NOx formation in C. I. Engine Carbon monoxide and unearned hydrocarbon emissions in S.I. and C.I. engines, EGR Particulate emissions, measurement technique. Catalytic converters, particulate traps.

Engine Design and Operating Parameters

Important engine characteristics, Geometrical properties of Reciprocating engines, Brake, Torque & Power, Indicated work per cycle, Mechanical efficiency, Road load power, Mean effective pressure, Specific fuel consumption and efficiency, Air/Fuel and Fuel/Air ratios, Volumetric efficiency, Engine

specific weight and specific volume, Correction factors for power and efficiency, Specific emission and emission index, Relationship between performance parameters

Measurement and Testing

Measurement of friction 'power indicated power, Brake power, Fuel consumption, Air consumption, Performance parameters and characteristics: Engine Power, Engine efficiencies, Engine performance characteristics, Variables affecting performance characteristics

REFERENCES

1. Heywood J.B., "Internal Combustion Engine Fundamentals", McGraw Hill 1988
2. Obert E.F., "Internal Combustion Engines and Air pollution", Intext Educational Pub 1974
3. Ganesan, V., "Internal Combustion Engines", Tata Mc Graw Hill Publishing Co. 6th Ed
4. Domkundwar, V.M., "Internal Combustion Engines"
5. Mathur, M.C., Sharma, R. D., "Internal Combustion Engines", Dhanpat Rai Pub 8th Ed 2003

Course Outcomes: On completion of this course, students will be

1. Analyze engine cycles and the factors responsible for making the cycle different from the Ideal cycle
2. Apply principles of thermodynamics, fluid mechanics, and heat transfer to influence the engine's performance
3. To Demonstrate the delay period and fuel injection system

Course Name: MEP430 - ADVANCED IC ENGINES LAB

Pre-requisites: Nil

Offered in: VIII Semester (Even Semester)

Scheme and Credit: [(0-0-2); Credits: 2]

Type of Course: Elective

Course Pre-requisite: **NIL**

Course Assessment Method: Continuous evaluation

Course Objectives:

List of Experiments:

1. Study of Carburetors
2. Study of Fuel Injection Systems
3. Study of Engine Components
4. Performance Characteristics of C.I. Engine
5. Performance Characteristics of C.I. Engine
6. Experiment on Air Pollution

Course Outcomes: On completion of this course, students will be

1. Understand the current available engines, their operating principles and their characteristics
2. Be able to test the performance of engines

Course Name: MEL443 - AIR POLLUTION CONTROL

Pre-requisites: Nil

Offered in: VIII Semester (Even Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Elective

Course Pre-requisite: NIL

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. The course objectives has three components i.e., sources of air pollution, pathways (air Pollutants transformation and transport) and receptors.
2. Students would get an insight into the dispersion of air pollution in the atmosphere
3. This life cycle of air pollution will enable the student to first identify the pollutants and their sources and then the transport mechanisms of the pollutants followed by the affected Population and there control mechanisms.

Syllabus:

Introduction

Conventional energy conversion methods using fossil fuels. Their environmental aspects, Pollution from the thermal power plants, thermal and particulate pollution and its control.

IC Engines

Combustion in petrol and diesel engines. Emissions from I.C. Engines and its control. Primary and Secondary Pollutants. Use of various alternative fuels, additives and their effect on pollution.

Conventional and microprocessor based control of Air/Fuel ratio, ignition and injection timing, speed and emissions from I. C. Engines.

Noise pollution

Noise pollution and noise control. Standardization for environmental control pollution

REFERENCES

1. Rao, “Air Pollution”, Tata Mc Graw Hill, 7th Edition, 2001
2. Obert E.F., “IC Engines and Air Pollution” , Harper & Row Pub, 1979
3. Reston, “Automotive Pollution Control”, Reston Pub Co1984
4. Prabhakar V.K , “Air Pollution Monitoring and Control”, Anmol Prakashan, 1st Edition, 2001

Course Outcomes:

1. After attending the course the students shall have acquired knowledge and understanding to evaluate air quality management and analyze the causes and effects of air pollution.
2. Students would be able to understand the type and nature of air pollutants, the behavior of plumes and relevant meteorological determinants influencing the dispersion of air pollutants.

Course Name: MEL449- ADVANCE TURBO MACHINERY

Pre-requisites: Nil

Offered in: VIII Semester (Even Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Elective

Course Pre-requisite: NIL

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

The course aims at giving an overview of different types of turbomachinery used for energy transformation, such as pumps, fans, compressors, as well as hydraulic, steam and gas turbines. It will focus on applications in power generation, transport, refrigeration and the built environment.

Syllabus:

Machinery, dimensionless parameters, specific speed, applications, stage velocity triangles, work and efficiency.

Centrifugal fans and blowers: Types, stage and design parameters, flow analysis in impeller blades-volute and diffusers, losses, characteristic curves and selection, fan drives and fan noise.

Centrifugal Compressor: Construction details, impeller flow losses, slip factor, diffuser analysis, losses and performance curves.

Axial flow compressor: Stage velocity diagrams, enthalpy-entropy diagrams, stage losses and efficiency, work done, stage design problems and performance characteristics.

Axial and radial flow turbines: Stage velocity diagrams, reaction stages, losses and coefficients, blade design principles, testing and performance characteristics.

CFD for Turbo machinery, General Aspects.

REFERENCES

1. Yahya, S.H., "Turbines Compressors and Fans", Tata McGraw-Hill Publishing Company, 1996
2. Earl Logan, Jr., "Hand book of Turbomachinery", Marcel Dekker Inc, 1992
3. Dixon, S.I., "Fluid Mechanics and Thermodynamics of Turbomachinery", Pergamon Press, 1990
4. Shepherd, D.G, "Principles of Turbomachinery", Macmillan, 1969**.**

Course Outcomes: On completion of this course, students will be able to

1. Use dimensional Analysis to compare homologous Machines
2. Classify and explain the function of dimensionless number
3. Design Prototype from Model
4. Select Fluid Machines for Appropriate Operations
5. Explain the Applications of Thermodynamics Laws.
6. Design both positive Displacement and Rotor dynamic Fluid Machines

Course Name: MEL415- MECHANICAL VIBRATION

Pre-requisites: Nil

Offered in: VIII Semester (Even Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Elective

Course Pre-requisite: NIL

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. To learn importance of vibration in machine design and dynamic stress analysis.
2. To learn how to present dynamic stress analysis
3. To learn how to present dynamic stress related failure in machines and structure
4. To learn vibration measurement in industrial machines.

Syllabus:

Introduction to vibration in mechanical and structural systems. Discrete system modeling. Hamilton's principle and Lagrange's equation. Free and forced vibration response of single degree of freedom system with and without damping under harmonic excitation. Discussion on various types of damping; viscous, coulomb, hysteretic etc. Forced response under periodic excitation and transient response through Du-hamel's integral.

Concept of response spectrum. Rotor whirling and critical speed. Vibration isolation and transmissibility ratio. Vibration isolation in automobiles. Dynamic vibration absorber. Torsional vibration in rotors. Numerical simulation in Cosmo-Kgp using Bond graph modeling and in Simulink of Matlab.

Modeling of multi degree of freedom systems. Determination of natural frequencies using matrix iteration and deflation technique. Concept of mode shapes and orthogonality principle. Rayleigh's quotient. Free and forced response through modal analysis. Vibration of continuous systems. Longitudinal vibration of rods, transverse vibration of beams and torsional vibration of shafts.

Determination of natural frequencies and mode shapes under various boundary conditions. Introduction to FEM modeling of continuous systems. Free and forced response through modal analysis. Introduction and distinguishing characteristics of nonlinear vibration. Phase plane, equilibrium points and limit cycles.

Random vibration, correlation and spectral density functions. Vibration measurement parameters and procedures. Vibration transducers and instruments. Source of vibration in Machineries. Role of vibration measurement and analysis in machine design and machine condition monitoring.

REFERENCES

1. Rao, Gupta, "Theory & practice of Mechanical vibration," 3rd Edition, New Age Publication.
2. Thomson, "Theory of Vibration," 3rd Ed , CBS publication
3. Meirovitch, " Elements of Vibration analysis", 2nd Ed, McGraw Hill
4. Timoshenko, "Vibration Problems in Engineering," 5th Ed, John Willey & Sons
5. S. S. Rao , "Mechanical Vibration", Fourth Edition, Pearson Education

Course Outcomes: On completion of this course, students will have

1. Appreciation for the need and importance of vibration analysis in mechanical design of machine parts that operate in vibratory conditions
2. Ability to analyze the mathematical model of a linear vibratory system to determine its response
3. Ability to obtain linear mathematical models of real life engineering systems
4. Ability to use Lagrange's equations for linear and nonlinear vibratory systems
5. Ability to determine vibratory responses of SDOF and MDOF systems to harmonic, periodic and non-periodic excitation
6. General notion on frequency and time response of vibratory systems

Course Name: MEL424- INDUSTRIAL ENGINEERING MANAGEMENT

Pre-requisites: Nil

Offered in: VIII Semester (Even Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Elective

Course Pre-requisite: NIL

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

To understand various fundamental disciplines of management like personnel management, marketing management, financial management etc. To apply this basic knowledge to understand the working of corporate world.

Syllabus:

Principles of management : Concepts of management, development of scientific management, principles of Fredric Taylor & functions such as planning organizing, staffing, leading motivating, communicating, controlling, decision making, span of control

Personal management: Meaning, functions of personal management, manpower planning, collective bargaining, wages & salary administration, labor welfare, training, trade unions, industrial factories Act, industrial boilers Act, Trade union act.

Plant management : Plant location, plant layout, types of maintenance such as break down, predictive & preventive maintenance, stores of management, industrial safety, causes & cost of accidents, safety programs, production planning & control, job, batch & process type of production

Marketing management : Definition & selling & modern concept of marketing, market research, new product development, product life cycle product launching, sales promotion, pricing, channels of distribution, advertising, market segmentation, marketing mix.

Material management : Importance of material management, classification, codification, forecasting, necessity of inventory

Financial management : Sources of finance, financing organizations, types of capital, elements of costs & allocation of indirect expenses, cost control, break even analysis, budgets & budgetary control, equipment replacement policy, make or buy analysis, balance sheet, ratio analysis, profit & loss statement.

REFERENCES

1. Koontz, O Daniall "Principles of management".
2. Kuchal S.C "Financial management" Chaitanya Publishing House, 1996.
3. Banga T.R. Sharma S.C "Industrial organization & engineering Economics", Khanna Pub.
4. Kotler P., Stauton William. "Principles of marketing management", 5th Ed., Prentice Hall, 1985.

Course Outcomes: On completion of this course, students will be

1. Able to function on multidisciplinary teams.
2. Able to identify, formulate, and solve engineering problems.
3. Able understanding of professional and ethical responsibility.
4. Able to communicate effectively.

Course Name: MEL428- MACHINE TOOL DESIGN

Pre-requisites: Nil

Offered in: VIII Semester (Even Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Elective

Course Pre-requisite: NIL

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. The students will be able to apply knowledge of basic mechanical engineering for design of various machine tools & their sub systems.
2. They will be able to analyze the vibrations in machine tools,
3. They will be able to perform testing of machine tools.

Syllabus:

Principles of machine tool design,
Design of machine tool structures,
Regulation of speeds and feeds. Design of speed, feed and spindle drives / gearboxes.
Design of spindles and spindle supports,
Design of Guide ways,
Machine tool dynamics and vibration behavior,
Control systems in machine tools,
Testing of machine tools**.**

REFERENCES

1. Mehta N. K "Machine Tool design and Numerical Control" Tata McGraw Hill 6th Edition 2006.
2. Boothroyd G. and Knight W. A. "Fundamentals of Machining and Machine Tools" CRC Press, Taylor and Francis, New Delhi 3rd Edition 2006
3. Nicholas Lisitsyn, Alexis V. Kudryashov and Oleg Trifonov "Machine Tool Design" University Press of the Pacific Paperback 4th Edition 2000.
4. Khanna O. P. and Lal M. "A Text Book of Production Technology – Vol. II" Dhanpat Rai Publications 13th Reprint 2012.
5. Jain K. C. and Chitale A. K. "A Text Book of Production Engineering" Prentice Hall India, New Delhi 2010

Course Outcomes: On completion of this course, students will be

1. Able to identify, formulate, and solve engineering problems.
2. Having broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
3. Able to work professionally in the area of mechanical systems
4. Able to design and conduct experiments, as well as to analyze and interpret data.

Course Name: MEL403- OPERATIONS RESEARCH

Offered in: VIII Semester (Even Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Elective

Course Pre-requisite: NIL

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. To study the various OR tools,
2. Study to apply a appropriate model to the given situatuation.
3. Formulate the problem.
4. Solve and analyse the problem.

Syllabus:

Introduction to OR& basic OR models, definition, characteristics and limitations of OR, linear programming: solutions of LPP by graphical method and simplex method, formulation of dual of LPP.

Assignment model, travelling salesman problem by, Transportation Problems, transshipment model.

Dynamic programming, structure and characteristics of dynamic programming, application of dynamic programming to resource allocation, inventory control & linear programming.

Project management: drawing of network, CPM & PERT, Probability of completion of project, cost analysis of project, allocation and updating of networks. .

Replacement models: concept of equivalent, interest rate, present worth, economic evaluation of alternatives, group replacement models. Inventory control models, analysis of single product deterministic models.

Waiting line situations, queuing theory and models (no derivations expected). Simulation concept and its application in waiting line situations, inventory and networks

REFERENCES

1. Mohan, C. and Deep, Kusum: "Optimization Techniques", New Age, 2009.
2. Mittal, K. V. and Mohan, C. "Optimization Methods in Operations Research and Systems Analysis", New Age, 2003.
3. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
4. Ravindran, A., Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Willey and Sons, 2nd Edition, 2009.
5. Hiller, F. S. and Liebermann, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
6. Chandra, Suresh, Jayadeva and Mehra, Aparna, "Numerical Optimization with Applications", Narosa, 2009.

Course Outcomes: On completion of this course, students will be able to

1. recognize the importance and value of Operations Research and mathematical modeling in solving practical problems in industry;
2. formulate a managerial decision problem into a mathematical model;
3. understand Operations Research models and apply them to real-life problems;
4. Use computer tools to solve a mathematical model for a practical problem.

Course Name: MEL448- ARTIFICIAL INTELLIGENCE IN MANUFACTURING

Pre-requisites: Nil

Offered in: VIII Semester (Even Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Elective

Course Pre-requisite: NIL

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. The main objective of this course is to make students conversant with the various machine learning artificial intelligence algorithms and their application in context with manufacturing processes.
2. The students opting for this course will be in position to get an overview of various artificial intelligence algorithms and hands on experience to model complicated engineering problems to solve them using soft computing techniques.

Syllabus:

Overview of artificial intelligence: Introduction to AI, evolution of AI, application areas, advantages, limitations, future applications.

Knowledge base expert systems: Introduction, expert system components and human interfaces, expert system characteristics and features, knowledge acquisition, knowledge base, inference engine, forward chaining, backward chaining, expert system shell, explanation.

Fuzzy logic: Introduction, Sources of Uncertainty, Membership Functions and Uncertainty, type I and II fuzzy logic systems, application of fuzzy logic to manufacturing engineering problems.

Genetic algorithms: Introduction, random heuristic search, simple genetic algorithm (SGA): algebra, selection, mutation, crossover, mixing, application of SGA for solving single objective multi constraint problems.

Artificial neural networks: Introduction, supervised and unsupervised neural networks, single and multilayered neural networks, applications, advantages, drawbacks.

Introduction to Fusion of ANN, fuzzy and GA.

Case studies: Based on total number of students opting for this course will be grouped and asked to select problems from manufacturing engineering to solve them using learned techniques.

1. Learning of expert system software like VIDWAN, CLIPS and its application to make a decision support system to solve manufacturing engineering problems like, selection of tool characteristics based on application, selection of manufacturing systems, fault diagnostics for vehicles and advance machines.
2. Application of fuzzy logic for selection of layered manufacturing systems, fluid flow control and temperature control systems
3. Application of GA for solving scheduling and cellular manufacturing
4. Modeling and application of ANN to manufacturing problems like optimal parameter selection for drilling, milling, EDM etc.

REFERENCES

1. Rajashekaran, S. and Pai, GAV, "Neural Networks, Fuzzy logic & G. A. Synthesis & Application", PHI, 1st Edition, 2012.
2. K. Deb, "Genetic Algorithms", Wiley, 2010.
3. David E Goldberg, Genetic Algorithms in Search, Optimization, and Machine Learning ", Pearson Education India.
4. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", John Wiley Publication.
5. Satish Kumar, "Neural Networks: A Classroom Approach", Tata McGraw-Hill Education.

Course Outcomes: On completion of this course, students will be able to

1. Explain importance of artificial intelligence techniques used in expert system software
2. Estimate the difference between forward and backward chaining inference strategies
3. Explain the difference between fault diagnosis and failure analysis solve the case studies of typical applications in solving manufacturing problems like process selection, tool selection etc.

Course Name: MEL413 - FRACTURE MECHANICS

Pre-requisites: Nil

Offered in: VIII Semester (Even Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Elective

Course Pre-requisite: NIL

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1.To know characteristics of basic mechanics of crack propagation and fracture phenomenon
2.Design the parts from fracture mechanics point of view by selecting proper materials and geometric features.
3.To Damage tolerance design of the components

Syllabus:

Introduction to Fracture Mechanics: Introduction to the realm of fracture and back ground history of development of fracture mechanics; Discrepancy between theoretical and real strength of materials, conventional failure criteria based on stress concentration and characteristic brittle failures, Griffith's work.

Linear Elastic Fracture Mechanics (LEFM): Crack deformation modes and basic concepts, crack tip stresses and deformation, Stress Intensity Factor (SIF) and its criticality in different modes, superposition of SIFs, LEFM design concept applications; Concept of energy release rate, equivalence of energy release rate and SIF.

Fracture toughness and its laboratory determination procedure, test specimen size requirement etc.; Effect of temperature and loading rate on fracture toughness; Fatigue and fatigue crack propagation laws, fatigue life calculations under constant and variable amplitude loading, mixed-mode fatigue crack propagation

Elastic Plastic Fracture Mechanics (EPFM): Design criteria for non-brittle materials; plastic zone corrections, crack opening displacement (COD), J-contour integral and crack growth resistance (R-curve) concepts.

REFERENCES

1. P.Kumar, "Elements of Fracture Mechanics", McGraw Hill, 2012.
2. M. Jansen, J. Zuidema, R. Wanhill, "Fracture Mechanics" Spon Press, 2004.
3. T.L. Anderson, "Fracture Mechanics: - Fundamentals and Application", Taylor and Francis, 2005.
4. R.W. Hetzberg, "Deformation and fracture mechanics of engineering material", John wiley and son, 1996.

Course Outcomes: On completion of this course,

1. Student will have knowledge of basic crack growth mechanism.
2. Student will select proper design based on fracture mechanics.
3. Student will be able to estimate the safe life design product.
4. Students will be able to get the knowledge of different NDT testing.

Course Name: MED402- Project Phase II

Offered in: VIII Semester (Even Semester)

Scheme and Credit: [(3-0-0); Credits: 3]

Type of Course: Elective

Course Pre-requisite: MED401

Course Assessment Method: Sessional I (15%), Sessional II (15%), Internal assessment through assignments (10%), End Semester exam (60%).

Course Objectives:

1. To complete the fabrication or experimentation or simulation work of the project work finalized in MED401.
2. To carry out the analysis of the work done

Course Outcomes: On completion of this course, students will be

1. Able to work in a team
2. Able to compile research or development work in the form of a document
3. Able to learn systematic approach for solving engineering problems