ANDHRA UNIVERSITY
VISAKHAPATNAM
SCHEME OF INSTRUCTION & EXAMINATION
B.Tech (FOUR YEAR COURSE)
&
B.Tech + M.Tech (SIX YEAR DOUBLE DEGREE COURSE)
(With effect from 2015-2016 admitted batches onwards)
Under Choice Based Credit System

MECHANICAL ENGINEERING

II YEAR
FIRST SEMESTER

Code No.	Course	Credits	Lecture Hrs	Tutorial Hrs	Lab Hrs	Total Contact Hrs/Week	Sessional Marks	Exam Marks	Total Marks
ME 2101	Mathematics – IV	4	3	1	--	4	30	70	100
ME 2102	Engineering Mechanics	4	3	1	--	4	30	70	100
ME 2103	Mechanics of Solids	4	3	1	--	4	30	70	100
ME 2104	Basic Thermodynamics	4	3	1	--	4	30	70	100
ME 2105	Manufacturing Processes	4	3	1	--	4	30	70	100
ME 2106	Industrial Electronics	4	3	1	--	4	30	70	100
ME 2107	Mechanical Engg Drawing	2	--	--	3	3	50	50	100
ME 2108	Mechanics of Solids Lab	2	--	--	3	3	50	50	100
ME 2109	Mechanical Engineering Lab – I	2	--	--	3	3	50	50	100
	TOTAL	**30**	**18**	**6**	**9**	**33**			

SECOND SEMESTER

Code No.	Course	Credits	Lecture Hrs	Tutorial Hrs	Lab Hrs	Total Contact Hrs/Week	Sessional Marks	Exam Marks	Total Marks
ME 2201	Electrical Technology	4	3	1	--	4	30	70	100
ME 2202	Advanced Strength of Materials	4	3	1	--	4	30	70	100
ME 2203	Theory of Machines	4	3	1	--	4	30	70	100
ME 2204	Metal Cutting & Machine Tools	4	3	1	--	4	30	70	100
ME 2205	Environmental Science	2	2	--	--	2	30	70	100
ME 2206	Engineering Economics	4	4	--	--	4	30	70	100
ME 2207	Production Drawing	2	--	--	3	3	50	50	100
ME 2208	Manufacturing Technology Lab-I	2	--	--	3	3	50	50	100
ME 2209	Electrical Technology Lab	2			3	3	50	50	100
	TOTAL	**28**	**18**	**4**	**9**	**33**			

III- YEAR
FIRST SEMESTER

Code No.	Course	Credits	Lecture Hrs	Tutorial Hrs	Lab Hrs	Total Contact Hrs/Week	Sessional Marks	Exam Marks	Total Marks
ME 3101	Dynamics of Machinery	4	3	1	--	4	30	70	100
ME 3102	Advanced Thermodynamics-I	4	3	1	--	4	30	70	100
ME 3103	Industrial Engineering & Management	4	3	1	--	4	30	70	100
ME 3104	Operations Research	4	3	1	--	4	30	70	100
ME 3105	Measurements & CNC	4	4	--	--	4	30	70	100
ME 3106	Elective-I	4	4	--	--	2	30	70	100
ME 3107	MOOCS-I	2	--	--	3	3	50	50	100
ME 3108	Mechanical Engineering Lab – II	2			3	3	50	50	100
ME 3109	Manufacturing Technology Lab-II	2	--	--	3	3	50	50	100
	TOTAL	**30**	**20**	**4**	**9**	**31**			

SECOND SEMESTER

Code No.	Course	Credits	Lecture Hrs	Tutorial Hrs	Lab Hrs	Total Contact Hrs/Week	Sessional Marks	Exam Marks	Total Marks
ME 3201	Fluid Mechanics & Machinery	4	3	1	--	4	30	70	100
ME 3202	CAD/CAM	4	3	1	--	4	30	70	100
ME 3203	Design of Machine Elements	4	3	1	--	4	30	70	100
ME 3204	Production Planning and Control	4	3	1	--	4	30	70	100
ME 3205	Advanced Thermodynamics-II	4	3	1	--	4	30	70	100
ME 3206	Elective-II	4	4	--	--	2	30	70	100
ME 3207	MOOCS-II	2	--	--	3	3	50	50	100
ME 3208	Metrology and Mechatronics Lab	2	--	--	3	3	50	50	100
ME 3209	Industrial Engineering Lab	2	--	--	3	3	50	50	100
	TOTAL	**30**	**24**	**4**	**6**	**34**			

IV-YEAR
FIRST SEMESTER

Code No.	Course	Credits	Lecture Hrs	Tutorial Hrs	Lab Hrs	Total Contact Hrs/Week	Sessional Marks	Exam Marks	Total Marks
ME 4101	Machine Design	4	3	1	--	4	30	70	100
ME 4102	Heat and Mass Transfer	4	3	1	--	4	30	70	100
ME 4103	Refrigeration & Air-conditioning	4	3	1	--	4	30	70	100
ME 4104	Statistical Quality Control	4	3	1	--	4	30	70	100
ME 4105	Elective-III	4	4	--	--	4	30	70	100
ME 4106	Elective-IV	4	4	--	--	4	30	70	100
ME 4107	Heat and Mass Transfer Lab	2	--	--	3	3	50	50	100
ME 4108	FMM Lab	2	--	--	3	3	50	50	100
ME 4109	CAD/CAM Lab	2	--	--	3	3	50	50	100
	TOTAL	**30**	**20**	**4**	**6**	**30**			

SECOND SEMESTER

Code No.	Course	Credits	Lecture Hrs	Tutorial Hrs	Lab Hrs	Total Contact Hrs/Week	Sessional Marks	Exam Marks	Total Marks
ME 4201	Project	14		---	--	--	50	50	100
ME 4202	MOOCS-III	2	--	--	3	4	50	50	100
ME 4203	MOOCS-IV	2	--	--	3	4	50	50	100
	TOTAL	**15**			**6**	**6**			

Elective – I
(A) Advanced Foundry and Welding Technology
(B) Work Study
(C) Finite Element Analysis
(D) Mechatronics

Elective – II
(A) Automobile Engineering
(B) Mechanical Vibrations
(C) Robotics
(D) Reliability Engineering

Elective – III
(A) Renewable Energy Technologies
(B) Total Quality Management
(C) Optimization Design
(D) Tool Design

Elective – IV
(A) Instrumentation and Control Systems
(B) Supply Chain Management
(C) Power Plant Engineering
(D) Condition Monitoring

MOOCS

a) Computational Mechanics of Materials
b) Compressible Fluid Dynamics
c) Engineering of Nuclear Reactors
d) Mechanical Assembly and its Role in Product Development
e) Dynamics and Vibrations
f) Introduction to Modeling and Simulation

II YEAR
FIRST SEMESTER

ME 2101 MATHEMATICS – IV

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week :3Th+ 1 Tut Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

COURSE OBJECTIVES:

In general , the students are introduced with a knowledge on - Vector Calculus, Partial differential equations, their applicationsand Integral Transforms(Fourier transforms, FST, FCT) to facilitate them to use these concepts in their core subjects.

The objectives, in particular are to learn:

- The basic knowledge and applications of Vector Calculus used in Engineering problems.
- About the gradient, divergence and curl under the differentiation of scalar and vector point functions, also on Line-, Surface- and Volume integrals under the integration of point functions; their applications in Engineering problems.
- The transformation theorems such as **Green's** theorem in the plane, **Stoke's**theorem, **Gauss Divergence** theorem and their applications
- How to formulate the Partial Differential Equations from the relations between the dependent and independent variables, and understand the methods of solving first order first degree linear, non-linear P**artial Differential Equations**, Homogeneous and Non homogeneous linear partial differential equations with constant coefficients .
- The procedure to find out the solutions of Partial Differential Equations by using the method of separation of variables (product method)
- About the formulation of one dimensional wave (string equation), one-and two-dimensional **Heat flow equations**, **Laplace's equation** in Cartesian and polar coordinates; also to solve these equations by the method of separation of variables.
- On the concept of integral transforms, namely, **Fourier transforms**, **Fourier Sine, Cosine and related inversetransforms;** their applications in solving several Physical and Engineering problems

COURSE OUTCOMES: After going through this course , the students would be able to:

- Operate the differential operator 'del' to the scalar and vector point functions, Calculate the Gradient, Divergence and Curl, Vector normal to a surface, maximum rate of change of a scalar field, test whether two surfaces are to cut orthogonally or not .
- Find the rate per unit volume at which the physical quantity is issuing from a point, the rate of inflow minus out flow using the Divergence and the angular velocity of rotation at any point of the vector field using the Curl.

- **Test** whether the given motion is irrotational or rotational, whether a vector force acting on a particle is conservativeor not
- Find out the potential function from a given vector field.
- Obtain the well known Laplace and poisson equations from an irrotational field
- Understand to determine the work done by a force field and circulation using a Line integral
- Find out the Line, Surface and Volume integrals - find the flux using surface integral and volumes using the volume integral
- Apply the vector integral theorems (Green's theorem in the plane, Stoke's and Divergence theorems) for evaluating the double and triple integrals as these are used to find areas and volumes.
- Know the methods of solving Linear and Non linear first order and first degree partial differential equations.
- Solve the Linear Partial Differential Equations with constant coefficients (homogeneous and non homogeneous) and know the procedure for finding the complementary function and particular integrals
- Apply the method of separation of variables to obtain solutions of most of the boundary value problems involving Linear partial differential equations occurred in engineering studies
- Solve, in particular the wave equations, heat equations and Laplace's equations in Cartesian and polar coordinates using the method of separation of variables.

apply and extend the knowledge of Fourier transform techniques in solving several Initial and Boundary value problems of Engineering, such as in Conduction of heat / Thermodynamics, Hydraulics transverse vibrations of a string, oscillations of an elastic beam, bending of beams, electrical circuits, free and forced vibrations of a membrane and transmission lines , etc.

SYLLABUS:

VECTOR CALCULUS-1: Differentiation of vectors, curves in space, velocity and acceleration, relative velocity and relative acceleration, scalar and vector point functions, vector operator ∇ applied to scalar point functions- gradient, ∇ applied to vector point functions- divergence and curl. Physical interpretation of ∇f, $\nabla.\overline{F}$, $\nabla \times \overline{F}$, ∇ applied twice to point functions, ∇ applied to products of two functions; Irrotational and Solenoidal fields.

VECTOR CALCULUS-2: Integration of vectors, line integral, circulation, work done, surface integral-flux, Green's theorem in the plane, Stoke's theorem, volume integral, Gauss Divergence theorem.
Introduction of orthogonal curvilinear coordinates, cylindrical and spherical polar coordinates

INTRODUCTION OF PARTIAL DIFFERENTIAL EQUATIONS: Formation of partial differential equations, solutions of partial differential equations- equations solvable by direct

integration, linear equations of first order: Lagrange's Linear equation, non-linear equations of first order, Charpit's method.
Homogeneous linear equations with constant coefficients- rules for finding the complementary function, rules for finding the particular integral (working procedure), non-homogeneous linear equations.

APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS: Method of separation of variables, One dimensional wave equation-vibrations of a stretched string, one dimensional Heat equation, Two dimensional heat flow in steady state - solution of Laplace's equation in Cartesian and polar coordinates (two dimensional).

INTEGRAL TRANSFORMS: Introduction, definition, Fourier integral, Sine and Cosine integrals, Complex form of Fourier integral, Fourier transform, Fourier Sine and Cosine transforms, Finite Fourier Sine and Cosine transforms, properties of Fourier transforms, Convolution theorem for Fourier transforms, Parseval's identity for Fourier transforms, Fourier transforms of the derivatives of a function, simple applications to Boundary value problems.

TEXT BOOKS:

Scope and treatment as in "Higher Engineering Mathematics", by Dr. B.S.Grewal, **43rd Edition**, Khanna Publishers.

REFERENCE BOOKS:

1. A text book of Engineering Mathematics by N.P. Bali and Dr. Manish Goyal, Lakshmi Publications.
2. Mathematical Methods of Science & Engineering aided with MATLAB by KantiB.Dutta, Cengage Learning India Pvt. Ltd.
3. Advanced Engineering Mathematics by Erwin Kreyszig.
4. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw Hill Company.
5. Advanced Engineering Mathematics by H.K.Dass. S.Chand Company.
6. Higher Engineering Mathematics by Dr. M.K.Venkataraman.

ME 2102 ENGINEERING MECHANICS

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 3 Th+ 1 Tut Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

COURSE OBJECTIVES:

1. General Objectives

- The course uses the Laws of Mechanics to predict forces in and motions of machines and structures.
- The course is the key prerequisite course to sequences of courses dealing with mechanics of machines, stress analysis and design of mechanical systems.

2. Specific Objectives

- Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline.
- In-depth understanding of specialist bodies of knowledge within the engineering discipline.
- Application of established engineering methods to complex engineering problem solving.
- Application of systematic engineering synthesis and design processes.

COURSE OUTCOMES:

Upon successful completion of this course student should be able to:

1. Use scalar and vector analytical techniques for analyzing forces in statically determinate structures.
2. Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems.
3. Apply basic knowledge of maths and physics to solve real-world problems

SYLLABUS:

STATICS

Basic Concepts: Scalar and vector quantities- Representation vectors- Free vector force, Specification of force- Effect of force on rigid body- Free body diagram.

Concurrent Forces and Parallel Forces in a Plane: Principles of statics- Equilibrium of concurrent forces in a plane- Method of projections- Equilibrium of three forces in a plane- Method of moments- **Friction.** Two parallel forces- General case of parallel forces in a plane-Centre of parallel forces and centre of gravity- Centroids of composite plane figures and curves- Distributed force in a plane.

General Case of Forces in a Plane: Composition of forces in a plane- Equilibrium of forces in a plane- Plane trusses, Funicular polygon, Maxwell diagrams, method of joints, method of sections- Plane frame- method of members, Distributed force in a plane- Flexible suspension cables.

Force Systems in Space: Concurrent forces in space; method of projections, method of moments; Couples in space- Parallel forces in space- Centre of parallel forces and centre of gravity- General case of forces in space.

DYNAMICS

Basic concepts: Kinematics- Kinetics- Newton laws of motion- Particle- Rigid body- Path of particle.

Rectilinear Translation: Kinematics of rectilinear motion Principles of dynamics- Differential equation of rectilinear motion- Motion of a particle acted upon by a constant force, Force as a function of time- Force proportional to displacement; free vibrations- D'Alembert's principle- Momentum and impulse- Work and energy- Ideal systems: conservation of energy. **Curvilinear Translation:** Kinematics of curvilinear motion- Differential equations of curvilinear- Motion of a projectile- D'Alembert's principle- Moment of momentum- work and energy in curvilinear motion.

Rotation of rigid body about a fixed axis: Kinematics of rotation- Equation of motion for a rigid body rotating about a fixed axis- Rotation under the action of a constant moment

Torsional vibration- The compound pendulum- General case of moment proportional to angle of rotation- D'Alembert's principle in rotation.

Plane Motion of a Rigid Body: Kinematics of plane motion- Instantaneous center- Equations of plane motion- D'Alembert's principle in plane motion- The principle of angular momentum in plane motion- Energy equation for plane motion.

Text Book:

1. Engineering Mechanics by S.Timoshenko and D.HYoung McGraw-Hill.

References:

1. Engineering Mechanics, Vol.1 & 2 by J.L. Meriems and L.G. Kraige.
2. Engineering Mechanics by Singer.
3. Engineering Mechanics by K.L. Kumar, Tata Mc-Graw Hill.
4. Engineering mechanics by Bhavikatti. New age international.

ME 2103 MECHANICS OF SOLIDS

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 3 Th+ 1 Tut Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

COURSE OBJECTIVES:

To acquire knowledge about the basic principles and terminology of solid mechanics, mechanical behaviour of engineering materials, methods to solve important types of solid mechanics problems and ability to apply this knowledge for solution of simple problems of practical importance.

The course contains amongst other things: definitions and basic concepts regarding to the Solid Mechanics, for example the concepts of stress and strain, stress and strain curves and elastic limits, the basic concept of fatigue and Euler buckling. Some special topics are expanded in more depth:

- Axial load: Stress, strains and deformation for determinate and indeterminate systems and thermal loads.
- Torsion: Stress, strains and deformation for determinate loaded shafts of thin walled sections, basic arbitrary thin-walled sections.
- Bending of beams: Stress, strains and deformation for determinate beams, shearing force and bending moment diagrams.
- determine stresses and deformations in truss structures, frames and composites using models for rods and beams
- determine stresses and deformations in axisymmetric structures.
- design the structures mentioned above from knowledge of the applied loading and the mechanical behaviour of the material.
- be able to determine the applicability of the models above and also understand the order of the approximations included in the models.

COURSE OUTCOMES:

- The students will be able to understand the basic concepts of stress, strain and relations based on linear elasticity and also will be able to understand the material behavior due to different types of loading.
- The students will be able to understand different types of beams and loads and also able to calculate SF & BM and draw the SFD & BMD for various applications. Solve problems for deflection of beams.
- The students will be able to derive the torsion equation and solve problems on torsion of mechanical components, understand and Solve problems on thin cylinders.
- Provides inputs useful for structural and mechanical design of components

SYLLABUS:

Simple Stresses: Stress, Strain, Stress- Strain curve, Lateral strain, Relationship between elastic constants, Bars of varying cross-section, Compound bars, Temperature stresses in bars. Complex Stresses: Stresses on an inclined plane under different uniaxial and biaxial stress conditions, Principal planes and principal stresses, Mohr's circle, Relation between elastic constants, Strain energy, Impact loading.

Bending Moments and Shear Forces: Beam - Types of loads, Types of supports, S.F. and B.M. diagrams for Cantilever, Simply supported and Over hanging beams.

Center of Gravity and Moment of Inertia:.Determination of Center of Gravity, Area and Mass Moment of Inertia of simple and composite sections, Area and Mass Product of Moment of Inertia

Stresses in Beams: Theory of bending, Flexural formula, Determination bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections – Design of simple beam sections, Shear stresses in beams, Shear stress distribution across various beams sections like rectangular, circular, triangular, I, T, angle sections..

Deflections of Beams: Relation between curvature, slope and deflection, double integration method, Macaulay's method, Moment area method -application to simple cases including Cantilever, Simply supported and Over hanging beams.

Torsional Stresses in Shafts and Springs: Analysis of torsional stresses, Power transmitted, Combined bending and torsion, Closed and open coiled helical springs, Theories of Failure: Application to design of shafts

Cylinders and Spherical Shells: Stresses and strains in thin cylinders, Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and Volumetric strains – changes in dia, and volume of thin cylinders and Thin spherical shell.

Text Books:

1. Analysis of Structures, by Vazirani and Ratwani, Vol. 1, 1993 edition.
2. Mechanics of Materials by James M. Gere , Stephen P. Timoshenko , CBS Publishers
3. Solid Mechanics, by Popov

Reference:

1. Strength of Materials, by Timoshenko
2. Strength of Materials -By Jindal, Umesh Publications.
3. Analysis of structures by Vazirani and Ratwani.
4. Mechanics of Structures Vol-III, by S.B.Junnarkar.
5. Strength of Materials by Andrew Pytel and Ferdinond L. Singer Longman

ME 2104 BASIC THERMODYNAMICS

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 3 Th+ 1 Tut Ses. : 30 Exam : 70

Examination (Theory): 3hrs.

Credits : 4

OBJECTIVES COURSE

- To educate students about the behavior of real gases and the significance of ideal gas theory
- To educate the students about the properties of ideal gas and their relationship
- To familiarize the students about the behavior of ideal gases under heating, cooling, compression and expansion processes
- To educate the students about the working principle of combustion engines (internal and external) and their cycles such as Otto, Diesel, Atkinson, Ericson, Brayton, etc., and their comparison

OUTCOMES COURSE

- Students realize the practical importance of ideal gas theory and the use of real gases in combustion engines such as IC Engines and Gas turbines
- Students are able to calculate the properties of the gases such as internal energy, enthalpy and entropy.
- Students are able to estimate the losses which occur during operation of the heat engines, and their maximum possible operating efficiencies under STP conditions.
- Students can estimate the maximum work-output delivered by the heat engines and maximum work consumed by the reversed heat engines

SYLLABUS:

Introduction: Basic concepts; Thermodynamic systems; Micro & Macro systems; Homogeneous and heterogeneous systems; Concept of continuum; Pure substance; Thermodynamic equilibrium; State; Property; Path; Process; Reversible and irreversible cycles; Work; Heat; Point function; Path function; Heat transfer.

Zeroth law of thermodynamics; Concept of equality of temperatures- Joule's experiments- First law of thermodynamics- Isolated systems and steady flow systems- Specific heats at constant volume and pressure - Enthalpy- First law applied to flow systems- Systems undergoing a cycle and change of state- First law applied to steady flow processes- Limitations of first law of thermodynamics.

Perfect gas laws- Equation of state- Universal gas constant, various non-flow processes- Properties of end states- Heat transfer and work transfer- Change in internal energy-throttling and free expansion- Flow processes- Deviations from perfect gas model-Vanderwall's equation of state- Compressibility charts- Variable specific heats.

Second law of thermodynamics- Kelvin Plank statement and Clasius statement and their equivalence, Corollaries- Perpetual motion machines of first kind and second kind- Reversibility and irreversibility- Cause of irreversibility- Carnot cycle- Heat engines and heat pumps- Carnot efficiency- Clasius theorem- Clasius inequality- Concept of entropy- Principles of increase of entropy- Entropy and disorder.

Availability and irreversibility- Helmholtz function and Gibbs function- Availability in steady flow- Entropy equation for flow process- Maxwell's equations- Tds relations- Heat capacities.

Air standard cycles-Air standard efficiency- Otto cycle-Diesel cycle- Dual cycle- Brayton cycle- Atkinson cycle- Stirling cycle- Erickson cycle

Text Books:

1. Engineering Thermodynamics, by P.K. Nag, Tata McGraw-Hill Publications Company.
2. Applied Thermodynamics-I by R. Yadav, Central Book House.
3. Engineering Thermodynamics by K. Ramakrishna, Anuradha agencies.

References Books:

1. Engineering Thermodynamics by Rathakrishnan, Prentice - Hall India.
2. Engineering Thermodynamics by Y.V.C. Rao.
3. Thermal Engineering by R.K. Rajput, S.Chand& Co.
4. Engineering Thermodynamics Work and Heat Transfer, by G.F.C Rogers and Y.R. Mayhew, ELBS publication
5. Engineering Thermodynamics by Zemansky.

ME 2105 MANUFACTURING PROCESSES

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 3 Th+ 1 Tut Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

COURSE OBJECTIVES:

- To provide an understanding and appreciation of the different manufacturing (Casting, Forming) and fabrication (Welding, Soldering and Brazing) methods to the students.
- To expose the students to various applications of the manufacturing process in real life articles/ products.

COURSE OUTCOMES: Students will be Able

- To compare various manufacturing materials, their sources, properties and uses:
- *Ferrous* (iron and steel) and *non-ferrous* metals (copper, aluminum, brass, lead, etc.) *Alloys* (mixing of metals: brass, steel, aluminum alloys, gold alloys)
- To appreciate how cast iron products will be casted by sand casting technique
- To know manufacturing of seamless Pipes, Toys, Gears, Angles, Rail tracks, Channels (T, L I etc.), Connecting rods etc.
- To know the importance and principle of metal forming process like Coining, Embossing, Stretch forming and High Energy Rate of Process etc.
- Understand manufacturing of seamless Pipes, Toys, Gears, Angles, Rail tracks, Channels (T, L I etc.), Connecting rods etc. by using metal forming processes
- Understand the principles of various welding process, soldering and brazing.
- Understand the position welding techniques.
- Understand how to check the welds quality.

SYLLABUS:

Manufacturing concepts; Product cycle; Job, batch and mass production; Primary and secondary manufacturing processes; Principle of metal casting; Terminology; Pattern; Types; Allowances; Materials; Core boxes; Selection; Testing and preparation of moulding sands; Moulding tools and equipment; Machine moulding; Core making; Sprue; Runner, gates and risers; Types and designing; Melting and pouring the metal; Shell mold casting; Investment casting; Permanent mould casting; Casting defects.

Formability of metals; Cold and hot working; Rolling; Types; Roll size; Stretch forming, metal spinning, embossing and coining; Peening; Sheet metal forming operations; Presses; Die design.

Forging materials; Forging processes; Forging techniques; Forging presses; Forging pressure distribution and forging force; Automation of forging; Swaging; Drawing; Extrusion; High energy rate forming.

Weldability; Welding metallurgy; Principles and processes of arc welding (SMAW, GTAW, GMAW, FCAW, PAW, SAW); Welding equipment; Weld positioners and fixtures; Oxyacetylene welding; Flame cutting; Brazing and soldering; Principle of resistance welding; Types of resistance welds; Seam welding; Projection welding; Resistance butt welding; Solid state welding; Weld inspection and testing.

Text Book:

1. Process and Materials of Manufacture (4^{th} Edition) by Roy A. Lindberg, Prentice-Hall of India Private Limited.

Reference Books:

1. Manufacturing Engineering & Technology by Kalpak Jain, Addition Wesley Edition.
2. Materials and Processes in Manufacturing by De Margo, Black and Kohsen, Prentice Hall of India.
3. Principles of Metal Casting by Hein and Rosenthol, Tata Mc-Graw Hill India.
4. Manufacturing Technology-Foundary, Forming and Welding by P.N. Rao, Tata McGraw-Hill Publishing Company.

ME 2106 INDUSTRIAL ELECTRONICS

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 3 Th+ 1 Tut Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

Objective:

This course is designed as an introduction to the principles of analog and digital electronic circuits and motors for mechanical engineering students. This course builds upon the theories and experimental practices in electrical circuits taught in the pre-requisite course, to develop a basic understanding of the operation of circuits containing amplifiers, transistors and diodes. In addition, basic digital circuits and simple microprocessors(8085) are discussed to prepare the student for microprocessors systems. The experimental skills developed during the laboratory portion of the prerequisite course together with the theory of this course will enable students to perform basic design and analysis of simple analog and digital electronic circuits and motors covered during this course.

COURSE OBJECTIVES:

- Analyze the steady state and small signal AC response of simple electronic circuits containing diodes, transistors, and operational amplifiers
- Apply performance criteria in the design of basic amplifier circuits and verify that the criteria were met.
- Design and analyze circuits containing digital components and microprocessors.
- Analyze and evaluate performance parameters of AC and DC motors

COURSE OUTCOMES:

1. Describe how electronic input and output circuits are used to control automated manufacturing and/or process systems
2. Identify basic elements used for input, output, timing, and control
3. Define how programmable electronic systems use input data to alter output responses
4. Troubleshoot a representative system
5. Demonstrate how system operation can be altered with software programming
6. Electronics Design Engineer
7. To provide graduates with skills to assist them in the following job roles
8. In addition to the above, this module will provide support to other modules Automation/Facilities Engineer

SYLLABUS:

Devices: Semi-conductor diode, Zener diode - Transistor - Silicon control rectifier. Rectifiers, Amplifiers, Oscillators, Cathode ray oscilloscope.
Industrial Applications: Poly-phase rectifiers - Control circuits - Motor speed control voltage control, Time delay relay circuits - Photo electric circuits. Resistance welding, inducting heating - Dielectric heating.
Servomechanism: Open loop and closed loop systems (Elementary treatment only).
Introduction to Digital Electronics: Fundamentals of digital electronics, Number system and codes, Logic gates, Boolean algebra, Arithmetic-logic units, Flip-flops, Registers and counters, Memories: ROM, PROM, EPROM and RAM.
Introduction to Microprocessors: The Intel-8085 microprocessor; Architecture, Instruction set, Execution of instructions, Addressing structures, Timing and machine cycles of 8085 and programming I/O operations, Interrupts, Serial input and serial output, Programming the I/O ports, Programming the timer.

Text Books:

1. Industrial Electronics by Mithal (Khanna Publications).
2. Digital Computer Electronics - An Introduction to Micro Computer by Albert Paul Malvino, Tata McGraw-Hill Publishing Co. Ltd., New Delhi-2.

References:

1. Engineering Electronics by Ryder-McGraw Hill.
2. Micro Processors by Leventhal.
3. Industrial Electronics by Bhatacharya, Tata Mc-Graw Hill.
4. Industrial Electronics and Control by S.K. Bhatacharya and S. Chatarjee, 1995 Ed., Tata Mc-Graw Hill Pub. Co.Ltd.

ME 2107 MECHANICAL ENGG DRAWING

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 3 Lab Ses. : 50 Exam : 50

Examination (Theory): 3hrs. Credits : 2

COURSE OBJECTIVES:

- To provide an understanding and draw the assembly drawing of various engine components and machine tool components to the students.
- To expose the students to draw various fastenings (Screw, Riveted, welded etc.) , Bearings, couplings, key etc.

COURSE OUTCOMES: Students will be able to

1. Know drawing of Screw threads and Screw Fastenings using standard Empirical formulae
2. Draw Riveted joints, Keys, Cotter-joints, Pin-joints
3. Draw Couplings (Shaft couplings: Box and split muff couplings, Flanged, Flexible, Universal and Oldham couplings) , Pipe joints and Bearings (shaft bearings, Brackets and Hangers)
4. Draw Orthogonal views and Sectional views of machine parts
5. Draw Assembly drawing of various engine components and machine tool components

SYLLABUS:

Screw threads and Screw Fastenings using standard Empirical formulae.

Riveted joints, Keys, Cotter-joints, Pin-joints.

Shaft couplings: Box and split muff couplings, Flanged, Flexible, Universal and Oldham couplings,

shaft bearings, Brackets and Hangers, Pipe joints.

Orthogonal views and Sectional views of machine parts.

Assembly drawing of various engine components and machine tool components.

Text Books:

1. Machine Drawing, by N.D.Bhatt, Charotal Publishing House.
2. Engineering Drawing, by A.C.Parkinson, Wheeler Publishing.

Reference:

1. Machine Drawing by K.L Narayan, P. Kannaiah and K. Venkata Reddy, New Age.

ME 2108 MECHANICS OF SOLIDS LAB

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 3 Lab Ses. : 50 Exam : 50

Examination (Theory): 3hrs. Credits : 2

Course Outcomes:

- Ability to identify different types of loads and measure them.
- Ability to measure material properties of different materials using different methods.
- Ability to measure bulking property and fineness of sand grains.

Course Objectives:

1. To understand the different types of loading and measure the loads.
2. To understand the material properties of different materials and the ways of finding them.
3. To understand the bulking property and fineness of sand grains and the methods of finding them.

List of Experiments:

1. To study the stress strain characteristics (tension and compression) of metals by using UTM.
2. To study the stress strain characteristics of metals by using HounsefieldTensometer.
3. Determination of compression strength of wood.
4. Determination of hardness using different hardness testing machines- Brinnels, Vickers and Rockwell's.
5. Impact test by using Izod and Charpy methods.
6. Deflection test on beams using UTM.
7. Tension shear test on M.S. Rods.
8. To find stiffness and modulus of rigidity by conducting compression tests on springs.
9. Torsion tests on circular shafts.
10. Bulking of sand.
11. Punch shear test, hardness test and compression test by using Hounsefieldtensometer.
12. Sieve Analysis and determination of fineness number.

ME 2109 MECHANICAL ENGINEERING LAB – I

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 3 Lab Ses. : 50 Exam : 50

Examination (Theory): 3hrs. Credits : 2

COURSE OBJECTIVES:

1. To understand the principle and functioning of various mechanical devices such as boilers, engines etc.
2. Ability to understand the working of two stroke and four stroke engines.
3. Acquiring the knowledge of operation of a reciprocating compressor and to assess the pressure gauge performance.
4. The way of determination of flash and fire points of oil samples and carbon residue and their importance is acquired.
5. The procedure for determination of calorific values of the fuels and viscosities of oil samples can be understood.
6. Practically the procedure for moment of inertia of fly wheel, connecting rod and modulus of rigidity is acquired.

COURSE OUTCOMES:

1. Students are now aware of the use of drawing valve timing diagrams of an engine and method to evaluate the volumetric efficiency of air compressor.
2. They are also aware of method of calibrating pressure gauge, the importance of flash and fire points and calorific values of fuels.
3. The importance and application by calculating viscosities of oil samples are understood.
4. The use of moment of inertia and modulus of rigidity is understood.
5. They are also now able to identify the parts of boiler and engines etc.

List of Experiments:

1. Study and valve timing diagrams for four-stroke and study & PTD of two-stroke engines.
2. Determination of volumetric efficiency of the given air compressor by (i) plate orifice method and (ii) tank capacity method.
3. Calibration of the given pressure gauge.
4. a) Determination of flash and fire points and
   b) Canradsons carbon residue test.
5. Determination of calorific value of flues (solid, liquid and gaseous) by Bomb calorimeter/Gas calorimeter.
6. Determination of the kinematic and absolute viscosity of the given sample oils.
7. Determination of inertia of the given flywheel and connecting rod.
8. Determination of modulus of rigidity of the given wire with torsion pendulum.
9. Study of boilers, various mountings and accessories.
10. Assembling of the given two-stroke petrol engine. (Instead of engine, any mechanical unit can be given for this experiment.)

SECOND SEMESTER

ME 2201 ELECTRICAL TECHNOLOGY

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 3 Th+ 1 Tut Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

COURSE OBJECTIVES:

1. An electrical machine is a required course for students in the mechanical engineering associate degree program. The purpose of the course is to teach principles of AC and DC motors and generators, AC transformers and how they work.
2. Basic concepts of electromagnetic circuits as they relate to voltage, current, and physical forces induced in conductors are covered, including application to practical problems of machine design.
3. Practical analytical models for most types of motors, generate and transformers commonly used in industry are developed and the models are used to analyze power requirements, power capability, efficiency, operating characteristics, control requirements and electrical demand of these machines.
4. Electrical machines writing is also a writing intensive course that teaches students to prepare formal, written technical documents.
5. This goal is accomplished through extensive writing exercises performed in the context of laboratory exercises that accompany the course.

COURSE OUTCOMES:

1. Students will be able to use standard methods to determine accurate modelling/simulation parameters for various general purpose electrical machines.
2. Students will be able to use modelling/simulation parameters with standard equalent circuit models to predict correctly the expected performance of various general purpose electrical machines.
3. Students will demonstrate and understanding of the fundamentals control practices associated with AC and DC machines.
4. Students will be able to use concepts in trigonometry, complex algebra and phasors to find correct solutions to electrical machines performance question.

SYLLABUS:

Magnetic Circuits: Definitions of magnetic circuit, Reluctance, Magnetomotive force (m.m.f), Magnetic flux, Simple problems on magnetic circuits, Hysteresis loss.

Electromagnetic Induction: Faraday's laws of Electromagnetic induction, Induced E.M.F., Dynamically induced E.M.F., Statically induced E.M.F., Self inductance, Mutual inductance.

D.C. Generators: D.C. generator principle, Construction of D.C. generator, E.M.F. equation of D.C. generator, Types of D.C. generators, Armature reaction, Losses in D.C. generator, Efficiency, Characteristics of D.C. generators, Applications of D.C. generator.

D.C. Motors: D.C. motor principle, Working of D.C. motors, Significance of back E.M.F., Torque equation of D.C. motors, Types of D.C. motors, Characteristics of D.C. motors, Speed control methods of D.C. motors, Applications of D.C. motor. Testing of D.C. machines: Losses and efficiency, Direct load test and Swinburne's test.

A.C. Circuits: Introduction of steady state analysis of A.C. circuits, Single and balanced 3-phase circuits.

Transformers: Transformer principle, E.M.F. equation of transformer, Transformer on load, Equivalent circuit of transformer, Voltage regulation of transformer, Losses in a transformer, Calculation of efficiency and regulation by open circuit and short circuit tests.

Three Phase Induction Motor: Induction motor working principle, Construction of 3-phase induction motor, Principle of operation, Types of 3-phase induction motor, Torque equation of induction motor, Slip-torque characteristics, Starting torque, Torque under running condition, Maximum torque equation, Power stages of induction motor, Efficiency calculation of induction motor by direct loading.

Alternator: Alternator working principle, E.M.F. equation of alternator, Voltage regulation by sync, impedance method.

Synchronous Motor: Synchronous motor principle of operation, Construction. Methods of starting of synchronous motor.

Electrical Measurements: Principles of measurement of current, voltage, power and energy. Types of Ammeters, Voltmeters, Watt-meters, Energy meters, Electrical conductivity meter.Potentiometer, Megger.

Text Book:

1. Elements of Electrical Engineering and Electronics by V.K. Mehta, S. Chand & Co.

Reference:

1. A First Course in Electrical Engineering by Kothari.

ME 2202 ADVANCED STRENGTH OF MATERIALS

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 3 Th+ 1 Tut Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

COURSE OBJECTIVES:

1) To enrich the student on the concept of fixed beams with uniform Moment of inertia as well as Non uniform Moment of inertia both under stability of beam supports and under sinking & rotation of the supports

2)To make the student capable of evaluating the deflection ,slope and stress of the fixed beamwith uniform Moment of inertia as well as Non uniform Moment of inertia both under the stability of beam supports and under the sinking &rotation of the supports.

3)To make the student understand the concept of continuous beams with uniform Moment of inertia as well as Non uniform Moment of inertia both under stability of supports as well as sinking of supports

4)To make the student capable of evaluating the support moments and support reactions of the continuous beam with uniform Moment of inertia as well as Non uniform Moment of inertia.

5)To make the student understand the concept of vertical compression loading on an engineering beam with four different end conditions.

6) To make the student understand the concept of vertical compression loading acting on an engineering beam which is having initial curvature.

7) To make the student understand the concept of eccentrical vertical compression loading acting on an engineering beam with four different end conditions.

8) To make the student understand the concept of vertical compression loading acting along with central point load acting perpendicular to the axis of the engineering beam with four different end conditions.

9) To make the student understand the concept of vertical compression loading acting along with Non central point load acting perpendicular to the axis of the engineering beam with four different end conditions.

10) To make the student understand the concept of vertical compression loading acting along with uniformly distributed load acting perpendicular to the axis of the engineering beam with four different end conditions.

11) To make the student understand the concept of curved beams having different cross sections along with calculation of bending stress at any point across the cross section of the curved beam.

12)To make the student understand the concept of circular rotating discs having uniform thickness and make him capable of calculating the stress on any point of the circular rotating disc.

13)To make the student understand the concept of circular rotating discs having uniform strength and make him capable of modeling the thickness of the circular rotating disc.

14) To make the student understand the concept of circular rotating cylinder having uniform thickness and make him capable of calculating the stress on any point of the circular rotating disc.

15) To make the student understand the concept of thick cylinder under different pressure conditions so that the student can evaluate radial stress and circumferential stress at any radius of the thick cylinder.

16) To make the student understand the concept of compound cylinder under different pressure conditions so that the student can evaluate radial stress and circumferential stress at any radius of the compound cylinder.
17)To make the student capable understanding Bending axis , shear centre and unsymmetrical bending and make him capable of evaluating the stresses at any point on a both symmetrical and unsymmetrical sections
18) To make the student understand the energy methods and Castigliano"s theorem-1 &2 and their application for cantilever beams and simply supported beams .

COURSE OUTCOMES:

Course Outcomes:
1)The student is capable of evaluating an already exisisting fixed beam with uniform Moment of inertia as well as Non uniform Moment of inertia which is under different loading conditions and with different support conditions and can even able to design a fixed engineering beam for any loading conditions.
2) The student is capable of evaluating an already exisistingcontinuous beam with uniform Moment of inertia as well as Non uniform Moment of inertia which is under different loading conditions and with different support conditions and can even able to design a continuous engineering beam for any loading conditions
3)The student is capable of evaluating any engineering column or strut under different end conditions and under different specified variable loading conditions as mentioned under objectives
4) The student is capable of evaluating curved beams of different cross sections and can able to evaluate the stresses across the cross-sections of the curved beam.
5) The student is capable of calculating the radial stress and circumferential stress for rotating circular disc(both hollow and solid) of uniform thickness.
6) The student is capable of modeling the thickness of circular rotating disc having uniform strength.
7) The student is capable of calculating the radial stress and circumferential stress for rotating circular cylinder of uniform thickness.
8) The student is capable understanding Bending axis , shear centre and unsymmetrical bending and is capable of evaluating the stresses at any point on a both symmetrical and unsymmetrical sections
9)The student is capable of calculating the radial and circumferential stress for both thick and compound cylinders under different pressurized conditions.
10) The student is capable of using different energy methods for evaluating the deflection and slope of simply supported beams and cantilever beams

SYLLABUS

Fixed Beams: Fixing moments for a fixed beam of uniform and variable sections, Effect of sinking support, slope and deflection.

Continuous beams: Analysis of continuous beam, Reactions at the supports, Effect of sinking of supports.

Energy Methods -Castigliano's theorems I & II applications.

Columns and Struts: Columns with one end free and the other fixed, Both ends fixed, One end fixed and other hinged, Limitation of Euler's formula, Column with initial curvature,

Column carrying eccentric load, Laterally loaded columns with Central point load and Uniformly distributed load, Empirical formulae.

Bending of Curved Bars: Stresses in bars of circular, rectangular and trapezoidal sections.

Stresses due to rotation: Wheel rim, disc of uniform thickness, disc of uniform strength.

Thick cylinders subjected to internal and external pressure and compound cylinders.

Text Books:

1. Analysis of Structures, Vol. 1, 1993 edition, by Vazirani and Ratwani.
2. Chapter VI from Advanced Topics in Strength of Materials, by Prof. L.B.Shah and Dr.R.T.Shah.

References:

1. Strength of Materials, by Timoshenko.

ME 2203 THEORY OF MACHINES

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 3 Th+ 1 Tut Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

COURSE OBJECTIVES:

- To know the basics of Machine and mechanism.
- To know the degrees of freedom of machine
- Kinematic pairs and kinematic inversion
- To know the Kinematic analysis of mechanism and cams
- To know velocity polygons, instantaneous centre method,
- To know the synthesis of mechanism by graphical method
- To know lower pair mechanism.
- To know the Friction and motion
- To understand the drive mechanism
- To understand the Dynamic Force Analysis.
- To understand the governors
- Static and dynamic analysis

COURSE OUTCOMES:

- Understanding of machine and mechanism.
- How the static and dynamic strength parameters for a material are measured in standardized tests.
- Ability to draw the kinematic analysis by displacement, velocity and acceleration diagrams.
- Understanding the geometric analysis of various mechanism by instantaneous centre, Kennedy,s theorem.
- Understanding the four bar mechanism, slider crank mechanism Grashof's criterion of movability and synthesis of mechanism by graphical method.
- Understanding the lower pair mechanism by straight line motion mechanism, pantographs, engine indicator mechanisms, Automobile steering mechanism and Hooke's joint.
- Understanding various types of friction and friction on bearings and clutches.
- Understanding various drives like gears, gear trains,
- Understanding D'Alembert's principle, Dynamically equivalent system and Turning-moment diagrams.
- Understanding principle of governors its types and Sensitiveness of a governor

SYLLABUS

Mechanisms and Machines: Introduction; Mechanism and machine; Rigid and resistant bodies; Link; Kinematic pair; Degrees of freedom; Classification of kinematic pairs; Kinematic chain; Linkage, mechanism and structure; Mobility of mechanisms; The four-bar chain; Mechanical advantage; Transmission angle; The slider-crank chain; Double slider-crank chain; Miscellaneous mechanisms.

Velocity Analysis: Introduction; Absolute and relative motions; Vectors; Additional and subtraction of vectors; Motion of a link; Four-link mechanism; Velocity images; Angular velocity of links; Velocity of rubbing; Slider-crank mechanism; Crank and slotted lever mechanism; Algebraic methods; Instantaneous center (I-center); Kennedy's theorem; Locating I-centers; Angular velocity ratio theorem; centrode.

Acceleration Analysis: Introduction; Acceleration; Four-link mechanism; Four-link mechanism; Acceleration of intermediate and offset points; Slider-crank mechanism; Corriolis acceleration component; Crank and slotted lever mechanism; Algebraic methods; Klein's construction; Velocity and acceleration from displacement-time curve.

Lower Pairs: Introduction; Pantograph; Straight line mechanisms; Engine indicators; Automobile steering gears; Types of steering gears; Hooke's joint; Double Hooke's joint.

Friction: Introduction; Kinds of friction; Laws of friction; Coefficient of friction; Inclined plane; Screw threads; Wedge; Pivots and collars; Friction clutches; Rolling friction; Antifriction bearings; Greasy friction; Greasy friction at a journal; Friction axis of a link; Film friction; Mitchell thrust bearing.

Dynamic Force Analysis: Introduction; D'Alembert's principle; Equivalent offset inertia force; Dynamic analysis of four-link mechanism; Dynamic analysis of slider-crank mechanism; Velocity and acceleration of piston; Angular velocity and angular acceleration of connecting rod; Engine force analysis; Turning moment on crankshaft; Dynamically equivalent system; Inertia of the connecting rod; Inertia force in reciprocating engines (Graphical method); Turning-moment diagrams; Fluctuations of energy; Flywheels.

Governors: Introduction; Types of governors; Wait governor (simple conical governor); Portor governor; Proell governor; Hartnell governor; Hartung governor; Wilson-Hartnell governor (radial-spring governor); Pickering governor; Spring-controlled gravity governor; Inertia governor; Sensitiveness of a governor; Hunting; Isochronism; Stability; Effort of a governor; Power of a governor; Controlling force.

Text Book:

1. Theory of Machines by R.S.Khurmi&J.K.Gupta

Reference books:

1. Theory of Machines by Thomas Bevan.
2. Theory of Machines by S.S. Rattan.

ME 2204 METAL CUTTING & MACHINE TOOLS

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 3 Th+ 1 Tut Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

COURSE OBJECTIVES:

- To give a clear understanding of the mechanism of machining to the students
- To describe the mechanisms of the various metal cutting machines, types of machines, various operations that can be performed on them, machining time and force calculations etc to the students.

COURSE OUTCOMES:

- The student can be able to know the mechanism of metal cutting
- They will be in a position to work on the metal cutting machines directly without a little assistance.
- They can calculate the machining times on all metal cutting machines.
- They can calculate the forces developed on all metal cutting machines.
- They will be in a position to use different types of cutting fluids for different metals on all types of machines.
- They know the importance, use, applications, advantages and limitations of various Un-conventional machining methods
- They will know the specifications and how to specify the metal cutting machines.

SYLLABUS

Mechanics of Metal Cutting; Chip formation & Types; Machinability; Tool materials; Tool geometry and tool signature ASA&ISO systems; Tool wear and tool life; Cutting forces and power; Measurement of forces and temperatures; Metal cutting economics; Cutting fluids.

Engine lathe; Operations; Turret and capstan lathes; Turning center; Boring machine and operations; Shaper, planner and slotter; Types; Operations; Mechanisms.

Drill geometry and cutting actions; Special drills; Drill forces and power-drilling speeds & feeds; Torque & thrust calculation; Drilling machines; Features and operations; Milling process; Milling cutting geometry; Cutting speed, feed, time and power in milling; Types of milling machines; Machining center; Broaching; Types; Tools; Machines; Broach time.

Principle; Operations; Grinding wheel manufacturing and marking balancing; Truing and dressing of grinding wheel; Grinding wheel selection; Grinding force; Grinding machines.

Abrasive belt machining; Lapping, honing and super finishing; Electro polishing and buffing.

Equipment; Process; Characteristics; Advantages; Limitations; Applications of chemical milling; Photochemical milling; EDM-computer controlled-traveling wire; ECM; AJM; LBM; EBM; WJM.

Text Book:

1. Process and Materials of Manufacture (4th Edition) by Roy A. Lindberg, Prentice-Hall of India Private Limited.

Reference Books:

1. Fundamentals of Metal Machining and Machine Tools by Geoffrey Boothroyd, International Student Edition, McGraw-Hill Book Company.
2. Metal Cutting Principles by M.C. Shaw, MIT Press, Cambridge.
3. Advanced Methods of Machining by J. A. McGeough, Chapman & Hall Publishers.
4. Metal Cutting-Theory and Practice by Amitabha Bhattacharya, Central Book Publishers.
5. Production Engineering by P.C. Sharma, S. Chand and Company.

ME 2205 ENVIRONMENTAL SCIENCE

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week :2 Th Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits :2

(Common to All Branches)

ME 2206 ENGINEERING ECONOMICS

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 4 Th Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

COURSE OBJECTIVES:

1. The concept and tools of Engineering Economics familiarize engineering students with th real world of business.

2. Engineering Economics provides a capacity to analyse business decisions with a depth of understanding.

3. Engineering Economics helps engineers to evaluate each alternative in terms of its costs and revenue.

4. Engineering economics helps engineers to suggest the course of action from the available alternatives for optimal solutions.

COURSE OUTCOMES:

1. With the fast changing environment, an engineer has to make himself aware of new improvements, trends and changes and constantly update his knowledge to be able play his role.

2. Engineering Economics will help engineers to achieve their role in changed environment.

3. Will be able to prepare and evaluate project proposals efficiently.

4. Capable to understand different market situations.

5. Capable of finding breakeven points and depreciation.

SYLLABUS:

Introduction to Economics: Definition of economics; Micro and Macro economics: Demand - Law of Demand. Elasticity of Demand - Measurement rat elasticity of demand Wand types of elasticity of demand.

Economic Systems and Factors of Production: Economic Systems - Capitalism, Socialism and Mixed Economy; Factors of Production -Classification of Factors of Production - Meaning and characteristics of Land, Labor, Capital and Organization.

Markets: Perfect Competition - Features and Price determination under perfect competition; Imperfect Competition Monopoly, Monopolistic competition. Duopoly and Oligopoly. (in brief)

Business Cycles (Trade Cycles) and Inflation: Business Cycles - Meaning, Phases of Business Cycle, causes and consequences of business Cycle: inflation - Types of Inflation, causes of inflation and effects of inflation.

Cost classification and Break-even Analysis: Costs - Classification of costs, Elements of cost. Components of total cost; Methods of costing - Job costing, Process costing and Unit costing; Break- even Analysis Determination of Break-even point and application of Break-even analysis.

Forms of Business Organizations : SoL Proprietorship, Partnership. Co-operative Society. Joint Stock company (Private and Public Ltd) - Features. Merits and Demerits: Public Enterprises and their types.

Depreciation and Financial Accounting: Depreciation - causes of depreciation. Methods of depreciation; Financial Accounting - Preparation of Trading Account.Profit & Loss Account and Balance Sheet of a Sole Proprietor.

Text Book:

1. Managerial Economics and Financial Analysis - By A.R. Aryasri, Tata McGraw Hill Education Private Ltd, New Delhi.
2. Engineering Economics - ByTara Chand. Nem Chand & Bros, Roorke

References:

1. Modern Economic – By K.K.Dewett, S. Chand & Co, New Delhi.
2. Principles of Economics - Vrinda Publications (P) Ltd. New Delhi

ME 2207 PRODUCTION DRAWING

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 3 Lab Ses. : 50 Exam : 50

Examination (Theory): 3hrs. Credits : 2

COURSE OBJECTIVES:

- Students will be able to understand and demonstrate the basics of Geometric Dimensioning and Tolerancing (GD&T).
- Draw and place feature control symbols and datum references on a drawing.
- Students will be able to understand and identify basic welding symbols.
- Students will be able to understand and demonstrate the use of fasteners.

COURSE OUTCOMES:

- To gain knowledge about understanding and representing notations used as per ASME and ISO standard in production drawing.
- To study Component drawing, Assembly drawing, Machine shop drawing, Pattern-shop drawing, Sheet metal drawing, Limits, Tolerances and Fits- Indication of surface roughness, preparation of process sheets. Production drawings of Spur, Bevel and Helical gears, swivel bracket, main spindle, crank, revolving centre, jigs and fixtures.
- Drawing of Dies. Sheet metal dies. Forging dies, stock strip layouts in sheet metal work, process layout for forge and press operations.
- Cutting tool layout. Single point, multi point cutting tools for conventional and CNC machine tools.
- Students will be able to read and understand various symbols and notations used in the production drawings.

SYLLABUS:

Introduction to Production drawing, Component drawing, Assembly drawing, Machine shop drawing, Pattern-shop drawing, Sheet metal drawing. Limits, Tolerances and Fits- Indication of surface roughness, preparation of process sheets.

Production drawings of Spur, Bevel and Helical gears, swivel bracket, main spindle, crank, revolving centre, jigs and fixtures.

Drawing of Dies. Sheet metal dies. Forging dies, stock strip layouts in sheet metal work, process layout for forge and press operations.

Cutting tool layout.Single point, multi point cutting tools for conventional and CNC machine tools.

Text Book:

1. A Text Book on Production Drawing by K.L.Narayana, P.Kannaiah and K.Venkata Reddy, New age international.

References:

1. Manufacturing technology Foundry, Forming and Welding by P.N.Rao, Tata McGraw Hill Publishing Company Ltd, New Delhi.

2. Production Technologies, HMT.

ME 2208 MANUFACTURING TECHNOLOGY LAB-I

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 3 Lab Ses. : 50 Exam : 50

Examination (Theory): 3hrs. Credits : 2

COURSE OBJECTIVES:

1. To appreciate the tools, materials, machines used for making products in Foundry, Welding and Machine shop.
2. Be aware of the work and tool material relationship in machine shop.
3. To recognize the different welding techniques for different materials.
4. To realize the various molding sands, core sands used for making of moulds and cors.

COURSE OUTCOMES: They have

1. Ability to prepare molds, cores for a given component.
2. Capability to complete different joints, welds for given component by GAS and ARC welding processes.
3. Aptitude to made taper turning, thread cutting and off set turning on different materials by Lathe machine.
4. Skill to made spur gears, key ways etc. by using different machines.

LIST OF EXPERIMENTS:

Use of basic tools and operations of the following trades.

S. No.	Trade	No. of exercises
1.	Foundry	3
2.	Welding	2
3.	Lathe Step and taper turning Thread cutting Offset turning	1 1 1
4.	Milling	1 (Spur gear)
5.	Shaper	1

1. Cylindrical grinding, Surface grinding, Planing, Slotting and Capstan lathe (only demonstration in one class for the entire batch of students).
7. Dissembling and assembling of *

   i. Machine Tool (Lathe)

   ii. I.C. engine

   iii. Pump

   iv. Gear box

* Not for examination.

ME 2209 ELECTRICAL TECHNOLOGY LAB

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 3 Lab Ses. : 50 Exam : 50

Examination (Theory): 3hrs. Credits : 2

LIST OF EXPERIMENTS:

1. Study and Calibration of wattmeter and energy meter.
2. Measurement of armature resistance, field resistance and filament resistance.
3. Verification of KCL and KVL.
4. Superposition theorem.
5. Parameters of a choke coil.
6. O.C. and S.C. tests on transformer.
7. Load test on D.C. shunt machine.
8. O.C. test on D.C. separately excited machine.
9. Swinburnes test.
10. 3 phase induction motor (No load and rotor block tests) load tests.
11. Alternator regulation by Syn. Impedance method.

III- YEAR

FIRST SEMESTER
ME 3101 DYNAMICS OF MACHINERY

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 3 Th+ 1 Tut Ses. : 30 Exam : 70
Examination (Theory): 3hrs. Credits : 4

SYLLABUS:

Gyroscopic Couple and Precessional Motion: Precessional and angular motion- gyroscopic couple- effect of gyroscopic couple on an aero plane and on a naval ship, stability of a four wheel vehicle moving in a curved path, stability of a two-wheel vehicle taking a turn.

Cams: Classification of followers and cams- Definitions- Motions of the follower- Uniform velocity- Simple harmonic motion- Uniform acceleration and retardation- Displacement-Velocity and acceleration diagrams. Construction of cam profiles- Cam with knife edged follower and roller follower- Cams with specified contours- Tangent cam with roller follower- Circular arc cam with flat faced follower.

Toothed gearing: Classification of toothed wheels, technical terms, conditions for constant velocity ratio of toothed wheels- Law of gearing- Velocity of sliding of teeth, forms of teeth-Length of contact, arc of contact, interference in involute gears, minimum number of teeth required on pinion to avoid interference- Methods of avoiding interference- Helical gears, Spiral gears- Efficiency of spiral gears.

Gear Trains: Types of gear trains- Simple, compound, reverted and epicyclic gear trains-Velocity ratio of epicyclic gear train- Tabular method- Algebraic method- Torques and tooth loads in epicyclic gear trains.

Balancing of Rotating and Reciprocating Masses: Balancing of a single rotating mass in the same plane and by two masses in different planes, balancing of several masses revolving in the same plane- Balancing of several masses revolving in different planes- Primary and secondary unbalanced forces of reciprocating masses, Partial balancing of unbalanced primary forces in a reciprocating engine, Partial balancing of locomotives- Effect of partial balancing of reciprocating parts of two cylinder locomotives- Variation of tractive force, Swaying couple and hammer blow- Balancing of primary and secondary forces in multi cylinder in-line engines- Direct and reverse cranks- Balancing of V- Engines.

Vibrations: Definitions- Types of vibrations- Natural frequencies of free longitudinal vibrations of systems having single degree of freedom- Equilibrium method- Energy method and Rayleghy's method. Frequency of damped vibration and forced vibration with damping-Magnification factor or dynamic magnifier.

Transverse and Torsional Vibrations: Natural frequency of free transverse vibrations due to point load and uniformly distributed load acting over a simply supported shaft- Transverse vibrations for a shaft subjected to number of point loads- Energy method- Dunkerley's method, Critical speed of a shaft. Natural frequency of free torsional vibrations- Free

torsional vibrations of single rotor system, two rotor system, three rotor system and gear system.

Text Book:

1. Theory of Machines by R.S.Khurmi&J.K.Gupta.

Reference books:

1. Theory of Machines by Thomas Bevan.
2. Theory of Machines by S.S. Rattan.

ME 3102 ADVANCED THERMODYNAMICS-I

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 3 Th+ 1 Tut Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

COURSE OBJECTIVES:

1. To gear the student with basic principles of steam properties.
2. To prepare the student for industrial application of steam.
3. The student is taught to design the steam equipment so that R&D in industry is improved.

COURSE OUTCOMES:

1. The student gets complete knowledge of steam and its properties.
2. The student learns the complete calculation procedures for designing steam turbines, steam condensers, nozzles etc. used in thermal power plants, steam engines, water turbines and many other industrial applications.
3. The student is prepared to work in industry immediately after his course

SYLLABUS:

Properties of Pure Substance: Definition of pure substance, phase change of a pure substance, p-T (Pressure-Temperature) diagram for a pure substance, p-V-T(Pressure-Volume-Temperature) surface, phase change terminology and definitions, property Diagrams in common use, Formation of steam, Important terms relating to steam formation, Thermodynamic properties of steam and steam tables, External work done during evaporation, Internal latent heat, Internal energy of steam, Entropy of water, Entropy of evaporation, Entropy of wet steam, Entropy of superheated steam, Enthalpy-Entropy (h-s) charts for Mollier diagram, Determination of dryness fraction-Tank or bucket calorimeter, throttling calorimeter, separating and throttling calorimeter.

Gases and Vapour Mixtures and Vapor Power Cycles : Introduction, Daltons law and Gibbs-Dalton law, Volumetric Analysis of gas mixtures, Apparent molecular weight and gas constant, specific heats of gas mixture, Adaibatic mixing of perfect gases, Gas and vapourmixtures.Vapor power cycle- Rankine cycle- Reheat cycle- Regenerative cycle- Thermodynamic variables effecting efficiency and output of Rankine and Regenerative cycles- Improvements of efficiency, Binary vapor power cycle.**Steam Nozzles**: Type of nozzles- Flow through nozzles- Condition for maximum discharge- Nozzle efficiency- Super saturated flow in nozzles- Relationship between area velocity and pressure in nozzle flow- Steam injectors.

Steam Turbines: Classification of steam turbines- Impulse turbine and reaction turbine- Compounding in turbines- Velocity diagrams in impulse and reaction turbines- Degree of reaction- Condition for maximum efficiency of reaction turbines- Effect of friction on turbines constructional features governing of turbines.

Condensers: Classification of condenser- Jet, Evaporative and surface condensers- Vacuum and its measurement- Vacuum efficiency- Sources of air leakage in condensers- Condenser efficiency- Daltons law of partial pressures- Determination of mass of cooling water- Air pumps.

Refrigeration: Bell Colemen cycle, Vapor compression cycle- effect of suction and condensing temperature on cycle performance, Properties of common refrigerants, Vapor absorption system, Electrolux refrigerator. Principles of psychrometry and Air conditioning - Psychrometric terms, psychrometric process, air conditioning systems.

Text Books:

1. A Treatise on Heat Engineering by Vasandhani and Kumar.
2. Applied Thermodynamics-II by R. Yadav.
3. Fundamentals of Engineering Thermodynamics by E. Radhakrishna, PHI.

References:

1. Thermal Engineering, by R. K. Rajput.
2. Fluid Flow Machines, by M.S. GovindaRao, Tata McGraw Hill publishing company Ltd.
3. Refrigeration and Air-conditioning, by C.P.Arora and Domokundwar.
4. Thermal Science and Engineering by D.S. Kumar, S.K. Kataria and Sons
5. Refrigeration and Air-conditioning, by AhamadulAmeen, PHI.

ME 3103 INDUSTRIAL ENGINEERING & MANAGEMENT

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 3 Th+ 1 Tut Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

COURSE OBJECTIVES:

1. To know management practices in industry
2. To acquire capacity to handle industrial disputes
3. To know much about production activities and to improve productivity
4. To learn the work study procedures and quality concepts to get more productivity
5. To have exposure on some maintenance practices in industry.

COURSE OUTCOMES:

1. Students will be able to apply management theories in organization
2. They will know personal management techniques to motivate the workers.
3. They are able to settle the industrial disputes in organization.
4. They are also acquire full knowledge on production planning and control procedures
5. They understand the economics of plant layout
6. Students are aware of materials handling principles and equipment
7. They will be able to apply maintenance practices
8. They will have knowledge of materials management
9. They will be able to improve the productivity by applying work study procedures and quality concepts

SYLLABUS:

Concepts of Industrial Management: Principles of management- Growth of management thought, Functions of management, Principles of organization, Types of organization and committees.

Introduction to personnel management- Functions, Motivation, Theories of motivation, Hawthrone studies, Discipline in industry, Promotion, Transfer, lay off and discharge, Labour turnover.

Industrial relations- Trade unions, Industrial disputes, Strikes, Lock-out, Picketing, Gherao, Settlement of industrial disputes, Collective bargaining, Industrial dispute act 1947 and factories act 1948.

Production Planning and Control: Types of productions, Production cycle, Product design and development, Process planning, Forecasting, Loading, Scheduling, Dispatching, Routing, Progress, Control, Simple problems.

Plant Layout: Economics of plant location, Rural Vs Suburban sites, Types of layouts, Types of building, Travel chart technique, Assembly line balancing simple problems.

Materials Handling- Principles, Concept of unit load, Containerization, Pelletization, Selection of material handling equipment, Applications of belt conveyors, Cranes, Forklift trucks in industry.

Plant Maintenance: Objectives and types.

Work Study: Concept of productivity, Method Study - Basic steps in method study, Process charts, Diagrams, Models and Templates, Principles of motion economy, Micro motion study, Therbligs, SIMO chart. Work Measurement - Stop watch procedure of time study, Performance rating, allowances, Work sampling, Simple problems.

Materials Management: Introduction, Purchasing, Objectives of purchasing department, Buying techniques, Purchase procedure, Stores and material control, Receipt and issue of materials, Store records. Inventory Control, EOQ model(Simple problems).

Quality Control - Control charts of variables and attributes (Use of formulae only). Single and Double sampling plans.

Text Book:

1. Industrial Engineering Management, by Dr. O. P .Khanna.

References:

1. Principles of Management by Koontz &Donnel.
2. Production and Operations Management by Everette Adam & Ronald Ebert.
3. Operations Management by John McClain & Joseph Thames.
4. Industrial Engineering and Production Management by Telsay, S. Chand & Co.

ME 3104 OPERATIONS RESEARCH

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 3 Th+ 1 Tut Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

COURSE OBJECTIVES: To introduce

- The mathematical, engineering, and modeling skills that are the basis for operations research, and they will be prepared to apply those skills to the efficient design, analysis, operation and control of complex systems.
- The Advanced theory on applications in supply chain and manufacturing systems; data analysis; information engineering; financial engineering; or service systems.
- The experiences with identifying, accessing, evaluating, and interpreting information and data in support of assignments, projects, or research.

COURSE OUTCOMES: The student will be able to understand:

- Proficiency with tools from optimization, probability, statistics, simulation, and engineering economic analysis, including fundamental applications of those tools in industry and the public sector in contexts involving uncertainty and scarce or expensive resources.
- The facility with mathematical and computational modeling of real decision-making problems, including the use of modeling tools and computational tools, as well as analytic skills to evaluate the problems.
- The facility with the design, implementation, and analysis of computational experiments.

SYLLABUS:

Development: Definition, Characteristics and phase of Scientific Method, Types of models. General methods for solving operations research models.

Allocation: Introduction to linear programming formulation, graphical solution, Simplex method, Artificial variable technique, Duality theory and Dual simplex method.

Transportation Problem: Formulation optimal solution. Unbalanced transportation problems, Degeneracy. Assignment problem, Formulation optimal solution, Variations i.e., Non-square (m*n) matrix restrictions.

Sequencing: Introduction, Terminology, notations and assumptions, problems with n-jobs and two machines, optimal sequence algorithm, problems with n-jobs and three machines, problems with n-jobs and m-machines, graphic solutions. Travelling salesman problem.

Waiting lines: Single channel Poisson arrivals, Exponential service times, Unrestricted queue with infinite population and finite population models; Single channel Poisson arrivals, Exponential service times with infinite population and restricted queue.

Replacement: Introduction, Replacement of items that deteriorate with time - value of money unchanging and changing, Replacement of items that fail completely.

Theory of games: Introduction, Two-person zero-sum games, The Maximum -Minimax principle, Games without saddle points - Mixed Strategies, 2xn and mx2 Games - Graphical solutions, Dominance property, Use of L.P. to games, Algebraic solutions to rectangular games.

Inventory: Introduction, inventory costs, Independent demand systems: Deterministic models - Fixed order size systems - Economic order quantity (EOQ) - Single items, back ordering, Quantity discounts (all units quantity discounts), Batch - type production systems: Economic production quantity - Single items, Economic production quantity multiple items. Fixed order interval systems: Economic order interval (EOI) - Single items, Economic order interval (EOI) - Multiple items.

Network Analysis: Network definitions, Minimum spanning tree algorithm, Shortest root problem, Maximum flow model. Elements of project scheduling by CPM and PERT.

Text Books:

1. Operation Research, by TAHA (PHI)
2. Operations Research Methods and Problems, by M.Sasiene, A.Yespal and L.Friedman.(John Wiely)
3. Operation Research by S.D.Sharma.(KedarnadhRamnadh& Co.,)
4. Operation Research by R.Pannerselvam, (PHI)

ME 3105 MEASUREMENTS& CNC

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 4 Th Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

COURSE OBJECTIVES:

The main objectives of this module are:To provide to the students an understanding and appreciation of the science of Measurement.

- To expose the students to various mechanical and electrical engineering measuring devices, and understand the different degree of accuracy obtained from different types of instruments.

COURSE OUTCOMES:

1. Students will be able to program using G-codes and M-codes and feed to CNC machine to carry out the necessary process.
2. Students will be able to appreciate FMS, perform robot programming along with the hydraulics and pneumatics Students who successfully complete this course will be able to:

- identify the uncertainties in dimensional metrology and the define the measurement standards;
- describe the fundamentals of dimensional and geometrical tolerances;
- measure length and angles using line-graduated instruments, i. e. vernier calipers, micrometers, bevel protractor, sine bar and surface plates;
- use comparative length-measuring instruments, i.e. dial indicator, to measure variations in the distance between two or more surfaces;
- use effective methods of measuring straightness, flatness, roundness, profile, screw threads and gear teeth;
- measure dimensions of shafts, bearings and linear surfaces in metric and imperial units using calibers, micrometers, and scales;
- use contour projector ad coordinate measuring machine to record measurements of complex profiles with high sensitivity;
- use gage blocks, fixed gages, pneumatic gages gage blocks to measure various workpieces;
- explain the effect of environmental conditions on the accuracy of measurements;
- demonstrate the correct methods for adjustment and calibration of various measurement
- instruments;
- use appropriate method for determination of accuracy based on product function and manufacturing capability.

SYLLABUS:

Automatic screw lathes, Multi spindle automatic lathes, Turret lathes, Numerical control, NC operation, Coordinate system, Data input devices, Data storage, Programme editing, Machining centres, Turning centres, Vertical turning centres, Milling centres, Advantages of NC, Computers & NC, CNC, DNC, CNC part programming: Designation of co-ordinate axes for CNC machines, Functions of machine control units, Tape format, Manual part

programming and computer assisted part programming (using APT language). Exercises involving simple contours and positioning.

ISO system of limits, Fits and Tolerances, Interchangeability, Plain limit gauges, Measurement of screw threads, major diameters, Minor diameters and effective diameter, Pitch, Limit gauges for internal and external threads, Measurement of spur gears, pitch, profile, lead, backlash, tooth thickness.

Tool maker's microscope, Straightness measurement, Slip gauges, Twisted strip mechanical comparator, Optical lever comparator, Optical projector, Electric comparator, Pneumatic comparator, Squareness testing, Optical bevel protractor, Sine bar, Angle gauges, Precision level, Autocollimeter, Angle dekkor, Optical dividing heads and rotary tables, Flatness measurement, Roundness measurement. Co-ordinate measuring machines.

Surface texture: Parameters, sampling length, Specification, Stylus instruments for surface roughness measurement. Acceptance tests on machine tools: Lathe, Milling machine, Radial drill, Laser equipment.

Instrumentations: Concepts of measurements, static performance, characteristics accuracy of measurement and its analysis. Instrumentation, for measurement: Force, torque, strain. pressure, flow, temperature and vibration.

Optical Methods of Measurement: Introduction, Laser beam as a light pointer, length/displacement measurement, temperature sensors, seismographic measurement.

Introduction to fiber optics, fiber types, properties of optical fibres and a fibre optic sensor configuration.

Text Books:

1. Process & Materials of Manufacture, R.A.Lindberg, 4th edition, Prentice-Hall of India, New Delhi.
2. A Text Book of Engineering Metrology, I.C.Gupta, DhanpatRai& Sons, Delhi.
3. CNC and Computer Aided Manufacturing, T.K.Kundra, P.N.Rao&N.K.Tewari, Tata McGraw-Hill Publishing Company Ltd, Delhi.
4. Mechanical Measurements, by R.S.Sirohi, H.G. Radha Krishna, Wiley Eastern, New Delhi.

References:

1. A.S.T.M.E., Hand book of Industrial Metrology, Prentice-Hall of India, New Delhi.
1. A.S.T.M.E., Hand book of Manufacturing Engineering.
2. Manufacturing Processes & Materials for Engineers, L.E.Doyle& others, Prentice-Hall of India, New Delhi.
3. Manufacturing Technology by Adithan, New age international.
4. Instrumentation for Engineering Measurements, by R.H. Cerni and L.E.Foster, J.Wiley& Sons, New York.

ME 3106 ELECTIVE-I (A) ADVANCED FOUNDRY AND WELDING TECHNOLOGY

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 4 Th | Ses. : 30 | Exam : 70
Examination (Theory): 3hrs. | Credits : 4

COURSE OBJECTIVES:

The main objectives are:

- To provide an understanding and appreciation of the different advanced manufacturing processes, melting of metals and fabrication (Welding, Soldering and Brazing) methods to the students.

To expose the students to various applications of the manufacturing process in real life articles/ products.

COURSE OUTCOMES: Students will be able

1.To compare various manufacturing materials, their sources, properties and uses:

• *Ferrous* (iron and steel) and *non-ferrous* metals (copper, aluminum, brass, lead, etc.) *Alloys* (mixing of metals: brass, steel, aluminum alloys, gold alloys)

2. To appreciate how cast iron products will be casted by sand casting technique

3. To know how the metals are meted.

4. Understand the principles of various welding process, soldering and brazing.

5. Understand the position welding techniques.

6. Understand how to check the welds quality.

7. Understand how to melt the metals.

SYLLABUS:

Moulding: Development of metal castings- Materials for moulding- Foundry sand control- Different types of cores- Core making processes- Materials for core making- Moulding and core making machines. Recent developments in core mould making- Cold set process- Investment process- Shell moulding- Hot box method- Shaw process. Vacuum moulding- moulding for mass production.

Melting and Solidification: Furnaces used in foundry for melting ferrous and nonferrous metals- principals of operation of cupola and charge calculations. Family of cast irons- Production of malleable and S.G. Irons- Methods of alloying and inoculants and their effects on the structure and properties of cast iron. Principles of Solidification: Nucleation- Crystal growth- Morphology and structure of cast metals and alloys- Pure metals- Single phase alloys and eutectics. Solidification in sand and chill moulds.

Foundry Mechanization: Layout for ferrous and nonferrous foundries- Description of equipment used for mechanization- Sand conditioners- Conveyors- Cranes- Equipment for handling moulds, Cores and molten metal- Knock out of moulds- Fettling equipment.

Special Welding Processes: Resistance welding processes- Spot, Seam, Projection, Flash butt welding - Machine cycle for resistance welding- Parameters in resistance welding- Electrodes for resistance welding – Solid State Welding: Cold welding – Forge welding - Ultrasonic welding Diffusion welding – Radiation welding: Laser Beam Welding, Electron Beam Welding – Automatic welding systems.

Weldability of Metals: Factors influencing weldability of metals- Welding of Cast steels, Carbon steels, Stainless steels and Cast iron. Weldability of Cu and its alloys, Al and its alloys- Ti and its alloys- Mg and its alloys- Temperature changes in welding and their effects on mechanical properties. Absorption of gases by welds and their effects- Residual stresses and distortion- Heat treatment of welded parts.

Welding Joints, Weld Symbols and Joint Design principles: Types of joints – types of welds – Variants of joints and weld types - Welding symbols – principles of weld joint design and evolving of good weld designs.

Text Books:

1. Foundry Technology, by Jain P.L.
2. Welding Engineering and Technology, by R.S. Parmar.

References:

1. Foundry Engineering, by Agarwal.
2. Foundry Engineering, by Taylor F. & Others.
3. Principles of Metal Castings, by Heine & Others.
4. Modern Welding Technology, by H.B. Cary.
5. Welding Technology, by Koenisburger.
6. Welding Metallurgy, S.Kou, 2ndedition, John Wiley and Sons, New York, NY (2003).

ME 3106 ELECTIVE-I (B) WORK STUDY

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 4 Th Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

COURSE OBJECTIVES:

1. To understand the meaning of productivity and the means of increasing the productivity.

2. To know about work study and method study. To get acquainted with different methods of recording the work and ways to improve the method of doing work.

3. To know the different methods of measuring the work done and compute standard time.

4. To know the principles of motion economy.

5. To learn about job evaluation and merit rating.

6. To understand the meaning of Ergonomics and Anthropometry.

COURSE OUTCOMES:

1. Understand the factors for low productivity, eliminate them and improve productivity.

2. Analyse the existing method of doing work, improve the method by eliminating unwanted steps in the process.

3. Will be able to measure the work and find the standard time required for doing the work.

4. Will be able to apply principles of motion economy and make work easier and improve the performance of the workers.

5. Will be able to analyse the job and fix the monitory benefits.

6. Will be able to evaluate the performance of the workers.

7. Will be able to understand the importance of ergonomic and measure anthropometric data.

SYLLABUS

Introduction to work study: Scientific management – Productivity - Advantages of work study to management, Supervisors and workers.

Method Study: Introduction - Process charts, Critical Examination, Identification of key activities on process charts, Diagrams and Templates, Therbligs, Micro motion analysis, Memo motion study. Developing new method - Job survey report writing.

Principles of Motion Economy: Related to human body, work place, equipment.

Work Measurement: Work measurement techniques – Rating - Measuring the job – Allowances - Standard time - Synthetic data - Analytical estimating – PMTS ,Work factor, MTM, Activity sampling, Its applications.

Job Evaluation, Techniques of job evaluation - Merit rating - Incentive plans.

Ergonomics: Basics of Ergonomics**,** Anthropometry.

Text Books:

1. Introduction to Work Study - International LabourOrganisation.
2. Elements of Work Study and Ergonomics by Dalela et al, Standard Publications.

References:

1. Motion and Time Study, by Barnes, John Wiely.

ME 3106 ELECTIVE-I (C) FINITE ELEMENT ANALYSIS

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 4 Th | Ses. : 30 | Exam : 70
Examination (Theory): 3hrs. | Credits : 4

COURSE OBJECTIVES:

1.This subject deals with fundamentals of the finite element method for the analysis of engineering problems arising in solids and structures.
2. Emphasis an ability to apply knowledge of mathematics, science and engineering to do the analysis of simple and complex elastic structures using the finite element analysis.
3. Demonstrate an ability to design and conduct numerical analysis as well as analyze and interpret the results.
4. It deals with ability to identify, formulate, and solve engineering problems using the finite element analysis.

COURSE OUTCOMES:

1. Ability To gain the knowledge and understand the basics concepts of Finite element analysis.
2.Ability to understand the mathematical problems and get experience for problems solving of machine members.
3.To gain the knowledge of dynamics of fluids is introduced through the control volume approach which gives an integrated under standing of the transport of mass, momentum and energy.
4. Ability to understand advanced computing techniques and tools in the area develop the applications of FEA in engineering. To gain experience in the application of FE analysis to real engineering designs/Problems.
5. Get experience to implement different FEA/FEM tools for solving Structural engineering problems and write code for some of them in MATLAB.
6. To build up the skills in the actual implementation of FEM methods (e.g. boundary conditions, Elements, Meshing etc.) in using commercial FEM codes. Also get exposure to solve problems by using analysis software's like ANSYS/NISA/NASTRAN etc.

SYLLABUS:

Fundamental Concepts: Introduction, Historical background, Outline of presentation, General procedure for FEA, Stresses and Equilibrium, Boundary conditions, Strain-Displacement relations, Stress-Strain relations, Plane stress, Plane strain problems, Temperature effects, Potential energy and equilibrium. The Rayleigh-Ritz method, Hamilton's principle.Galerkin's method, Saint Venant's principle.

One-dimensional Problems: Introduction, Finite element modeling, Coordinates and Shape functions. The potential energy approach.The Galerkin approach, Assembly of the global stiffness matrix- mass matrix and load vector, Treatment of boundary conditions, Quadratic

shape functions, Temperature effects. Trusses: Introduction, Plane trusses, Three-dimensional trusses, Assembly of global stiffness matrix for the Banded and Skyline solutions.

Two-dimensional Problems Using Constant Strain Triangles: Introduction, Finite element modeling, Constant strain triangle, In plane and Bending, problem modeling and boundary conditions.

Axisymmetric Solids Subjected to Axisymmetric Loading: Introduction, Axisymmetric formulation, Finite element modeling, Triangular element, Problem modeling and boundary conditions.

Two-dimensional Isoparametric Elements and Numerical Integration: Introduction, The four-node quadrilateral, Numerical integration, requirements, h-refinement and p-refinement, Higher-order elements, Convergence

Beams and Frames: Introduction, Finite element formulation, Load vector, Boundary considerations, Shear force and bending moment, Beams on elastic supports, Plane frames.

Text Book:

1. Introduction to Finite Elements in Engineering, by Tirupathi R. Chandrupatla, Ashok D.Belegundu (chapters 1 to 8 only).

References:

1. Introduction to Finite Element Method, by S.S.Rao
2. Finite Element Method, by O.C. Zienkiewicz.
3. Concepts and Applications of Finite Element Analysis, by Robert D. Cook.
4. Introduction to Finite Element Method, by J.N.Reddy.

ME 3106 ELECTIVE-I (D) MECHATRONICS

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 4 Th Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

COURSE OBJECTIVES:

- Find the importance of industrial automation to reduce the production time
- Development of the various modelling and simulation techniques to analyse the physical systems
- Application of electronics and electrical principles to mechanical systems

COURSE OUTCOMES:

The main purpose of this course is to make the students aware of :

- Understand mechatronics systems and its working principles
- Known the basic principles of sensors, transducers, limit switches and relays
- Able to understand the advanced industrial applications by fundamental knowledge of mechatronics principles

After successful completion of this course student can know the operation of mechatronics controls in automated manufacturing industries

SYLLABUS:

Mechatronics system design: Introduction to Mechatronics: What is mechatronics, integrated design issues in mechatronics, Mechatronics key elements, the mechatronics design process, advanced approaches in mechatronics.

Modeling and simulation of physical systems: Simulation and block diagrams, Analogies and impedance diagrams, Electrical systems, Mechanical translational systems, Mechanical rotational systems, electromechanical coupling, Fluid systems.

Sensors and transducers: An introduction to sensors and transducers, Sensors for motion and position measurement, Force, torque and tactile sensors, Flow sensors, Temperature-sensing devices. Actuating devices: Direct current motor, Permanent magnet stepper motor, Fluid power actuation.

Signals, systems and controls: Introduction to signals, systems and controls, System representation, Linearization of nonlinear systems, Time delays.

Real time interfacing: Introduction, Elements of a data acquisition and control system, Overview of the I/O process, Installation of the I/O card and software.

Advanced applications in mechatronics: Sensors for condition monitoring, Mechatronic control in automated manufacturing, Artificial intelligence in mechatronics, Microsensors in mechatronics.

Text Book:

1. Mechatronics System Design by DevdasShetty and Richard A. Kolk, P.W.S. Publishing Company, 2001.

References:

1. Mechatronics by W. Bolton, Pearson Education, Asia, II-Edition, 2001

2.Introduction to Mechatronics and Measurement Systems by David G. Alciatore and Michael B. Histand, Tata McGraw Hill Company Ltd.

ME 3107 MOOCS-I

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : --	Ses. : 50	Exam : 50
Examination (Theory): 3hrs.		Credits : 2

ME 3108 MECHANICAL ENGINEERING LAB – II

((Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 3 Lab Ses. : 50 Exam : 50

Examination (Theory): 3hrs. Credits : 2

1. Load test and smoke test on I.C. Engines.
2. Morse test on multi-cylinder engine.
3. Heat balance sheet on I.C. Engines.
4. Study of multi-cylinder engines and determination of its firing order.
5. Calculations of efficiencies of the given air compressor.
6. Determination of pressure distribution around the given (1) cylinder and (2) airfoil specimens kept in a uniform flow wind-tunnel.
7. Study of automobile mechanisms.
8. Verification of laws of balancing.
9. a) Determination of ratios of angular speeds of shafts connected by Hooke's joint.
   b) Determination of the ratio of times and ram velocities of Withworth quick return motion mechanism.
10. To draw curves of slider displacement and crank angle and linear velocities w.r.t. time for a slider crank mechanism and compare with theoretical values.
11. To determine the relation of gyroscopic couple and compare with the theoretical values.
12. To draw the crank angle vs. pressure diagram for an I.C. engine using pressure transducer and cathode ray oscilloscope.

ME 3109 MANUFACTURING TECHNOLOGY LAB-II

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 3 Lab Ses. : 50 Exam : 50

Examination (Theory): 3hrs. Credits : 2

COURSE OBJECTIVES:

1. To make the student to measure the tool tip temparature and the cutting forces during turning
2. To make the student to make a single point cutting tool and to measure the tool angles
3. To make the student to measure the drilling forces.
4. To make the student to measure the surface roughness.
5. To make the student to measure the chip details.
6. To make the student to measure the different parameters of sand and sand moulds.

COURSE OUTCOMES:

1. The student will be in a position to measure the tool tip temparature and the cutting forces during machining.
2. The student will be in a position to fabricate a single point cutting tool and to measure the tool angles
3. The student will be in a position to measure the drilling forces.
4. The student will be in a position to measure the surface roughness.
5. The student will be in a position to measure the chip details.
6. The student will be in a position to measure the different parameters of sand and sand moulds.

LIST OF EXPERIMENTS:

1. Experiments on Lathe to establish the following curves
    a) Depth of cut Vs Cutting force.
    b) Feed Vs Cutting force.
    c) Cutting speed Vs Cutting force.
2. Grinding of single point cutting tool as per given specifications (to check the tool angles).
3. Study of chip formations on shaping machine (with lead sample).
4. Torque measurement on drilling/milling machine.
5. Effect of speed and feed on surface roughness.
6. Measurement of cutting tool temperature in turning.
7. Sieve analysis to evaluate G.F.No.
8. Moisture and clay content test.
9. Green compression and shear test.
10. Shatter Index & Hardness Testing

SECOND SEMESTER

ME 3201 FLUID MECHANICS & MACHINERY

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 3 Th+ 1 Tut Ses. : 30 Exam : 70
Examination (Theory): 3hrs. Credits : 4

Fluid Statics: Fundamentals of fluid properties, Fundamental equations of fluid statics, pressure measurement, hydrostatic forces on surfaces, Buoyancy and floatation, Kinematics of fluid flow: Flow field and description of fluid motion

Fluid dynamics: Conservation equations, analysis of finite control volumes, Euler's equation, conservation of energy, Bernoulli's equation, principles of hydraulic siphon, losses due to geometric changes, measurement of flow rate through pipe, flow through orifices and mouthpieces.

Flow of ideal fluids, flow along a curved stream line, free and forced vortex flows, Flow of viscous incompressible flows.

Boundary layer theory: Laminar and turbulent flows, Flow around immersed bodies, Application of viscous flow through pipes, Flows with a free surface.

Compressible flows: speed of sound, pressure field due to a moving source, basic equations for one dimensional flow, stagnation and sonic properties, effect of area variation on flow properties.

Principles of fluid machines: classification of fluid machines, Impact of jets, different types of Rotodynamic machines, performance of different turbines, pumps, hydraulic systems.

Text Books:

1. Introduction to Fluid mechanics and fluid machines by S.K.Som and G.Biswas, Tata McGraw – Publishing.
2. Fluid Mechanics by K.L.Kumar, Eurasis Publishing House, New Delhi, 1995.

References:

1. Turbomachines, by Yahya S.M., SatyaPrakashan, New Delhi, 1972.
2. Fluid Mechanics, by F .M. White, Springer-Verlag. New York. 1999.

ME 3202 CAD/CAM

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 3 Th+ 1 Tut Ses. : 30 Exam : 70
Examination (Theory): 3hrs. Credits : 4

COURSE OBJECTIVES:

1. General Objectives -
   - Understand the importance of the computer aided designing and manufacturing techniques
   - Know the development of the various design steps to manufacture the products with high quality in less time
2. Specific Objectives –
   - Introduction of the different hardware devices, benefits of display methods in computer aided design (CAD)
   - Know the different modelling techniques, finite element analysis procedures to analyse and develop the products
   - Application of CAD/CAM packages to solving the real life applications in modeling, analysis and manufacturing
   - Motivation of students towards the innovative product development which leads to produce the newly developed automobile and aircraft components

COURSE OUTCOMES:

The main purpose of this course is to make the students aware of :

- Application of computer in design and manufacturing of different products
- From the basic principles of production drawing the CAD/CAM techniques were utilized for the different engineering applications
- Students will able to understand the industrial products by fundamental knowledge of geometric modeling and advanced manufacturing concepts
- After successful completion of this course student can know the prerequisites to do the job in CAD/CAM industry

SYLLABUS:

COMPUTER AIDED DESIGN

Fundamentals of CAD - Introduction - The design process - Application of computers for design - Operating systems - Hardware in CAD: The design work station - I/O Devices - CAD system configuration - Creating database for manufacturing - Benefits of CAD.

Interactive Computer Graphics - Graphic display devices- Graphics system- Graphics standards - Graphical user interface- Transformation systems- 2D and 3D transformations - Linear transformation- windowing – clipping - Geometric Modeling - Modeling Techniques - Wire frame Modeling - Surface Modeling - 3 D Solid Modeling.

Introduction to Finite Element Analysis – Steps of FEM for solving physical problem, CAD techniques to finite element data preparation- Automatic mesh generation- Presentation of results - CAD applications of FEM.

COMPUTER AIDED MANUFACTURING

Group technology: Merits & demerits, Organization, Classification and Coding systems, Cellular manufacturing.

Computer aided process planning: Introduction to process planning, Methods of process planning, Computer aided process planning, CAPP systems

Computer aided material handling: Robots: Structure and operation of Robots, robot sensors and applications. Automatic conveyor systems.Automated guided vehicles.

Computer aided inspection and quality control: Quality assurance and quality control. Contact and Non-contact inspection -Coordinate measuring machine.

FMS & CIMS: Building blocks of Flexible Manufacturing Systems (FMS), Machining systems of FMS, Tool management systems, Advantages of FMS, Computer integrated manufacturing systems (CIMS).

Text Books:

1. CAD/CAM- Computer Aided Design & Manufacturing, by M.D.Groover&E.W.Zimmer.
2. Computer Aided Design and Manufacturing, by Dr.Sadhu Singh, Khanna Publishers.

References:

1. Computer Aided Design in Mechanical Engineering, by V.Rama Murthy.
2. Elements of Computer Aided Design & Manufacturing, by Y.C.Pao.
3. Computer Aided Kinetics for Machine Design, by D.L.Ryan.
4. Computer Aided Design and Manufacturing, by C.B.Besant&C.W.K.Lui.
5. Computer-Aided Analysis & Design by S. Ghosal, Prentice Hall of India.
6. CAD/CAM/CIM by Radhakrishna, New age international.
7. Computer Integrated Design and Manufacturing, by David D.Bedworth, Mark R.Henderson& Philip M.Wolfe, McGraw-Hill Book Company, Singapore.
8. Computer Aided Manufacturing, by P.N.Rao, N.K.Tewari&T.K.Kundra, Tata McGraw-Hill publishing company Ltd, NewtDelhi.

ME 3203 DESIGN OF MACHINE ELEMENTS

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 3 Th+ 1 Tut Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

COURSE OBJECTIVES:

The main objectives are:Students will be acquainted with standards like ASTM, ASME etc., safety, reliability, importance of dimensional parameters, manufacturing aspects in mechanical design.

Students will understand to formulate and analyze stresses and strains in machine elements like shafts, springs etc. and structures under static and/ or dynamic load conditions

COURSE OUTCOMES:

Students are able to

-Understand the standadars used for for machine elements, safety and reliability concepts in the design of machine elements and the influence of manufacturing processes in the design of machine elements.

-Analyze stresses, strains and deflections in a machine member

-Know static failure criteria for different materials, in the design and analysis of machine components

-Know about various multidimensional fatigue failure criteria, fatigue failure and load-life relation

-Know the terminology, and types of permanent and detachable joints and design and analyze permanent joints (riveted, welded, etc.) under concentric and eccentric loading cconditions and power screws

-Know design and analyze shafts with different geometrical features under variousLoadingconditions and ability to calculate critical speed of shafts and make the design decisions accordingly

-know spring terminology, different types of springs, design and analyze coil springs(compression, tension, torsion) under various loads.

SYLLABUS:

Introduction to Mechanical engineering design: traditional design methods, different design models, Problem formulation, Design considerations, engineering materials and processes and their selection, BIS designation of steels, Mechanical properties, Load determination, manufacturing considerations in design.

Design against static loads: Modes of failure, Factory of safety, Axial, bending and torsional stresses, Stress concentration factors. Static failure theories.

Fluctuations and fatigue stresses, Soderberg, Goodman and modified Goodman diagrams, fatigue failure, design consideration in fatigue

Threaded and welded joints: forms of threads, basic types of screw fastenings, ISO metric screw threads, eccentrically loaded bolted joints, Torque requirement for bolt tightening, Fluctuations loads on bolted joints, fasteners, Joints with combined stresses. Power screws, Force analysis. Collar friction, Differential and compound screws design. Types and strength

of weld joints subjected to bending and fluctuating loads, cotter and knuckle joints, welded joints, different types welded joints and their design aspects, welding inspection

Shafts, keys and couplings: shafts design on strength basis, torsional rigidity basis, Design of hollow shafts, flexible shafts, ASME codes for shafts, Keys and cotter design, Flat, square keys, Splines, Rigid and flange couplings, Flexible couplings

Spring Design: classification and spring materials, Spring end formation, Design of helical compression springs, helical extension springs, torsion springs, laminated springs, Protective coatings, Equalized stress in spring leaves. Multi - leaf springs. Surge in springs, Nipping and shot peening.

Text Books:

1. Design of Machine Elements by V.B.Bhandari, TMH Publishing Co. Ltd., New Delhi

References:

1. Machine Design by Jain, Khanna Publications.
2. Machine Design by Pandya and Shaw, Charotar publications
3. Machine design , an integrated approach by R.L.Norton, 2nd edition, Pearson Education

ME 3204 PRODUCTION PLANNING AND CONTROL

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 3 Th+ 1 Tut Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

COURSE OBJECTIVES:

1)To make the student understand the concept of Production planning and production control. In this process the teacher will be attempting to make the student knowledgeable about the objectives of Production planning and production control.
2)To make the student understand the different types of production and their selection criteria and make the student knowledgeable to deal with production planning and control in different types of production.
3) To make the student to understand the concept of forecasting and its necesicity in real world requirements and its linkage to other functions of production manager
4)To make the student aware of different forecasting techniques and errors associated with each forecasting methods.
5)To make the student understand the concept of process planning and about computer aided process planning
6)To explain the student to understand the steps of production control , types of control and about control organization and its significance.
7)To make the student understand the meaning of inventory and different types of inventories and about need and necessicity of inventory control.
8) To make the student to understand EOQ and EBQ models without shortages and about necessary terminology of inventory control like buffer stock, safety stock, re-order level , lead time.
9) To make the student to understand EOQ and EBQ models with shortages
10)To make the student to understand the concept of MRP-1, MRP-2, JIT.
11)To make the student to understand Aggregate planning and Master processing instructions.
12)To make the student to understand the production inventory programs and about work design and job design .
13)To make student understand the about the concept of Routing , steps in Routing and about route sheet.
14)To make the student to understand the concept of scheduling and forward and backward scheduling , Master scheduling.
15)To explain the student to understand the evaluation of job shop schedules with reference to priority scheduling rules.
16)To make the student understand the Assignment techniques in production scheduling.
17) To make the student understand the concept of centralized and de-centralized Dispatching

COURSE OUTCOMES:

1. Student is able to participate and can interact in real world scenario regarding production planning and production control and suggest the type of production required for specific real world requirement.
2. Student can undertake the responsibility of doing forecasting in real world situation is able to suggest correct forecasting method/technique for a specific real world situation and can also able to judge the suitability of the method for a real world situation depending on the error associated with the method.

3. Student can understand the need of inventory control and can able to undertake activities relating to inventory management.
4. The student is knowledgeable about MRP-1&2, JIT , Aggregate planning can able to implement them in real world situation.
5. Student can understand and participate in the design of both forward and backward scheduling and Master scheduling and can able to evaluate different job shop schedules with reference to priority scheduling rules.

SYLLABUS:

Introduction : Definition – Objectives of production Planning and Control – Functions of production planning and control – Types of production – Organization of production planning and control department.

Forecasting : Importance – Types of forecasting– Forecasting techniques – qualitative methods and quantitative methods.

Inventory management : Functions of inventories – relevant inventory costs – EOQ model – Inventory control systems – ABC analysis – VED analysis

Material Requirement Planning, Bill of material, MRP II, Master Production Scheduling.

Aggregate planning,: Chase planning, Expediting, controlling aspects.

Routing : Definition – Routing procedure –Route sheets — Factors affecting routing, procedure – Difference with loading

Scheduling: Policies – Types of scheduling- Forward and Backward Scheduling – Gantt Charts – Flow shop Scheduling – n jobs and 2 machines, n jobs and 3 machines – Job shop Scheduling – 2 jobs and n machines – Line of Balance.

Dispatching : Activities of dispatcher – Dispatching procedure – follow up – priority rules for dispatching jobs.

Applications of computer in production planning and control.

Text Books:

1. Elements of Production Planning and Control / Samuel Eilon.

2. Modern Production/ operation managements / Baffa&RakeshSarin

References:

1. Operations Management – S.N. Chary.
2. Inventory Control Theory and Practice / Martin K. Starr and David W. Miller.
4. Production Control A Quantitative Approach / John E. Biegel.
5. Operations Management / Joseph Monks.

ME 3205 ADVANCED THERMODYNAMICS-II

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 3 Th+ 1 Tut Ses. : 30 Exam : 70
Examination (Theory): 3hrs. Credits : 4

COURSE OBJECTIVES:

- This Course comprehensively deals with Applied thermodynamics and Power plant Engineering which helps an undergraduate student to have a better understanding in this area.
- Help the student to understand the fundamentals phenomenon of combustion extended to reality in automobile engines
- To expose students to different methods of generating power with specific applications and limitations
- Non-conventional sources of energy being the need of the hour, this course would certainly educate the students and society at large.

COURSE OUTCOMES:

- Students would appreciate the fundamentals of thermodynamics being extended to real time applications
- Students might come out with innovative ideas which may be extended in the form of projects
- Course could bridge the gap between conventional and non-conventional methods of power generation.

SYLLABUS:

I.C. engines: classification-comparison of two stroke and four stroke engines- comparison of S.I. and C.I. engines-Air cycles-Otto, Diesel, Dual, Stirling, Ericson and Atkinson cycles and their analysis-Valve timing and port timing diagrams- Efficiencies- air standard efficiency,indicated thermal efficiency, brake thermal efficiency, mechanical efficiency, volumetric efficiency and relative efficiency-Testing and performances of I.C. engines-Basic principles of carburetion and fuel injection.

Combustion in I.C. Engines: S.I. engines- Normal combustion and abnormal combustion-Importance of flame speed and effect of engine variables-types of abnormal combustion pre-ignition and knock, Fuel requirements and fuel rating, anti-knock additions- Combustion chamber requirements and Types of combustion chamber- Design principles of combustion chambers-C.I. engines- Stages of combustion- Delay period and its importance- effect of engine variables, diesel knock, suction compression and combustion induced turbulence, open and divided combustion chambers.

Reciprocating and Rotary Compressors: Reciprocating compressors-effect of clearance in compressors, volumetric efficiency-single stage and multi stage compressors-effect of inter

cooling in multi stage compressors-Vane type blower-centrifugal compressor- Adiabatic efficiency- Diffuser- Axial flow compressors- Velocity diagrams, degree of reaction, performance characteristics.

Gas Turbines: Simple gas turbine plant- Ideal cycle, closed cycle and open cycle for gas turbines-Efficiency, work ratio and optimum pressure ratio for simple gas turbine cycle-Parameters of performance- Actual cycle, regeneration, Inter-cooling and reheating, closed and semi-closed cycle-Jet propulsion and Rockets.

Nuclear power plants: Classification of reactors-Thermal utilization-Fuels, Fuel moderator and coolant, Control and safety rods, Special properties of structural materials required, Induced radio-activity-Gas cooled reactors, Radiation hazards and shielding-Radio active waste disposal.

Direct Energy Conversions and non conventional energy sources: Solar Energy-Introduction, Solar radiation, Solar collectors, Energy storage-Wind Energy- Wind mills-Thermo Electric- MHD.

Text Books:

1. A Treatise on Heat Engineering by Vasandhani and Kumar.
2. Applied Thermodynamics-II by R. Yadav.

References:

1. Thermal Engineering, by R.K.Rajput.
2. I.C. Engines, by Mathur and Nehata.
3. Gas Turbines, by Cohen and Rogers.
4. Fluid Flow Machines, by M.S. GovindaRao, Tata McGraw Hill publishing company Ltd.
5. I.C. Engines by V. Ganesan.
6. Power Plant Engineering, P.K.Nag
7. Non ConventionalEnergy Sources, G.D.Rai
8. Internal Combustion Engines by R.K. Mohanty, Standard Book House.

ME 3206 ELECTIVE-II (A) AUTOMOBILE ENGINEERING

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 4 Th Ses. : 30 Exam : 70
Examination (Theory): 3hrs. Credits : 4

COURSE OBJECTIVES:

This course deals with the basic components of automotive vehicles, which includes the elements of power transmission system and vehicle control systems as follows:

- First chapter deals with the technological advancements of modern automotive vehicles/engines and the techniques of exhaust emission reduction.
- Chapter 2 & 3 describes the constructional features of power transmission components and their working principles.
- Chapter 4 & 5 describe the electrical circuits, and ignition systems including battery.
- Chapter 6 & 7 describes the constructional features of differential and alignment of axles (live & dead), including wheels.
- Chapter 8 provides the information on various aspects of vehicle maintenance. Also the driving aspects and Motor Vehicle Act of the Indian Government.

COURSE OUTCOMES:

After completing this course, students can learn and understand the following:

- Students are familiar with the basic knowledge of automotive vehicles, and various modes of vehicle driving, including the safety aspects.
- Students can understand the affects of automotive exhaust emissions on the environment and the health of human beings. And also the techniques of exhaust emission control/reduction techniques used in modern vehicles
- Students are able to understand the principle of electronic fuels injection and spark ignition.
- Students are familiar with the various design aspects of chassis and power transmission components, including the design of wheels and tires
- Students are exposed to different maintenance procedures of automotive vehicles and the safety aspects while driving, including traffic regulations.

SYLLABUS:

Introduction: Definition of automobile, Automobile Layout, Chassis and Transmission: Introduction to Drive Train: Clutch, Gearbox, Hook's Joint, Propeller /Drive Shaft, Slip Joint, Final Drive and Differential, Front and Rear Axles, Wheels and Tires, Control systems: Introduction to Steering, and Brakes. Electrical system: Introduction to Starting System, Ignition, dynamo/alternator, cut-out and wiring. Automobile Body: Parts and Stream lining, Automobile types: Front, Rear and Four wheel drive and Automotive materials.

Engine (Power Plant): Multi cylinder engine parts, Classification: 'In-line' and 'V' type, Multi-Valve Engines, VCR Engines, Super Charging/Turbo charging, Air filters, Fuel Systems: Petrol Engines: Carbureted and MPFI, Ignition Systems: Conventional and Electronic, Diesel Engines: Conventional, CRDI, and Duel Fuel engines., Performance, Combustion and Exhaust Emissions, Air pollution and their control: EGR and Catalytic Converters, EURO/Bharat Stage Norms: I, II, III, IV and V., Manifolds and Mufflers, Engine Cooling and Lubrication.

Clutch: Necessity, Clutch Assembly: Construction and Working Principle, Types: Single and Multiple Plates, Free-Play, Fluid coupling/Torque converter, Clutch Troubles and Remedies.

Gearbox: Necessity of Transmission and Transaxle, Construction and Working Principle, Selector Mechanism, Types: Sliding mesh, Constant mesh, Synchromesh, and Epicyclical. Three, Four and Five- Speed Gearbox, Overdrive, Automatic Gearbox, Gearbox Troubles and Remedies.

Drive shaft and Final Drive: Drive Shaft: Constructional Features: Universal/Hooks Joints, Slip Joint, and Working Principle., Types of Propeller shafts, Final drive and Differential: Necessity, Constructional Features and Working Principle., Front/Rear Axles: Constructional Features and Types of Rear Axle Floating, Wheels: Disc and Drum type, Tires: Tire Construction, Tube and Tubeless Tires, Radial Tires, Tire specification, Tire rotation and Tire Maintenance.

Suspension System and Vehicle Control: Coil and Leaf Springs, Shock absorbers, Wheel alignment: Kingpin angle, Caster, Camber, Toe-in, and Toe-out., Necessity of vehicle control, Steering Mechanism and its Elements: Steering gear box and its types, Steering gear ratio, Constant Velocity Joints and linkages. Power Steering, Brake system: Necessity, Parking and Power Brakes, Parts and Working Principle of Mechanical, Air and. Hydraulic Brakes: Mater and Wheel cylinder, Properties of Brake Fluids, Brake Diagnostics and Service: Brake Bleeding, Anti-lock Braking System, Automobile Accessories and Tips for Safe Driving.

Electrical and Electronic Systems: Basics of Electrical/Electronic Systems: Battery, Starting system, Charging System, Lighting and Signaling System, A/C Electrical System, Electronic Engine Management system, Automotive Embedded Systems: Vehicle Security System and Working Principle of Computer Sensors: Temperature, Flow, Cam, knock, and Oxygen, and ECU/ ECM.

Trouble shooting and Maintenance: Engine and Vehicle Troubles: Diagnostic Information: Symptom descriptions and their Causes and Remedies, Periodic, Preventive and Break down Maintenance: Engine tuning, Fuel and Air filters, Lubricants, Maintenance of Battery and Electrical/Electronic System, and Tires. The Motor Vehicle Act (India).

Text Books:

1. Automotive Mechanics (10/e) - William H. Crouse and Donald L. Anglin, Tata McGraw-Hill Publishing Company Limited, ISBN: 0-07-059054-0

2. Automobile Engineering – KK Jain/ RB Asthana, Tata McGraw-Hill Publishing Company Limited, ISBN: 0-07-044529-X
3. Internal Combustion Engines and Air Pollution- E.F. Obert, Harper & Row International Publishers Inc., ISBN: 0-06-350561-4

Reference Books:

1. Automotive Mechanics – S. Srinivasan, Tata McGraw-Hill Publishing company Limited, ISBN: 0-07-044941-6
2. Internal Combustion Engines – Heywood, John, B. McGraw-Hill Publications Limited.
3. Automotive Engines- S Srinivasan, Tata McGraw-Hill Publishing Company Limited, ISBN: 0-07-040265-5

ME 3206 ELECTIVE-II (B) MECHANICAL VIBRATIONS

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 4 Th Ses. : 30 Exam : 70
Examination (Theory): 3hrs. Credits : 4

COURSE OBJECTIVES:

1. To enrich the student on the concept of Mechanical vibrations.
2. To make the student understand the concept of single and two degree of freedom systems.
3. To make the student understand the use of damping, influence co-efficients, matrix methods and Lagrange's equations.
4. To make the student understand the concept of vibrations by A.H Church.
5. To make the student understand the concept of multiple degree of freedom systems.
6. To make the student understand the vibration problems in daily life
7. To make the student understand the principal of orthogonality classical and energy methods by Rayleigh, Ritz and Gelerkin.
8. To make the student understand the concept of Transient (shock) vibrations.

COURSE OUTCOMES:

1. The student is capable of understanding the various concepts in Mechanical vibrations.
2. The student is capable of understanding the concept of single and two degree of freedom systems.
3. The student is capable of understanding the concept of multiple degree of freedom systems.
4. The student is capable of understanding the different problems in single, two and multiple degree freedom systems.
5. The student is capable of understanding the damping, influence co-efficients, matrix methods and Lagrange's equations.
6. The student is capable of understanding the principal of orthogonality classical and energy methods by Rayleigh, Ritz and Gelerkin.
7. The student is capable of understanding the concept of Transient (shock) vibrations and problems in it.

SYLLABUS:

Single degree freedom systems -Introduction - Single degree freedom systems - free and forced vibrations - Damping classification and damped systems .

Two degree freedom systems - Free, forced damped and undamped motions - Use of influence coefficients, Matrix methods and Lagrange's equations - Phenomenon of beat - Dynamic absorbers – Applications.

Transient (Shock) vibrations as applied to single and two degree freedom systems - Use of mathematics and graphical techniques in the analysis (superposition integral, Laplace transformations, phase plane techniques).

Multi degree freedom systems - Free and forced motions in longitudinal, torsional and lateral modes - damped and undamped, critical speeds of rotors. Continuous systems - free and forced vibrations of string, bars and beams - Principle of orthogonality Classical and energy methods by Rayleigh, Ritz and Gelerkin.

References:

1. Mechanical Vibrations by A.H. Church.
2. Vibration Problems in Engineering by Timoshenko and Young.
3. Mechanical Vibrations by Den Hartog.

ME 3206 ELECTIVE-II (C) ROBOTICS

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 4 Th Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

COURSE OBJECTIVES:

Course covers fundamentals of robot working, programming and integration in a manufacturing process. It starts with examples of robotics idea over history and continue with a numerous of examples in nowadays robot applications on different areas of human activities. Topics to be covered include robot mechanical, power, measuring and control system, robot kinematics, dynamic, control and programming. Chapter of robots will cover robot kinematics, path planning and control. Overview of present research in robotics and view of the robotics impact in human future.

COURSE OUTCOMES:

Outcome 1: To teach students basic mathematical and computational tools for modeling and analysis of robotic systems.

1.1 Students will demonstrate an understanding of various mathematical models, such as joint and link models for serial and parallel manipulators, transformations between joint space and end effector space, and Jacobians for velocity and static analysis.

1.2 Students will demonstrate the ability to perform path planning using algebraic techniques for holonomic robots and artificial intelligence techniques for nonholonomic robots.

Outcome 2: To train students to identify, model, analyze, design, simulate, and implement robotic systems.

2.1 Students will demonstrate the ability to simulate the kinematics and control of robotic systems.

2.2Students will demonstrate the ability to integrate sensory and mechanical components within a robotic system.

SYLLABUS:

Introduction: Background- Historical Development-Robot Arm kinematics and Dynamics-Manipulator Trajectory Planning and Motion Control-Robot Sensing- Robot Programming Language- Machine Intelligence.

Robot Arm kinematics: Introduction – The Direct Kinematics Problem-The Inverse Kinematics Solution.

Robot Arm Dynamics: Introduction – Lagrange-Euler Formulation- Newton-Euler Formation - Generalized D'Alemberts Equations of Motion.

Planning of Manipulator Trajectories: Introduction-General Considerations on Trajectory Planning- Joint Interpolated Trajectories- Planning of Manipulator Cartesian Path Trajectories.

Control of Robot Manipulators: Introduction – Control of the Puma Robot arm- Computed Torque Technique- Near Minimum Time Control- Variable Structure Control- Nonlinear Decoupled Feedback Control- Resolved Motion Control- Adaptive Control.

Sensing: Introduction-Range Sensing-Proximity Sensing- Touch Sensors- Force and Torque Sensing.

Low-Level Vision: Introduction –Image acquisition- Illumination Techniques- Imaging Geometry- Some Basic Relationship Between Pixels – Preprocessing.

Robot Programming Languages: Introduction- Characteristics of Robot Level Languages- Characteristics of Task Level Languages.

Text Book:

1. Robotics By K.S. Fu, R.C. Gonzalez and C.S.G Le, McGraw- Hill International Editions1987.

Reference Books:

1. Industrial Robotics By M.P.Groover,Mitchell Weiss, Roger N. Nagel and N.G.Odrey, McGraw- Hill International Editions1986.
2. Robot Analysis- The Mechanics of Serial and Parallel Manipulators By Lung-Wen Tsai, Jhon Wiley and Sons,Inc

ME 3206 ELECTIVE-II (D) RELIABILITY ENGINEERING

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 4 Th Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

COURSE OBJECTIVES:

To understand

1. The interrelation between quality and reliability and importance of reliability
2. Basic terminology used in reliability engineering and the difference between failure rate and failure densities
3. Modeling of failures of engineering equipment/product/systems using different types of failure rates using a bath tub curve
4. Modeling of random failures using exponential distribution
5. Modeling of time-dependent failures using Weibull distribution
6. Modeling of time dependent failures using normal and lognormal distributions
7. Modeling the systems as series, parallel and combined configurations. Also, to find the reliability of k-out-of-n : G systems and complex configurations
8. To specify reliability, system effectiveness and life cycle costs concepts, reliability allocation methods
9. To incorporate reliability into designs using Failure Modes & Effects Analysis (FMEA) and Fault Tree Analysis (FTA)

COURSE OUTCOMES:

1. Understands that reliability is concerned with time based performance but a subset of quality
2. Understands the general terminology used in reliability engineering and also understands their limitations
3. Understands the different types of failures encountered in engineering failure analysis and the probable failure types for different types of products like electronic products, mechanical products, software products etc.,
4. Understands the lack of memory property of exponential distribution and its significance in modeling random failures
5. Understands that all types of failures- namely DFR , CFR and IFR can be efficiently modeled by a general distribution i.e. Weibull distribution
6. Understands the suitability of Normal distribution in reliability engineering and also as a foundation to study the lognormal failures. Also understands the interrelation between normal and lognormal distributions.
7. Understands the different configurations used in system reliability modeling.
8. Understands the importance of life-cycle costs in the design of reliable products and also understands the methods to allocate reliability to different components.
9. Understands the methods to incorporate reliability into products at design stage. Understands the importance of FMEA and FTA methods in reliability engineering

SYLLABUS:

Introduction: Concepts of quality and reliability, a brief history, terms, definitions, reliability function, MTTF, Hazard rate function, bath tub curve, conditional reliability.

Constant failure rate models: Exponential reliability, failure modes, failure modes with exponential distribution, applications, two parameter exponential distribution, Poisson process.

Time dependent failure models: Weibull distribution, burn-in screening for Weibull, three parameter Weibull distribution, Normal and Lognormal distributions

Reliability of systems: Series, parallel configurations, combined systems, k-out-of-n systems, complex configurations, common failure modes, minimal cuts and minimal paths.

State dependent systems: Markov analysis, load sharing, standby systems, degraded systems

Physical reliability models: Static models- random stress and random strength, dynamic models- periodic models, random loads.

Design for reliability: Reliability specification, Lifecycle costs, reliability allocation, design methods, failure analysis, FTA.

Reliability testing: Life testing, burn-in testing, acceptance testing-binomial acceptance testing.

Reliability growth testing: Reliability growth process, idealized growth curve, Duane growth model.

Text Book:

1. Introduction to Reliability and Maintenance engineering by Charles E Ebeling, Tata McGrawhill, India.

References:

1. Introduction to Reliability Engineering by E.E. Lewis, John Wiley& Sons, NewYork
2. Reliability based design by S.S.Rao, McGraw-Hill, New York

ME 3207 MOOCS-II

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : ---- Ses. : 50 Exam : 50

Examination (Theory): 3hrs. Credits : 2

ME 3208 METROLOGY AND MECHATRONICS LAB

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 3 Lab Ses. : 50 Exam : 50

Examination (Theory): 3hrs. Credits : 4

COURSE OBJECTIVES:

1. To demonstrate the fundamentals of Metrology and Measurement Engineering concepts, different tools used for minute measurements, and calibrate various kinds of measuring instruments.
2. To demonstrate the involvement of sensors and electronic devices in the mechanical oriented industries by introducing PLC, and Mechatronics equipment.
3. To demonstrate the use of logic circuits in controlling various mechanical devices including material handling equipment, lift control systems, pneumatic controller systems etc.
4. To demonstrate the techniques and processes followed for calibrating measuring instruments like Micrometer, Mechanical Comparator, and Vernier Caliper etc. and educate students about the metrology equipment.
5. To train the students on the fundamentals of logic circuit design, to write ladder logic programs and execute them to control various mechanical devices.

COURSE OUTCOMES:

1. Students will be able to understand the various logics involved in controlling mechanical industry equipment.
2. The student will be able to operate measurement instruments on their own and test different components for their dimensional accuracy.
3. A project involving writing ladder logic for controlling a mechanical device, executing the program is required from each student and graded by the instructor, so that the student will be able to understand the Mechatronics concept, practically and from the application point of view.

METROLOGY LAB.EXPERIMENTS - (Any Five)

1. Calibration of the following instruments: (using slip gauges)
   i. Calibration of Micrometer. ii. Calibration of Mechanical Comparator.
   iii. Calibration of Vernier Caliper. iv. Calibration of Dial Gauge.
2. Measurement of taper angle using
   i. Bevel Protractor ii. Dial Gauge iii. Sine-Bar iv. Auto-Collimator.
3. Alignment tests:
   i. Parallelism of the spindle ii. Circularity & Concentricity of the spindle
   iii. Trueness of running of the spindle.
4. Gear parameters Measurement
   i. diameter, pitch/module ii. Pitch circle diameter iii. Pressure angle iv. Tooth thickness.
5. Check the flatness of a surface plate.
   i. Using spirit level ii. Using Auto-collimator
6. Using light wave interference:

i. Study of flatness of slip gauges ii. To find the height of a slip gauge.

7. Tool Maker's Microscope:
   i. Establish the thread details ii. To find the cutting tool angles.
8. Miscellaneous:
   i. To find the diameter of a cylindrical piece ii. Taper angle of a V-block
   iii. Central distance of two holes of a specimen.

MECHATRONICS LAB. EXPERIMENTS - (Any Five)

I. Training on Programmable Logic Controller (any ONE of the Following)
   i) Lift Control Using Ladder Logic Programme
   ii) Traffic Signal Control using Ladder Logic Programme

II. Training on Programmable Logic Controller - Sensor Training Kit
   a) Proximity Switch
   b) Photo Electric Switch
   c) Limit Switch

III. Training on Sensor and Transducer (any ONE of the Following)
   i). Linear position or Force applications
      a. LVDT (Linear variable differential transformer)
      b. The strain gauge Transducer
   ii). Rotational Speed or Position Measurement (The inductive Transducer)
   iii). Linear or Rotational Motion
      a. D.C. Solenoid
      b. D.C. Relay

IV. Training on Automation Studios
   i). Punch Machine operation
   ii). Hydraulic Cylinder operation

V. Training on Material Handling

VI. Training on any Controller Package

VII. Training on Servo Fundamental Trainer.

ME 3209 INDUSTRIAL ENGINEERING LAB

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 3 Lab Ses. : 50 Exam : 50

Examination (Theory): 3hrs. Credits : 2

COURSE OBJECTIVES:

1. To make student acquainted with the control charts and measure the quality of the product.

2. To make the students aware of the different types of process charts used for improving the method of doing the work.

3. To help students to learn the different methods of finding the standard time for a job.

4. To make the students acquainted with the probability distributions.

5. To make the students learn the impact of work on the human physiology and the physiological constraints of the body.

COURSE OUTCOMES:

1. Students will be able to find the quality of the product using different charts.

2. Can improve the method of doing work by applying principle of motion economy and method study charts.

3. Can find the standard time required for completing a job by different methods..

4. Understands the basic probability distributions.

5. Understands the impact of work on the human body and also the physiological constraints of the body.

LIST OF EXPERIMENTS:

1. To measure the skill and dexterity in the movement of Wrist and Fingers using pin board.
2. To measure the Heart beat using Stethoscope.
3. To show that the sample means from a normal universe follow a normal distribution.
4. To draw the control chart for fraction defective for a given lot of marble balls.
5. To determine the cycle time using PMTS.
6. To draw two handed process charts for
    i. Bolt, Washer and nut assembly
    ii. Assembly of electric tester.
7. To study the changes in heart rate for different subjects using Tread mill.
8. To draw Multiple Activity chart using an electric toaster.
9. To determine the percentage utilization using work sampling.
10. To study the process capability of a given process.

11. To measure the Heart rate during working and recovery periods of the subjects under different loads, using Bicycle ergometer.
12. To draw flow process charts on activities in Workshop/ Laboratory/Office.
13. To determine the time required to perform motion sequence using work factor system.
14. To draw SIMO charts for
    i. Ball point pen assembly
    ii. Electric plug assembly.
15. To conduct time study of the bulb holder assembly operation of the existing method.
16. To collect the anthropometrics data using `Anthropolometer'.

IV-YEAR

FIRST SEMESTER

ME 4101 MACHINE DESIGN

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 3 Th+ 1 Tut Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

COURSE OBJECTIVES:

- The main objectives are:Students will be acquainted with standards like ASTM, ASME etc.,
- Students will understand
- To Design and formulate, to analyze stresses and strains in machine elements like gears, clutches,bearings, etc. under static and dynamic load conditions.
- To Design of Internal combustion engine parts like cylinder, pistons,connecting rod and crankshaft.
- To understand the stresses on miscallenous machine elements like crane hooks ,wrenches ,wire ropes etc.
- Selection and application of composite materials

COURSE OUTCOMES:

- Students are able to -Understand the standadars used for for machine elements,
- -Analyze static laod and dynamic load acting and factor of safety of the machine member like gears, clutches and bearings.
- -Understanding the static and dynamic failure criteria for different materials, in the design and analysis of machine components of internal combustion engine parts
- -Know about various multi-dimensional fatigue failure criteria, fatigue failure and load-life relation
- -Know design and analyze Gears
- Ability to select the material,
- thermo-mechanical condition and configuration of a variety of machine elements under a variety of environmental and service conditions
- .Able to select the bearings and to calculate its life.
- Understanding of wear and fracture mechanics and how they influence engineering design
- Ability to recognize the possibility of buckling failure in machine elements and estimate the critical load.
- Understanding the design and various stress acting on miscellaneous elements like crane hooks, wrenches, wire ropes etc.
- Understanding of the uncertainties inherent in composite material properties and engineering analysis as a real-world engineering application.

SYLLABUS:

Classification of gears.Standard tooth systems. Spur, Helical, Bevel and Worm gears. Terminology of each. Tooth failure. Face width an beam strength. Lewis equation. Design for dynamic and wear loads. Force analysis of Bevel and Worm gears. Thermal design considerations of worm gears.

Engine parts: I.C. engine design. Design of cylinders and heads.Design of pistons.Design of cross-head, connecting rods and crank shafts.

Friction clutches. Torque capacity multi-plate clutches. Design considerations. Energy considerations and Temperature rise friction materials. Centrifugal clutches. Brakes.Energy equations. Band and block brakes. Internal expanding shoe brakes, self locking, brake design.

Sliding contact bearings.Lubrication modes.Temperature effect on viscosity.Journal bearing design.Bearing modulus.McKee equations.Heating of bearings. Collar and thrust bearings. Roller and ball bearings.Static and dynamic load capacity.Equivalent bearing load.Load-life relationships. Load factor. Selection of bearings from manufacturers catalogue.

Design of crane hooks, Wire rope construction and classification. Stresses in wire ropes. Design for service like lifts and winches. Chain drives, Nomenclature: Brief outline and simple applications of composite materials.

Text books:

1. Design of Machine Elements by V.B. Bhandari, TMH publishing Co. Ltd., New Delhi.

References:

1. Machine Design by R.K. Jain, Khanna publications.
2. Mechanical Engineering Design by Joseph E. Shingley.

ME 4102 HEAT AND MASS TRANSFER

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 3 Th+ 1 Tut Ses. : 30 Exam : 70
Examination (Theory): 3hrs. Credits : 4

COURSE OBJECTIVES:

1. To know three modes of heat transfer i.e. in cartesian, cylindrical and spherical coordinates.
2. To acquire knowledge on steady and unsteady conduction on slabs, cylinders and spheres.
3. To understand the heat transfer on plates, internal and external flows of ducts and spheres in forced as well as natural convection.
4. To acquire knowledge on laws of radiation and importance of shape factor.
5. Analyse the types of heat exchangers and its performance.
6. Understand the basic principles of boiling, condensation and diffusion mass transfer.

COURSE OUTCOMES:

1. Students will be able to draw line diagrams and solve problems related to composite slabs, cylinders and spheres.
2. They are able to model and make certain assumptions in solving problems and they are able to understand Heisler charts in solving conduction problems.
3. They would understand how to look into Heat transfer data books and graphs.
4. They also understand to write empirical heat flow equations and heat balance equations in forced and natural convection in laminar and turbulent flows by knowing dimensional analysis concepts.
5. They understand the laws of radiation and use relations of shape factor in deriving certain equations for certain geometries.
6. Students are aware of solving problems on different heat exchangers basing on the concepts of three modes of heat transfer.
7. Having been familiar to concepts of boiling, condensation and diffusion mass transfer, students are made aware of certain non dimensional numbers in mass transfer and they are now introduced to two phase flow heat transfer.

SYLLABUS:

Introduction: Basic modes of heat transfer- Rate equations- Generalized heat conduction equation in Cartesian, Cylindrical and Spherical coordinate systems.

Steady state heat conduction solution for plain and composite slabs, cylinders and spheres- Critical thickness of insulation- Heat conduction through fins of uniform and variable cross section- Fin effectiveness and efficiency.

Unsteady steady state heat conduction- Transient heat conduction- Lumped system analysis, and use of Heisler charts.

Convection: Continuity, momentum and energy equations- Dimensional analysis- Boundary layer theory concepts- Free, and Forced convection- Approximate solution of the boundary

layer equations- Laminar and turbulent heat transfer correlation- Momentum equation and velocity profiles in turbulent boundary layers- Application of dimensional analysis to free and forced convection problems- Empirical correlation.

Radiation: Black body radiation- radiation field, Kirchoff's laws- shape factor- Stefan Boltzman equation- Heat radiation through absorbing media- Radiant heat exchange, parallel and perpendicular surfaces- Radiation shields.

Heat Exchangers: Types of heat exchangers- Parallel flow- Counter flow- Cross flow heat exchangers- Overall heat transfer coefficient- LMTD and NTU methods- Fouling in heat exchangers- Heat exchangers with phase change.

Boiling: Different regimes of boiling- Nucleate, Transition and Film boiling. Condensation: Laminar film condensation- Nusselt's theory- Condensation on vertical flat plate and horizontal tubes- Dropwise condensation.

Mass Transfer: Conservation laws and constitutive equations- Isothermal equimass, Equimolal diffusion- Fick's law of diffusion- diffusion of gases, Liquids- Mass transfer coefficient.

Text Books:

1. Heat Transfer, by J.P.Holman, Int. Student edition, McGraw Hill book company.
2. Analysis of Heat transfer, by Eckert and Drake, Int.Student edition, McGraw Hill Kogakusha Ltd.

References:

1. Heat and Mass Transfer by R.K. Rajput, S. Chand & Co.
2. Heat and mass transfer by Sachjdeva.
3. Heat and mass transfer by Kothandaramanna, New Age International

ME 4103 REFRIGERATION & AIR-CONDITIONING

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 3 Th+ 1 Tut Ses. : 30 Exam : 70
Examination (Theory): 3hrs. Credits : 4

COURSE OBJECTIVES:

1. Refrigeration and Air-conditioning course provides knowledge of how thermodynamic principles could be applied to refrigeration and air-conditioning equipment.
2. Students will learn how real systems in commercial, industrial refrigeration and air conditioning are built up.
3. Students will understand the ill effects of global warming and its remedies.

COURSE OUTCOMES:

1. After understanding the principles of refrigeration and air-conditioning the concept of indoor environmental comfort can be understood.
2. Self-attainment and knowledge in home air-conditioning.
3. Understanding the importance of research in designing systems which are global friendly.

SYLLABUS:

Principles of Refrigeration: Refrigeration and II law of thermodynamics- Methods of Refrigeration- Unit of Refrigeration- Applications of Refrigeration. Air cycle Refrigeration: Reversal Carnot cycle- Bell Colman cycle- Selection of Refrigeration systems for air crafts- Boot strap system- Regenerative cycle- Reduced ambient type- Comparisons of different systems.

Vapour Compression Refrigeration: Wet versus Dry compression- Effect of evaporator pressures and temperatures. Simple vapour compression Refrigeration cycle and its analysis. Advantages and disadvantages of vapour compression Refrigeration system over Air compression Refrigeration system- Methods of improving C.O.P.- Multi compression system- Multiple evaporators expansion valves- Flash inter cooler- Defrosting- Hot gas defrosting.

Classification of Refrigerants: Nomenclature- Properties- Secondary refrigerants- Selection of refrigerants- **Condensers-** Air cooled, Water cooled and evaporative type- Evaporators- Once through, flooded, shell and tube Baudelot cooler- **Expansion devices**- Capillary expansion device, Thermostatic expansion device.

Absorption Refrigeration System: Basic absorption system- Aqua ammonia absorption system- Li-Br absorption refrigeration system- Electrolux refrigeration- C.O.P. of absorption refrigeration system- Comparison of vapour compression and vapour absorption system. Steam jet refrigeration system and analysis- Advantages and limitation- Ejector compression system.

Psychrometry: Psychrometric properties and relations- Psy chart- Psy processes- Human comfort and comfort chart- Effective temperature and factors governing effective temperature. **Air conditioning**: Summer, Winter and year round air conditioning- Different types of Air conditioning load - By pass factor, RSHP, GSHF- Fresh air quantity- Cooling coils and Dehumidity- Air washers.

Text Books:

1. Refrigeration and Air conditioning, by C.P.Arora.
2. Refrigeration and Air conditioning, by P.L.Bellany.

References:

1. Refrigeration and Air conditioning, by Jordan R.C. and Priester G.B.
2. Principles of Refrigeration, by Dossat.
3. Refrigeration and Air-conditioning, by W.P.Stoecky.

ME 4104 STATISTICAL QUALITY CONTROL

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 3 Th+ 1 Tut Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

COURSE OBJECTIVES:

To understand

1. the different concepts of quality and the present philosophy of quality
2. the causes of variation and how they lead to inferior quality
3. use of control charts for both variable type and attribute type of quality characteristics
4. the meaning of statistical six sigma and six sigma procedure
5. the difference between the process control and process capability
6. the need for concurrent engineering
7. the different ways of taking random samples to accept a lot
8. the design of sampling plans for required protection
9. that there exist different types sampling plans to adopt

COURSE OUTCOMES:

1. Understands that quality is caused by variation
2. Understands to recognize and eliminate the causes of variation
3. Designs control charts for both variable and attribute quality characteristics
4. Understands the need of six sigma quality
5. Performs process capability analysis for process with N-type, L-type and S-type of quality characteristics
6. Understands the concept and need for rectifying inspection
7. Develops the ability to design different types of sampling plans
8. Understands the use of standard sampling plans
9. Becomes confident to work in any quality related teams in any type of industry

SYLLABUS:

Introduction to quality, definitions, Taguchi's loss function, examples of off-line and on-line quality control techniques, quality costs, Deming's philosophy, introduction to six sigma concept.

Shewart's normal bowl, control charts for variables, $\bar{X}$, R and sigma control charts, theory of runs, ARL and ATS, Type-I and Type-II errors

Control charts for attributes, p-chart, standardized p –chart, np-chart, c-chart, u-chart, demerit control chart.

Process capability analysis: using frequency distribution and control charts. Process capability ratios, C_p and C_{pk}Process capability ratios for nominal the batter type, smaller the better type and larger the better type product specifications.

Sampling palns: single, double, multiple and sequential sampling plans, rectifying inspection, AOQ, AOQL, and ATI. Use of Dodge Romig Tables, Design of single and sequential sampling plans.

Text Books:

1. Introduction to statistical quality control by E.L. Grant
2. Introduction to statistical quality control by D.C. Montgomery

ME 4105 ELECTIVE-III (A) RENEWABLE ENERGY TECHNOLOGIES

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 4 Th Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

COURSE OBJECTIVES:

- Students should have an exposure to non conventional sources of energy as it is one of the areas of emerging technologies.
- As energy needs of a developing country is on a rise, Students need to explore avenues to meet the rising demand
- Student has to expand his knowledge progressively

COURSE OUTCOMES:

- Students will have a broader outlook about Non conventional energy sources
- Students can design projects for better understanding the feasibility of Non conventional energy sources in India
- Course will be a platform for higher studies in the area of thermal engineering

SYLLABUS:

PRINCIPLES OF SOLAR RADIATION: Role and potential of new and renewable source, The solar energy option, Environmental impact of solar power, Physics of the sun, The solar constant, Extraterrestrial and terrestrial solar radiation, Solar radiation on titled surface, Instruments for measuring solar radiation and sun shine, Solar radiation data.

SOLAR ENERGY COLLECTION AND ITS APPLICATIONS: Flat plate and concentrating collectors, Classification of concentrating collectors, Orientation and thermal analysis, Advanced collectors. Solar energy storage and applications: Different methods, Sensible, Latent heat and stratified storage, Solar ponds. Solar Applications- Solar heating and cooling technique, Solar distillation and drying, Photovoltaic energy conversion.

WIND ENERGY AND BIO-MASS: Sources and potentials, Horizontal and vertical axis windmills, Performance characteristics, Betz criteria, Bio- mass: Principles of Bio-Conversion, Anaerobic/aerobic Digestion, Types of Bio-gas digesters, Gas yield, Combustion characteristics of bio-gas, Utilization for cooking, I.C.Engine operation and economic aspects.

GEOTHERMAL ENERGY AND OCEAN ENERGY: Resources, Types of wells, Methods of harnessing the energy, Potential in India, Ocean Energy: OTEC, Principles of utilization, Setting of OTEC plants, Thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, Mini-hydel power plants, and their economics.

DIRECT ENERGY CONVERSION : Need for Direct Energy Conversion, Carnot cycle, Limitations, Principles of DEC, Thermo-electric generators, Seebeck, Peltier and Joule Thomson effects, Figure of merit, Materials, Applications, MHD generators, Principles, Dissociation and Ionization, Hall effect, Magnetic flux, MHD accelerator, MHD, Engine, Power generation systems, Electron gas dynamic conversion, Economic aspects. Fuel cells, Principles, Faraday's law's, Thermodynamic aspects, Selection of fuels and operating conditions.

Text Books:

1. Renewable Energy Resources by Tiwari and Ghosal, Narosa Publications..
2. Non-ConventionalEnergy Sources by G.D. Rai

References:

1. Renewable Energy Sources by Twidell& Weir
2. Solar Energy bySukhatme
3. Solar Power Engineering by B.S Magal, Frank Kreith and J.F Kreith.
4. Principles of Solar Energy by Frank Krieth and John F Kreider.
5. Non-Conventional Energy by Ashok V Desai, Wiley Eastern Publications.
6. Non-Conventional Energy Systems by K Mittal , Wheeler.
7. Renewable Energy Technologies by Ramesh and Kumar, Narosa Publications

ME 4105 ELECTIVE-III (B) TOTAL QUALITY MANAGEMENT

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 4 Th Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

COURSE OBJECTIVES:

1. To understand the concept and philosophy of TQM.

2. To get acquainted with the tools of quality control.

3. To understand the quality function - Quality function deployment, Designing for quality, Manufacturing for quality.

4. To learn the importance and use of quality systems - ISO standards.

5. To understand the process of implementing the quality tools like KAIZEN, 5S, JIT, POKAYOKE, Taguchi methods and the difficulties in implementing them.

COURSE OUTCOMES:

1. Students will have knowledge of quality and the contributions of quality gurus' like Deming, Crossby and Miller.

2. Can apply the quality and management tools and methodologies for solving the problems.

3. Will be able to apply and use functions like quality function deployment, standardization, designing and manufacturing for quality.

4. Get acquainted with ISO series and the process of implementing it.

5. Will be able to apply quality tools like KAIZEN, 5S, JIT, POKAYOKE, Taguchi methods.

SYLLABUS:

Concepts of TQM: Philosophy of TQM, Customer focus, Organization, Top management commitment, Team work, Quality philosophies of Deming, Crossby and Muller.

TQM process: QC tools, Problem solving methodologies, New management tools, Work habits, Quality circles, Bench marking, Strategic quality planning.

TQM systems: Quality policy deployment, Quality function deployment, Standardization, Designing for quality, Manufacturing for quality.

Quality system: Need for ISO 9000 system, Advantages, Clauses of ISO 9000, Implementation of ISO 9000, Quality costs, Quality auditing, Case studies.

Implementation of TQM: Steps, KAIZEN, 5S, JIT, POKAYOKE, Taguchi methods, Case studies.

References:

1. Total Quality Management by Rose, J.E., Kogan Page Ltd., 1993.
2. The Essence of Total Quality Management by John Bank, PHI, 1993.
3. Beyond Total Quality Management by Greg Bounds, Lyle Yorks et al, McGraw Hill, 1994.
4. The Asian Productivity Organization by Takashi Osada, 1991.

5.KAIZEN by Masaki Imami, McGraw Hill, 1986.

ME 4105 ELECTIVE-III (C) OPTIMIZATION DESIGN

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 4 Th Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

COURSE OBJECTIVES: To introduce

1. The need and origin of the optimization methods in engineering.
2. The idea of the various applications of optimization methods used in engineering
3. The classical and various advanced optimization techniques used in engineering.

COURSE OUTCOMES: The student will be able to understand:

(1) The terminology in optimization
(2) Formulation of mathematical optimization models based on physical engineering problems
(3) Various solution techniques based on classification of optimization problems
(4) Applications to a wide range of engineering problems in design, manufacturing, production and management.

SYLLABUS:

Introduction to Optimization: Engineering applications of optimization- Statement of an optimization problem- Classification of optimization problem- Optimization techniques.

Classical Optimization Techniques: Single variable optimization- Multivariable optimization with equality constraints- Multivariable optimization with inequality constraints.

Nonlinear Programming: One-Dimensional Minimization: Unimodal function- Elimination methods- Unrestricted search- Exhaustive search- Dichotomous search- Fibonacci method- Golden section method- Interpolation

methods- Quadratic interpolation method- Cubic interpolation method- direct root method.

Nonlinear Programming: Unconstrained Optimization Techniques: Direct search methods- Random search methods- Univariate method- Pattern search method- Rosenbrock's method of rotating coordinates- The simplex method- Descent methods- Gradient of function- Steepest descent method- Conjugate gradient method (Fletcher-Reeves method)- Quasi-Newton methods- Variable metric method (Davidon- Fletcher-Powell method).

Nonlinear Programming: Constrained Optimization Techniques: Characteristics of a constrained problem- Direct method- The complex method- Cutting plane method- Methods of feasible directions- Indirect methods- Transformation techniques- Basic approach in the penalty function method- Interior penalty function method- Convex programming problem- Exterior penalty function method.

Geometric programming (G.P): Solution of an unconstrained geometric programming, differential calculus method and arithmetic method. Primal dual relationship and sufficiency

conditions.Solution of a constrained geometric programming problem (G.P.P). Complimentary geometric programming(C.G.P)

Dynamic programming(D.P): Multistage decision processes. Concepts of sub optimisation, computational procedure in dynamic programming calculus method and tabular methods.Linear programming as a case of D.P., Continuous D.P.

Integer programming(I.P): Graphical representation. Gomory's cutting plane method. Bala's algorithm for zero-one programming problem.Integer non linear programming.

Text Book:

1. Optimization Theory and Applications, by S.S.Rao, Wiley Eastern Limited, New Delhi.

References:

1. Optimization of Design of Machine Elements, by R.C.Johnson.
2. Computer Aided Analysis and Design of Machine Elements, by RaoV.Dukkipati, M.AnandaRao and R.B.Bhat.
3. Engineering optimization methods and applications, by G.V.Reklaits, A.Ravindarn and K.M.Ragsdell, by Publications John Wiley and Sons.

ME 4105 ELECTIVE-III (D) TOOL DESIGN

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 4 Th Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

COURSE OBJECTIVES:

1). To make the student to be familiar with jigs and fixtures

2). To make the student how to lacate and clamp the devices in industries for manufacturing, inspection and assembly processes.

3). To make the student proficient with the press working tools, terminology and various types of dies.

4). To provide full information regarding cutting tools used on NC machine tool and holding methods

5). Tomould the students in the field of designing of limit gauges.

COURSE OUTCOMES:

1) The students will be in a position to know about jigs and fixtures in detail.
2) The students can work with jigs and fixtures.
3) They will be effecitively work in mass production type industries.
4) The students will be in a position to work with press and press tools
5) They can design tooling for production on NC machines
6) They can effectively work with gauges and also in guage design.

SYLLABUS:

Locating and Clamping Devices: Principles of Jigs and Fixtures design-Locating principles-Locating elements-Standard parts-Clamping devices-Mechanical actuation-Pneumatic & hydraulic actuation-Analysis of clamping forces-Tolerance and error analysis.

Jigs & Fixtures: Drill bushes-Different types of Jigs-Plate latch, channel, box, post, angle plate, angular post, turnover, pot jigs- Automatic drill jigs-Rack & Pinion Operated, Air operated Jigs Components.

General principles of lathe, milling and broaching fixtures-Grinding, Drilling and shaping fixtures, Assembly, Inspection and Welding fixtures-Modular fixtures.Design and development of Jigs and fixtures for simple components.

Press Tools: Press working terminology-Presses and Press accessories-Computation of capacities and tonnage requirements-Design and development of various types of cutting, forming and drawing dies.

Tool Design for Numerically Controlled Machine Tools: Fixture Design for Numerically Controlled Machine Tools, Cutting Tools for Numerical Control, Tool-holding Methods for Numerical Control

Design of Limit Gauges: Elements, types and application of limit gauges, Gauge materials, their selection, Taylor's principles of gauge design, Types and methods to provide gauge tolerances. Design steps and design of plug & ring / snap gauge for given dimension and application.

Text Books:

1. Donaldson. C, Tool Design, Tata McGraw-Hill, 1986
2. "ASTME Handbook of Fixture Design ".Prentice Hall of India Pvt. Ltd.
3. Basu, Mukherjee, Mishra, Fundamentals of Tool Engg. Design, Oxford & IBH Publishing, N. Delhi

References:

1. A. K. Goroshkin, " Jigs and Fixtures Handbook ", Mir Publishers, Moscow, 1983.
2. "Die Design Handbook ", IvanaSuchy, McGraw Hill Book Co., 2005.
3. Production technology, HMT,Tata McGraw Hill.
4. P. Eugene Ostergaard, "Basic Die Making" - McGraw Hill Book, 1963.
5. Principle of Machine Tool. Sen& Bhattacharya,New Central Book Agencies, 1975.
6. Production tooling equipments,S. N. Parsons,Macmillan, 1966.

ME 4106 ELECTIVE-IV (A) INSTRUMENTATION AND CONTROL SYSTEMS

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 4 Th Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

Instrumentations: Concepts of measurements, static performance, characteristics accuracy of measurement and its analysis. Instrumentation, for measurement: Force, torque, strain. pressure, flow, temperature and vibration.

Optical Methods of Measurement: Introduction, Laser beam as a light pointer, length/displacement measurement, temperature sensors, seismographic measurement.

Introduction to fiber optics, fiber types, properties of optical fibres and a fibre optic sensor configuration.

Introduction: Control systems, Feedback and its effects. Transfer Function, Block Diagram and Signal Flow Graph: Impulse response and Transfer functions of linear systems, Block diagrams.

Mathematical Modeling of Physical Systems: Equations of electrical networks, Modeling of mechanical system elements, Equations of mechanical systems. State-variable Analysis of Linear Dynamic Systems: Matrix representation of state equations, State transition matrix, State transition equation, relationship between state equations and high-order differential equations, relationship between state equations and transfer functions, Characteristic equation, eigen values and eigen vectors.

Time-Domain Analysis of Control Systems: Typical test signals for the time response of control systems, Time- domain performance of control systems- The steady- state error, Time-domain performance of control systems- Stability of control systems- stability, Characteristic equation and the state transition matrix, Methods of determining stability of linear control systems, Routh- Hurwitz criterion.

Frequency-domain Analysis of Control Systems: Introduction, Nyquist stability criterion, Application of the Nyquist criterion, Stability of multi loop systems, Stability of linear control systems with time delays.

Text Books:

1. Automatic Control Systems, by Benjamin C. Kuo.
2. Mechanical Measurements, by R.S.Sirohi, H.G. Radha Krishna, Wiley Eastern, New Delhi.

References:

1. Experimental Methods for Engineers, by J.P.Holman, McGraw-Hill.
2. Instrumentation for Engineering Measurements, by R.H. Cerni and L.E.Foster, J.Wiley& Sons, New York.

3. Mechanical and Industrial Measurement, by R.K.Jain, Khanna publishers, Delhi.
4. Control Systems Engineering by Nagrath/Gopal ,New age international.

ME 4106 ELECTIVE-IV (B) SUPPLY CHAIN MANAGEMENT

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 4 Th Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

COURSE OBJECTIVES:

1. Supply Chain Management involves the flows of materials and information among all of the firms that contribute
2. Value to a product, from the source of raw materials to end customers. We will integrate issues from finance (investments in productive assets), marketing (channels of distribution), logistics, and operations management to
3. Develop a broad understanding of a supply chain. By taking a strategic perspective, we will focus on relatively
4. long term decisions involving the investment in productive resources, configuration of processes, product
5. Designs and development of partnerships with suppliers and channels of distribution.
6. Although the development of analytical tools is not the primary objective of the course, students should be
7. Comfortable with quantitative analysis. By the end of the course, you should have enhanced your ability to use
8. Analytical tools and conceptual frameworks to make decisions in supply chain contexts as well as a better
9. Understanding of the major strategic issues and trade-offs that arise in supply chain management

COURSE OUTCOMES:

1. Provide students with the requisite knowledge and skills to design and manage Supply chain. Analyse and improve the supply chain performance.
2. Align appropriate supply chain strategies with product characteristics.
3. To engage students in case studies based on real world logistics and supply chain decisions.
4. Acquaint the student with various Supply Chain Strategies; the differences between efficient and responsive supply chains and the correct strategies to use based on product type and location in the product life cycle.
5. Causes of Bullwhip Effect by playing a version of the well known "Beer Game" simulation.
6. The student will be able to explore three fundamental design concepts: component commonality, modularity vs. integral design, and universality, and a cost/benefit framework

7. Learn process improvements such as postponement, mass customization, re sequencing production operations, and shifting the push-pull point; these design changes can significantly improve the performance of your supply chain.
8. Understand the importance of technology in supply chain optimization

SYLLABUS:

Role of supply chain management in Economy and Organization- Introduction to SCM, Evolution, Key concepts, Decisions and Importance of SCM.

Supply chain strategy and Performance Measures- Competetive supply chain strategies, CRM strategy, Supplier relationship strategy- Performance Measures (Financial, Productivity, Quality and cycle time).

Supply chain drives- Introduction, Facilities, Inventory, Transportation and Information.

Supply chain design- Network design and operation models.

Sourcing and Transportation- Role of sourcing, Supplier selection and contracts, Procurement process, Role of Transportation, Design options for transportation network.

Planning and Managing Inventories-Introduction, cycle/safety/seasonal stock, Inventory for short life cycle products, Multi echelon inventory.

Information Technology in SCM- Role of IT, E-business and future trends.

Supply chain innovations- Introduction, Supply chain integration, Restructuring, Agile supply chains.

References:

1. Supply chain management text and cases: Janat Shah, Pearson Education, 2009.
2. Supply chain management strategy, planning and operation, Sunil Chopra, Peter Meindl, PHI.
3. Supply chain management: Chopra, Pearson Education, 2009.
4. Business logistics/ Supply chain management, 5/e: Ballou, Pearson Education.

ME 4106 ELECTIVE-IV (C) POWER PLANT ENGINEERING

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 4 Th Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

COURSE OBJECTIVES:

1. Students will learn the applications of basic thermodynamic cycles in power plant engineering
2. Student, will be exposed to different types of conventional, non-conventional, renewable and non- renewable energy power plants
3. Students will also be exposed to economics involved in power plant engineering

COURSE OUTCOMES:

1. Students will understand the working of different types of power plants and this exposure can help them during industrial visits to any power plant
2. Theoretical exposure and industrial visits can help the students to take up projects in power plant engineering
3. Theoretical and industrial exposure can aid them in fetching job opportunities in power plants

SYLLABUS:

Introduction : Definition – Objectives of production Planning and Control – Functions of production planning and control – Types of production – Organization of production planning and control department.

Forecasting : Importance – Types of forecasting– Forecasting techniques – qualitative methods and quantitative methods.

Inventory management : Functions of inventories – relevant inventory costs – EOQ model – Inventory control systems – ABC analysis – VED analysis

Material Requirement Planning, Bill of material, MRP II, Master Production Scheduling.

Aggregate planning,: Chase planning, Expediting, controlling aspects.

Routing : Definition – Routing procedure –Route sheets — Factors affecting routing, procedure – Difference with loading

Scheduling: Policies – Types of scheduling- Forward and Backward Scheduling – Gantt Charts – Flow shop Scheduling – n jobs and 2 machines, n jobs and 3 machines – Job shop Scheduling – 2 jobs and n machines – Line of Balance.

Dispatching : Activities of dispatcher – Dispatching procedure – follow up – priority rules for dispatching jobs.

Applications of computer in production planning and control.

Text Books :

1. Elements of Production Planning and Control / Samuel Eilon.
2. Modern Production/ operation managements / Baffa&RakeshSarin

References :

1. Operations Management – S.N. Chary.
2. Inventory Control Theory and Practice / Martin K. Starr and David W. Miller.
4. Production Control A Quantitative Approach / John E. Biegel.
5. Operations Management / Joseph Monks.

ME 4106 ELECTIVE-IV (D) CONDITION MONITORING

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 4 Th Ses. : 30 Exam : 70

Examination (Theory): 3hrs. Credits : 4

Introduction: Failures – System, Types of failures, Causes of failures, Maintenance Schemes – objectives – types and economic benefits, break down, preventive, predictive and Reliability monitoring.

Vibration Monitoring: Basic vibration theory, vibration measurement and analysis, machine vibration; Rotational machine faults and vibration characteristics. Applications of vibration monitoring to rotating machines. Vibration monitoring in practice - overall vibration monitoring and experience based spectrum analysis to detect machine condition and faults in bearings and gears. Current diagnostic techniques/tools commercially available, Commonly witnessed machinery faults diagnosed by vibration analysis.

Thermal Monitoring: Introduction to thermal monitoring; thermal monitoring techniques, application of thermal monitoring to manufacturing processes. Thermal imaging camera, and its application as a condition monitoring tool.

Lubricant analysis/monitoring: Introduction to tribology - lubricant types and their properties. Introduction to wear debris monitoring; collecting and quantifying wear debris; wear debris and oil analysis in practice.,SOAP, Ferrography and other spectrometric analysis techniques for wear rate evaluation and interpretation.

Sensors for condition monitoring: Accelerometers, strain gauges, eddy current probes and LVDT for measurement of displacement, velocity and acceleration. Lock in amplifier for signal conditioning. Thermocouples, thermistors, resistance thermometers and junction semiconductor devices for temperature measurement.Radiation pyrometers for temperature measurement, Thermal imaging devices.

Data acquisition and Analysis for condition monitoring: Fourier analysis and FFT, Sampling, Shannon's theorem, Analogue to digital conversion. Static characteristics of signals including mean, standard deviation, skewness and kurtosis, probability density function, power spectral density and autocorrelation.

Electrical Condition Monitoring: Overview of electrical plant and how the interaction of inherent stresses causes degradation of plant Components and affects equipment operation; Electrical contact methods for assessing electrical plant condition; Acoustic measurement of electrical plant condition; RF/UHF assessment of electrical plant condition; Chemical methods of assessing electrical plant condition

References

1. Rao J. S., Vibration Condition Monitoring, Narosa Publishing House, 2/e 2000.
2. Isermann R., Fault Diagnosis Application, Springer-Verlag Berlin, 2011.
3. Allan Davis, Hand book of Condition Monitoring, Chapman and Hall, 2000.
4. Choudary K K., Instrumentation, Measurement and Analysis, Tata McGraw Hill.
5. Collacott, R. A., Mechanical Faults Diagnosis, Chapman and Hall, London, 1990
6. Collacot R.A.- Mechanical fault diagnosis and condition monitoring
7. Hunt, T.M., (1993), Handbook of wear debris analysis and particle detection in liquids, Elsevier applied science, London and New York
8. Rao, B. (1996), Handbook of condition monitoring, Elsevier advanced technology, Oxford.
9. A Davis – Handbook of condition monitoring.
10. P Girdhar – Machinery vibration analysis and predictive maintenance
11. R G Eisenmann et-al – Machinery malfunction diagnosis and correction
12. John S Mitchell – Machinery analysis and monitoring
13. Mechanical Vibrations Practice with Basic Theory by V. Ramamurti, Narosa Publishing House.
14. Machinery Condition Monitoring: Principles and Practices *by* A. R. Mohanty (ISBN: 9781466593046, CRC Press, 2014)
15. NPTEL II Video Lectures: Machinery Condition Monitoring and Signal Processing *by* A R MOHANTY (NPTEL, 2013)

ME 4107 HEAT AND MASS TRANSFER LAB

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 3 Lab Ses. : 50 Exam : 50

Examination (Theory): 3hrs. Credits : 2

COURSE OBJECTIVES:

- Students have to be exposed to practical applications of various modes of heat transfer
- Studentshave to learn how to use measuring instruments related to heat transfer studies
- Students have to be exposed to latest equipment's related to heat transfer studies
- Students have to learn various experimental/analytical methods of evaluating parameters related to heat transfer studies

COURSE OUTCOMES:

- Students will learn applications of heat transfer in real time applications
- Students will have hands on experience of handling various equipment's used in heat transfer studies
- This exposure will help students to undertake projects related to heat transfer studies

LIST OF EXPERIMENTS:

1. Study of conduction phenomena in the composite slab system.
2. Determination of emmissivity, time constant, FouriesBiot module and study of variation of temperature with respect to time on a circular disc.
3. Study of heat transfer by forced convection through a horizontal test section.
4. Study of heat transfer by forced convection through a vertical test section.
5. Determination of free convective heat transfer coefficient from a horizontal cylinder in air.
6. Determination of thermal conductivity of brass employing it as a fin.
7. Tests on natural convection and pool boiling.
8. Study of forced convection with turbulence promoters.
9. Study of condensation on fin.
10. Tests on film condensation.
11. Determination of COP of a vapour compression refrigeration system.
12. Study of vapour compression air conditioning system.

ME 4108 FMM LAB

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 3 Pr. Ses. : 50 Exam : 50

Examination (Practical): 3hrs. Credits: 2

List of Experiments:

1. Calibration of flow meters,
    a. Venturi meter
    b. Orifice meter
    c. Nozzle meter
2. Determination of coefficient of discharge for
    a. small orifice
    b. cylindrical mouth piece
3. Finding coefficient of discharge for
    a. rectangular notch
    b. triangular notch
    c. trapezoidal notch
4. To draw the performance characteristics of C.F. pump.
5. To find the specific speed of
    a. Pelton turbine
    b. Francis turbine
6. To draw the characteristic curves for reciprocating pump.
7. To draw the pressure distribution and finding coefficient of drag for
    a. a bluff body
    b. an Aero foil
8. To draw the characteristic curves for the hydraulic ram.

ME 4109 CAD/CAM LAB

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : 3 Lab Ses. : 50 Exam : 50
Examination (Theory): 3hrs. Credits : 2

COMPUTER AIDED DESIGN LAB

COURSE OBJECTIVES:

1. Introduction to AUTOCAD package in design and drafting of the different parts by using computer aided modelling.
2. Develop the design skills of the students to practice the different 2D/3D engineering drawings.
3. Application of CAD packages to solving the simple problems in modeling and analysis.
4. Motivation of the students towards the good position in automated and software industries as a design engineer.

COURSE OUTCOMES:

1. Students will be able to know to produce the industrial drawings by using CAD/CAM software's.
2. After successful completion of this laboratory student can do the job in CAD/CAM industry as a design engineer.

CAD experiments:

1. Initiating the graphics package; Setting the paper size, space; setting the limits, units; use of snap and grid commands.
2. Drawing of primitives (line, arc, circle, ellipse, triangle etc.)
3. 3D GEOMETRIC MODELING:Creation of 3D Models,Wire Frame, Surface, Solid modeli ng Techniques Using CAD Packages – CSG, B-Rep Approaches in Solid Modeling Feature Based Modeling Technique – Assembly – Detailing Exposure to Industrial Components – Application of GD&T
4. Drawing a flange.
5. Drawing a Bushing assembly.
6. Dimensioning the drawing and adding text.
7. Setting the layers and application of the layers.
8. Isometric and orthographic projections.
9. Viewing in Three dimensions.
10. Removal of hidden lines - Shading and rendering.

CAM experiments:

1. Preparation of manual part programming for CNC turning/Milling.
2. Part programming preparation through AutoCAD.
3. APT part programming for 2D - contour.
4. Machining of one job on CNC machine tool.
5. Robot programming through Teaching Box method.
6. Robot programming through computer.

SECOND SEMESTER

ME 4201 PROJECT

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : ---- Ses. : 50 Exam : 50

Examination (Theory): ---- Credits : 14

ME 4202 MOOCS-III

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : ---- Ses. : 50 Exam : 50

Examination (Theory): 3hrs. Credits : 2

ME 4203 MOOCS-IV

(Effective from the batch admitted during 2015-2016- CBCS)

Periods/week : ---- Ses. : 50 Exam : 50

Examination (Theory): 3hrs. Credits : 2