SCHEME OF INSTRUCTION & EXAMINATION
AICTE Model Curriculum
B. E. V – Semester (MECHANICAL ENGINEERING)
(Proposed for the Academic year 2020-2021)

S. No.	Course Code	Course Title	Scheme of Instructions				Scheme of Examination			Credits
			L	T	P/D	Contact Hours/Week	CIE	SEE	Duration in Hours	
Theory Course										
1	PC408ME	Hydraulic Machines	3	-	-	3	30	70	3	3
2	PC409ME	Design of Machine Elements	3	-	-	3	30	70	3	3
3	PC410ME	Dynamics of Machines	3	-	-	3	30	70	3	3
4	PC411ME	Metrology and Instrumentation	3	-	-	3	30	70	3	3
5	PC412ME	Heat Transfer	3	-	-	3	30	70	3	3
6	PE51ME	Professional Elective-I	3	-	-	3	30	70	3	3
Practical / Laboratory Course										
7	PC455ME	Thermal Engineering Lab-2	-	-	2	2	25	50	3	1
8	PC456ME	Dynamics of Machines Lab	-	-	2	2	25	50	3	1
9	PC457ME	Fluid Mechanics and Hydraulics Machinery Lab	-	-	2	2	25	50	3	1
Total										**21**

Professional Elective-I		
S. No.	**Course Code**	**Course Title**
1	PE511ME	CAD/CAM
2	PE512ME	Automobile Engineering
3	PE513ME	Industrial Engineering

MC: Mandatory Course **BS**: Basic Science **ES:** Engineering Science
L: Lecture **T**: Tutorial **P**: Practical **D**: Drawing
CIE: Continuous Internal Evaluation **SEE:** Semester End Examination (Univ. Exam)

Note:
1. Each contact hour is a clock hour
2. The duration of the practical class is two hours, however it can be extended wherever necessary, to enable the student to complete the experiment.

HYDRAULIC MACHINES

PC408ME

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits : 3

Objectives:

It is intended to make the students to
1. The purpose of this course is to learn the Fluid properties and fundamentals of Fluid statics and fluid flow
2. To introduce the concepts of flow measurements and flow through pipes
3. To introduce the concepts of momentum principles
4. To impart the knowledge on pumps and turbines.

Outcomes:

After completing this course, , the student is able to
1. Apply conservation laws to fluid flow problems in engineering applications
2. Design and analyze the performance of the reciprocating pumps
3. Design, estimate the unit quantities and specific parameter of centrifugal pumps
4. Design, working of various types of turbines and could draw the characteristic curves of turbines
5. Estimate the performance of various hydraulic equipment and systems and design with Hydraulic power controls and fluidics

Unit-I
Hydraulic Machines: Classification – Impulse momentum equation – Layout of hydraulic power plant – Working principle – Impact of jets on Flat & Curved plates – Force exerted by a jet striking on a i) Fixed:-flat, Curved plates (Symmetrical & Unsymmetrical) ii) Moving:- Flat & Curved plates (Symmetrical & Unsymmetrical).
Unit-II:
Reciprocating Pumps: Classification, working principle-single and double acting pumps – discharge, work done and power required to drive the pumps-slip, % slip and negative slip variation of pressure head in the suction and delivery pipes due to acceleration of piston – variation of pressure head due to friction in the suction and delivery pipes. Indicatior diagrams – Ideal and actual diagrams. Effect of piston acceleration and pipe friction on indicator diagram – Maximum speed at which the pump must run to avoid separation during suction and delivey strokes – Air vessels – Function of air vessels – Work saved by fitting air vessels to single and double acting pumps – Discharge of liquid into and out of air vessels – Performance characteristic curves.
Unit-III
Centrifugal Pumps: Classification - Working principle – Comparison over Reciprocating pumps, Velocity triangles, Manometric head – Work done per second – Head equivalent of work done – Manometric, Mechanical and Overall efficiencies – Pressure rise in the impeller. Minimum starting speed – Physical significance of specific speed – Model testing – Conditions of similarity of CF pumps – Priming – Performance characteristic curves – Troubles (operational difficulties), reasons and remedies in CF pumps – Cavitation – Effects of cavitation – Precautions against cavitation
Unit-IV
Hydraulic Turbines: Classification of impulse and reaction turbines – Construction and working of Pelton wheels, Francis turbine and Kaplan turbine – Velocity triangles – Work done (power developed) – Hydraulic, Mechanical and Overall efficiencies – Maximum efficiency – Comparison between Impulse and Reaction turbines - Comparison between

Francis and Kaplan turbines –Specific speed – Physical significance of specific speed – Unit quantities – Draft tubes – functions and types of draft tubes – Surge tanks functions and types of surge tanks – Performance characteristic curves
Unit-V
Industrial Hydraulics: Basic components of hydraulic circuits; Properties and types of hydraulic oils, Working principles of external pumps – gear, lobe, vane, radial piston and axial piston. Specification of D.C. valve: Working of – flow control, pressure relief, pressure relief, pressure reducing and sequencing valves; Symbolic representation of various components; Working of various servo systems – hydro mechanical, hydraulic – hydraulic, electro-hydraulic; Construction details of oil reservoir and selection criteria for pumps.

Suggested Reading:

1. Bansal, R.K. “A text book of Fluid Mechanics and Hydraulic Machines” Laxmi Publication (P) Ltd., New Delhi, 2004.
2. Modi, P.N. and Seth, S.M. “Hydraulic and Fluid Machines”, Standard Book House, New Delhi, 2004. 3. Ramamrutham, S., “Hydraulics, Fluid Mechanics and Fluid Machines”, Dhanpat Rai & Sons, New Delhi, 2004.
3. Kumar, D.S., “Fluid Mechanics and Fluid Power Engineering”, S.K. Kataia & Sons, 2008.
4. Majumdar, S.R., “Oil Hydraulics Systems – Principles and Maintenance” , Tata-McGrawhill, New Delhi, 2004.

DESIGN OF MACHINE ELEMENTS

PC409ME

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits : 3

Objectives:

1. Importance of codes, materials, manufacturing process in design of mechanical components
2. Importance of theories of failure and effects of fatigue and stress concentration on the life of the component
3. Learn the concepts required to design machine components like keys, shafts, couplings
4. Will learn to determine size of rivets, welds and cotter joints for specific applications
5. Will Understand the concepts used for designing machine components like cotters, bolts, nuts

Outcomes:

1. Identify & Use codes and standards, selection proper material & perform static design.
2. Analyze cyclic loading conditions and provide fatigue design of components
3. Analyze machine elements like keys, shafts and couplings,
4. Evaluate various joining techniques like welding, riveting and cotter joints.
5. Synthesize an d design screw threads for fasteners and power screw applications.

Unit-I
Introduction: Materials used in Machine design, General Classification and Procedure in Machine design, preferred numbers, Review of type of loads and stresses. Stresses due to Bi-axial and Tri-axial loads, Factor of Safety, Stress concentration, Theories of failures for Bi-axial stress system, Fluctuating stresses, Fatigue strength, Notch sensitivity, Factor effecting fatigue strength, Gerber's, Soderberg's and Goodman's diagrams for fatigue design, Cumulative fatigue damage.
Unit-II:
Shafts: Introduction, Types of Shafts, Shafts subjected to twisting moment only, bending moment only, combined twisting & bending moment, axial loads in addition to combined twisting & bending moment and fluctuating loads. Keys: Introduction, Types of keys, Forces acting on sunk keys, Strength of a sunk key, Effect of keyways on shafts.
Unit-III
Couplings: Introduction, Types of Couplings, Rigid couplings-Muff, Spilt Muff, Flange and Flexible couplings- Bushed–pin. Cotter and Knuckle joints: Introduction, Type of Cotter joints, Design of Socket and Spigot Cotter joints, Sleeve Cotter joints and Knuckle joints.
Unit-IV
Riveted joints: Introduction, Type of Riveted joints, Terms used in Riveted joints, Caulking and Fullering, Failures of a Riveted joints, Efficiency of a Riveted joints, Design of Boiler joints and Lozenge joint, Riveted joints under eccentric loads. Welded joints: Introduction, Type of Welded joints, Strength of Transverse, Parallel and

Circular Fillet Welded joints, Strength of Butt joints, axially loaded Unsymmetrical sections Welded joints, eccentrically loaded Welded joints.
Unit-V
Screwed joints: Introduction, Type of Screwed joints, Locking devices, Stresses in Screwed joints due to static loads, Bolts of uniform strength, Bolted joints under eccentric loading. Power screws: Introduction,Design of a Screw Jack, Differential and Compound screws

Suggested Reading:

1. V. B. Bhandari, "Design of Machine Elements", Tata McGraw-Hill Publ, 3rd Edn. 2010.
2. J.E. Shigley & Charles R. Mischke "Mechanical Engineering Design", Tata McGraw-Hill.,6th ed.2010.
3. P. Kannaiah, Machine Design, Sci-Tech Publ., 2009.
4. P.C. Sharma & D.K. Aggarwal, "Machine Design", S.K. Kataria & Sons, 10th edn, 2003
5. V. B. Bhandari, "Design Data Book " 2nd edition, ", Tata McGraw-Hill Publ, 2019

DYNAMICS OF MACHINES

PC410ME

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits : 3

Objectives:

1. To know effect of inertia of links, and external forces on the input torque, and forces developed at joints in typical mechanisms in motion; understand the gyroscopic couple and its effect on vehicles inmotion.
2. To know the working principles and characteristics of typical governors, as also the function of flywheels.
3. To know the concept of unbalancing rotating and reciprocating masses in single and multi-cylinder in line and radial engines.
4. To understand the phenomena of free of free and forced, including the effect of damping for single dof systems, and concepts of isolating vibration.
5. To determine natural frequencies of undammed, damped and forced vibrating systems of one, two and multi degree freedom systems

Outcomes:

1. Analyse static and dynamic forces in slider crank and other mechanisms; determine the magnitude of gyroscopic couple and its effect on vehicles in motion.
2. Evaluate the performance of various types of governors and design flywheels considering speed and energy fluctuation
3. Analyse problems of balancing in rotating and reciprocating machinery.
4. Evaluate the natural frequencies of single and two degree of freedom systems in free and forced vibration mode, also considering the effect of damping.
5. Determine the natural frequencies and mode shapes of multi degree of freedom systems, including byDunkerley, Raleigh and Holzer methods.

Unit-I
Static and Dynamic Force Analysis: Static equilibrium: Constraint and Applied forces, Static Force analysis of Single slider crank mechanism without Friction and four bar mechanism. Dynamic Equilibrium: d'Alambert's Principle, Dynamic force Analysis of Slider Crank Mechanism. Engine Force Analysis: Piston effort ,Force along connecting rod, thrust on sides of cylinder, crank effort. Thrust on bearing. Dynamically Equivalent System for Connecting Rod. Gyroscope: Gyroscopic Couple, gyroscopic effects on aeroplanes, naval ships. Stability of two wheeler and four wheeler.
Unit-II:
Flywheels: Turning Moment Diagrams for different engines, Functions of flywheel, Differences between flywheel and governor, turning moment diagrams, flywheel analysis for I-C Engines and shearing/punching/riveting machines. Governors: Working principle of governor, Classification & types of governors, analysis of Watt, Porter, Proelland Hartnell governors. Characteristics of governors:Controlling Force, Stability, Isochronism, Sensitivity, Powerand Effort of governors.
Unit-III
Balancing: Static balancing, Dynamic balancing, balancing of several masses rotating in several planes, balancing of reciprocating masses, primary balancing shaking forces in single

cylinder engine, partial balancing and its effects, secondary balancing. Balancing of locomotives, hammer blow, variation of traction effort and swaying couple
Unit-IV
Vibrations: Vibrations of Single degree freedom system (axial, transverse and torsional),,Stepped shaft,Whirling speed of shafts. Damped Vibrations: Types of damping, Vibrations with viscous damping, damping factor and logarithmic decrement. Forced Damped Vibrations: Magnification factor, Resonance, Vibration isolation and Transmissibility
Unit-V
Torsional Vibrations of Two rotor, three rotor and Geared systems. Natural frequencies of two degree freedom systems Modes of vibration approximate methods for determining natural frequencies: Dunkerley's method, Rayleigh's method.

Suggested Reading:

1. S.S. Rattan, Theory of Machines, Tata McGraw-Hill, 3rdEdition,2009.
2. J. E. Shigley, Theory of Machines and Mechanisms, McGraw-HillPublications,2005.Thomas Bevan, Theory of Machines, PearsonEducation
3. Norton RL, Kinematics and Dynamics of Machinery, McGraw-HillPublications
4. Amitabha Ghosh and Ashok Kumar Mallik, Theory of Mechanisms and Machines, East West Press Pvt.Ltd,2008
5. Thomas Bevan, the Theory of Machines, CBS Publishers & Distributors, 2004.
6. J.S. Rao and Gupta, Theory and Practice of Mechanical Vib rations, Prentice Hall, 1984.

METROLOGY & INSTRUMENTATION

PC411ME

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits : 3

Objectives:

The objectives of this course is to impart knowledge of
1. To familiarize with Limits & fits, I.S.O. system and the instruments used to measure these limits.
2. To have knowledge of various precision linear and angular measuring instruments.
3. To learn the importance of form and how to measure form errors.
4. To understand the working principles of various instruments used for the measurement of strain, forces, pressure, temperature and vibrations.

Outcomes:

After completing this course, the student will be able to:
1. To understand limits, fits and tolerances and their applications. Linear and angular measurements and measuring instruments.
2. To understand the design of limit gauges, evaluate roughness and its measurement.
3. To understand basic measuring system, static and dynamic characteristics of instruments
4. To understand various principles to measure pressure, temperature, displacement, force, torque and vibrations.

Unit-I
Introduction to Engineering Metrology, Role of metrology in quality assurance, Linear and Angular measurements – Slip gauges and End bars – Gauge material and manufacturing methods, Different types of Micrometers, Height gauges, Tomlinson gauges. Precision polygon, Sine bar, Auto collimator. Limits and Fits, ISO system: Types of interchangeability Taylor's Principle or plain limit gauges, Use of Plug, Ring and Snap gauges. Indicating type limit gauges.
Unit-II:
Comparators: Dial indicator, Sigma and Mechanical comparator, free flow and Back pressure type Pneumatic comparator. Optical projector, Chart gauges, screen gauges and measuring methods.Tool maker's Microscope applications. Form measurements – Measurement of Straightness and Flatness. Roundness measurement with bench centers and talyrond, Coordinate Measuring Machine in complex geometries.
Unit-III
Surface Roughness Measurements, Profilometer, Taylor Hobson Talysurf. Application of Thread metrology - 2 wire, 3 wire method and best wire methods, Gear measurement - Gear tooth thickness, Parkinson gear tester, General geometric tests for testing machine tools – Lathe, drill and Mill.
Unit-IV
Elements of instrumentation system. Static and Dynamic characteristics. Instrument types - zero, first and second order instruments, Types of errors. Displacement transducers. LVDT. Strain measurement -Wire and foil type resistance strain gauges. Rosette Gauges. Bonding procedure. Lead resistance compensation. Adjacent arm and self-compensating gauges.

Proving ring. Strain gauge load cells, measurement of axial load and torsion by strain gauges. Piezo-electric load cell.
Unit-V
Introduction to Seismic Transducers -displacement and acceleration measurement, Pressure measurement -Bourdon pressure gauge, bulk modulus gauge, pirani gauge, Temperature measurement by thermo couples. Laws of thermo electricity. Types of materials used in thermocouples. Protection tubes. Extension wire. Series and parallel circuits. Ambient temperature compensation.

Suggested Reading:

1. I.C. Gupta – "Engineering metrology", Dhanpat Rai Publications, New Delhi.
2. Rega Rajendra, "Principles of Engineering Metrology", Jaico Publishing House, Mumbai.
3. RK Jain, "Engineering Metrology", Khanna Publications, 1996.
4. Doeblin,"Measurement Systems Application and Design", Tata Mc¬Graw Hill,5th ed., 2004.
5. Beckwith, Buck, Lienhard, Mechanical Measurements, Paerson education india.
6. P. Donald Echman, "Industrial Instrumentation", John Wiley and Sons, 1996.
7. Hume, "Engineering Metrology", Kalyani Publications, 1985.

HEAT TRANSFER

PC412ME

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits : 3

Objectives:

The objectives of this course is to impart knowledge of
1. The basic concepts of heat transfer.
2. The concepts of conduction, convection, radiation and heat exchangers applicable for commercial and industrial use.
3. The applications of various experimental heat transfer correlations in engineering applications.
4. Thermal analysis and sizing of heat exchanger.
5. solving problems on different modes of heat transfer which are related to thermal power plants, refrigeration and air conditioning

Outcomes:

After completing this course, the student will be able to:
1. To understand the basic concepts of heat transfer.
2. To understand the concepts of heat transfer through extended surfaces.
3. To Familiarize with time dependent heat transfer and compute convective heat transfer coefficients in forced, natural convection.
4. To understand radiation heat transfer
5. To understand , heat exchangers and mechanism involved in boiling and condensation.

Unit-I
Conduction: Modes of Heat Transfer, Laws of Heat Transfer - Fourier, Newton, Stefan-Boltzmann General conduction equation in cartesian, cylindrical and spherical coordinates, One dimensional steady state conduction through slabs, hollow cylinders and spheres with and without heat generation, Effects of variable thermal conductivity in heat transfer of one dimensional steady state conduction of plate, cylinders and spheres, Steady state heat transfer through composite slabs, cylinders and spheres, Critical radius of insulation.
Unit-II:
Fins: Heat transfer analysis of tips with heat dissipation environment - rectangular straight and pin fins, Application of fin to temperature measurement, unsteady state conduction, Lumped parameter, analysis of a body with negligible internal temperature gradients, Transient heat transfer analysis of finite slab with specified temperature and convective boundary conditions, Use of Grober and Heisler charts for solving problems of infinite slabs, cylinders and spheres.
Unit-III
Free and forced convection: Dimensional analysis and its use in free and forced convection, Buckingham theorem, Physical significance of different dimensionless numbers, Application of Von-Karman integral equation for the analysis of thermal

boundary layer in forced convection of flat plate, Reynold's analogy for flow over plane surfaces, calculation of heat transfer for flow over plates, cylinders, spheres and for flow through tubes in free and forced convection using empirical formulae.
Unit-IV
Radiation: Definition of absorptivity, reflectivity and transmissivity, Concept of black-body and emissivity. Kirchoffs law, Planck's black body spectral distribution, Wien's and Steffan Boltzmann law, Monochromatic and total emissive power, radiant heat exchange between two gray surfaces, Shape factor, Thermal circuit for radiant heat exchange between infinite parallel plates and between concentric, cylinders, Enclosures with black and gray surfaces, Radiation shields and re-radiation surfaces.
Unit-V
Heat Exchangers: Classification and applications of heat exchangers in industry, Analysis and design of counter flow and parallel flow heat exchanger, Fouling factors, solving problems for multi pass heat exchanger using non dimensional parameter plots. **Change of Phase:** Boiling-pool boiling regimes nucleate pool boiling, effect of surface wettability on bubble contact angle, Critical heat flux, boiling in forced convection, Condensation: Film condensation, Drop wise condensation, Condensation film thickness, Heat transfer coefficient in film condensation.

Suggested Reading:

1. Holman, J.P., "Heat Transfer", McGraw Hill Publication, New Delhi, 2010 2.
2. Rajput, R.K., "Heat and Mass Transfer", S. Chand & Company Ltd, New Delhi, 2004.
3. Yadav, R., Sanjay. and Rajay., "Heat and Mass Transfer ', Central Publishing House, Allahabad, 2004
4. Sachdeva,R.C., "Fundamentals of Engineering Heat and Mass Transfer ", New Age International (P) Ltd Publishers, New Delhi,
5. Arora, S.C. and Domkandwar., "A course in Heat and Mass Transfer ", DhanpatRai& Sons, New Delhi, 2004.

CAD/CAM

PE511ME

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits : 3

Objectives:

1. To introduce the concepts of CAD and advanced modeling techniques
2. To help the students in understanding the functioning of computer numerical control machine tools and also in writing programs for operating this machines.
3. To help the student in understanding advanced manufacturing concepts like Group technology, flexible manufacturing systems, Computer aided Process Planning, Computer aided quality control, Artificial Intelligence etc.

Outcomes:

The Students will be able to
1. Understand the fundamental applications of computer in design, manufacturing and geometric transformation techniques in CAD
2. Develop mathematical Model for curves, surfaces, solid models and understand the fundamental concepts of Finite Element Analysis
3. Write CNC Part program for manufacturing components
4. Understand the concepts of Machining Centres, adaptive control and as well as fundamentals knowledge of robotics
5. Understand the working of various components of an modern manufacturing systems

Unit-I
CAD Fundamentals, Product life cycle in conventional and computer-based manufacturing system, Hardware integration and networking. CAD Software: Definitions of system software and application software. Graphic Standards and Exchange Formats. CAD database and structure.
Unit-II:
Geometric modeling: 3-D wire frame modeling: wire frame entities and their definitions, Interpolation and approximation of curves, synthetic curves and curve fitting. Definitions of cubic, Bezier, and B-spline curves. Surface modeling: Definitions of basic surfaces, surface of revolution, blends, intersection, and Cubic, Bezier, B-spline surfaces. Solid Modeling: Solid entities, Boolean operations, B-rep and C-rep approaches. Feature based modeling: Concepts and applications, Assembly modeling.
Unit-III
Numerical Control of machine Tools: Features and elements of NC. Positional, paraxial and contouring types. Definitions of axes, punched type, formats of tape preparation. Definitions of interpolation, post-processor, preparatory and miscellaneous functions, canned cycles, tool length and cutter radius compensation. Manual and computer aided part programming (APT) for simple components. Programming with MACROS.
Unit-IV
CNC, DNC and adaptive control systems. Their types, typical configurations and relative features. Industrial Robots: Classification based on manipulator configurations, relative characteristics, Online and offline programming methods, controls and drives, applications.
Unit-V

Group Technology: Organization, G.T. layout, part classification and coding, CAPP: Variant and Generative approaches and their relative features. Computer Aided Quality Control: Computer in quality control, Contact and non-contact inspection, optical and non-optical computer aided testing, Experts systems. Artificial intelligence, CAD/CAM integration

Suggested Reading:

1. Ibrahim Zeid, "CAD/CAM, theory and practice", McGraw Hill Inc, N.Y.1991.
2. Grover, MP and Zimmers E.W., "CAD/CAM", Prenctice Hall of India 1989.
3. Rao P.N., Tiwari N.K., Kundra T.K., "Computer Aided Manufacturing", Tata McGraw Hill, New Delhi, 1993.
4. Radhakrishnan. P, Subramanyan. S, Raju. V, "CAD/CAM/CIM", New Age international (P) Ltd., 2nd Edn., 2004.

AUTOMOBILE ENGINEERING

PE512ME

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits : 3

Objectives:

The objectives of this course is to impart knowledge of
1. Understand the Working of Fuel, Ignition, and cooling Systems.
2. Understand the Working of Lubrication and Electrical Systems
3. Understand the Working of Suspension, Steering and Braking Systems.
4. Understand the Working of Power Transmission.
5. Understand the Necessity of Pollution Control and Maintenance.

Outcomes:

After completing this course, the student will be able to:
1. Generalize the different types of automobiles, list the engine components, describe the functioning of IC engines and classify the fuel supply system for S.I and C.I engines
2. Differentiate the types of lubrication system; identify different lubrication and cooling systems used in vehicles. Classify ignition system and describe the functioning of battery and automobile air conditioning system.
3. List the salient features of different steering mechanisms, describe the importance of wheel alignment and wheel balancing, describe the importance of different suspension systems and shock absorbers used in an automobile
4. Identify different components in power transmission system design a system, components, or process to meet desired needs with in realistic constrains such as economic, environmental, health and safety, describe about braking system
5. Adapt techniques, skills and modern engineering tools necessary to control the pollution, record the automobile parts maintenance, design and build components and system to reduce pollution of automobile vehicles

Unit-I
Types of automobiles: Normal, Hybrid and Hydrogen fuel vehicles. Engine location and its components, chassis layout, crank shaft proportion, firing order, piston and piston rings, cylinder liners, valves and operation mechanism, inlet and exhaust manifolds, carburetion and fuel injection system, mechanical fuel injection system & electronic fuel injection system.
Unit-II:
Lubricating systems: Wet sump, dry sump and petrol systems, and Cooling systems: Water pumps, radiators, thermostat control anti freezing compounds. Types of Ignition systems, modern ignition systems, types of batteries and charging systems, starting motors, lighting and electrical accessories, automobile air-conditioning.
Unit-III

Steering systems: Linkage arrangements and its components modified Ackerman linkage, wheel alignment, caster and camber. Rack and pinion assembly – recent trends Wheel and tyres: Tyre construction, specification. Tyre wear and causes, wheel balancing, types of suspension system, independent suspension coil and leaf springs, torsion bar, shock absorbers.
Unit-IV
Power Train: Clutches, gear and gearbox manual, semi-automatic and automatic gearboxes. Torque converter, propeller shaft, universal coupling differential, four-wheel drive system.Brake systems: Description and operation of hydraulic brake, leading and trailing shoe layout, disc brakes, master cylinder, hand brake linkage, recent trends.
Unit-V
Maintenance: Pollution control, trouble shooting and servicing procedure overhauling, engine tune up, tools and equipment for repair and overhaul, testing equipment, pollution control technologies used for petrol and diesel engines, types and study of catalytic converters, Euro norms 2 & 3 and Bharat Norms – recent trends.

Suggested Reading:

1. Crouse & Anglin, 'Automotive Mechanics' Tata McGraw Hill, Publishing Co., Ltd., New Delhi, Tenth edition - 2004..
2. Kirpal Singh, "Automobile Engineering", Vol I & II Standard Publishers, Delhi.
3. Joseph Heitner, 'Automotive Mechanics', Affiliated East West Pvt., Ltd.,
4. C.P. Nakra, "Basic Automobile Engineering", Dhanpat Rai Publishing Co.(P) Ltd., New Delhi, 2003

INDUSTRIAL ENGINEERING

PE513ME

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits : 3

Objectives:

1. To learn the concept of Management.
2. To understand role of Production Planning and Control in Industry.
3. To learn various material procurement policies.
4. To understand importance of quality control and various methods.
5. To interpret the role of Decision theory in Industry.

Outcomes:

After completing this course, the student will be able to
1. Explain various approaches for industrial management. Able to infer concept of management in human resource domain
2. Apply Philosophy of Production Planning and Control in Industry and control the activities in delivering the products in time
3. Determine the optimum requirement of inventory by developing the various quantitative models.
4. Develop various models or methods for ensuring the required quality of the products or processes.
5. Elaborate the role of Decision theory and apply various approaches under Uncertainty and Risk conditions

Unit-I
Management: Introduction to Management, Scientific Management, Systems approach to Management, MBO, and Decision Making Process. **Personnel Management:** Functions of personnel management, types of training, Job evaluation and Merit rating, Collective bargaining and labour participation in management.
Unit-II:
Production Planning & Control: Definition, Objectives, Importance and Functions of Production Planning & Control. **Production Control:** Routing, Scheduling, Dispatching, Follow-up and progress Report.
Unit-III
Inventory Control: Importance of inventory control, types of inventory models Inventory costs deterministic inventory models Basic EOQ models, production model without shortages, Purchase model with instantaneous replenishment and with shortages production model with shortages Inventory model with price breaks, Fixed order quality system, periodic review system Inventory model with probabilistic demand.
Unit-IV
Quality Control: Concept of quality, evolution of quality control, assignable and chance causes of variation, Variable Control charts (X and R charts) **Attributes control charts:** P chart and C chart

Acceptance Sampling – Single Sampling, Double Sampling and Multi sampling plans – OC curves of single
Unit-V
Decision Theory: Introduction, Decision, Decision Making & Decision Theory, Types of Decisions, decision making process, Types of Decision making Environment: **Decision making under Uncertainty**- Criterion of Optimism or Maximax, Criterion of Pessimism or Maximin, Minimax decision criteria **Decision making under Risk:** Expected Monetary Value(EMV), Expected Opportunity Loss (EOL) Criterion & Expected Value of Perfect Information(EVPI) Criterion **Decision Trees.**

Suggested Reading:

1. M.Mahajan, "Industrial Engineering and Production Management", Dhanpatrai& sons, New Delhi
2. S.K. Sharma and Savitasarma, "Industrial Engineering and Organization Management", SK Kataria& Sons, New Delhi.
3. S.D. Sharma, "Operations Research", Kedarnnath, Ramnath& Co., Meerut, 2009
4. S Kalavathi, "Operations Research", Vikas Publishing House Pvt. Ltd, 2009
5. V. K. Kapoor, "Operations Research", S. Chand, New Delhi.
6. SK Sharma &Savita Sharma," A course in Industrial Engineering & Operations Management", S K Kataria& Sons, 2008

THERMAL ENGINEERING LAB-II

PC455ME

Instruction: 2 periods per week *Duration of SEE: 3 hours*
CIE: 25 marks *SEE: 50 marks*
Credits : 1

Objectives:

1. Determining thermal conductivity of an insulating powder in composite slab or cylinder. The concepts of conduction, convection, radiation and heat exchangers applicable for commercial and industrial use
2. Evaluating the heat transfer coefficients under natural convection and forced convection phenomena Thermal analysis and sizing of heat exchanger.
3. determining the necessary constants pertaining to radiation
4. understanding the working principles of axial flow fan and its overall efficiency
5. estimating overall efficiency of a centrifugal compressors and pressure distribution over cylinder and an aerofoil section on turbo machines.

Outcomes:

After completing this course, the student will be able to:
1. Interpret the link between refrigeration effects, work done and COP of the system, describe different methods adopted to evaluate COP, list the different psychrometric processes and describe how those processes can be maintained
2. Calculate the overall efficiency of centrifugal blower and axial flow fan at different volume flow rates, show the variation of overall efficiency with load and speed graphically To understand radiation heat transfer, heat exchangers and mechanism involved in boiling and condensation.
3. Identify the various components of low speed wind tunnel, plot a graph showing variation of pressure over the entire length of aerofoil blade and also evaluate the lift and drag coefficient values for a given aerofoil blade at different angle of assign
4. Describe the modes of heat transfer, calculate thermal conductivity, heat transfer coefficient subjected to natural and forced convection environment and Stefan Boltzmann constant value of thermal radiation.
5. Express the working principle of heat exchangers and its application in real life, calculate the LMTD and effectiveness of a given heat exchanger for both parallel and counter flows.

List of Experiments:
1. Determination of thermal conductivity of metal bar
2. Determination of thermal conductivity of composite wall.
3. Determination of the efficiency of pin-fin subjected to natural and forced convection
4. Determination of effectiveness of parallel flow and counter flow heat exchanger
5. Determination of emissivity of given test plate
6. Determination of Stefan Boltzmann constant.
7. Determination of COP of the Air conditioning system
8. Determination of percentage relative humidity and study of humidification and

dehumidification process in Air Conditioning systems
9. Determination of COP of refrigeration systems using capillary tube/ thermostatic expansion valve
10. Determination of overall efficiency of centrifugal blower
11. Determination of overall efficiency of axial flow fan
12. Pressure distribution on symmetrical and non-symmetrical specimen in wind tunnel
13. Measurement of lift and drag force of the models in wind tunnel test section
14. Study of Nozzles.

Note: At least ten experiments should be conducted.

DYNAMICS OF MACHINES LAB

PC456ME

Instruction: 2 periods per week *Duration of SEE: 3 hours*
CIE: 25 marks *SEE: 50 marks*
Credits : 1

Objectives:

1. To understand the effects and importance of kinematic and dynamic analysis of mechanisms
2. To understand effects and analysis of Single degree freedom vibration systems
3. To study the gyroscope, governors and cams
4. To carry out the static and dynamic analysis of four bar mechanisms and drives

Outcomes:

1. Evaluate performance characteristics of centrifugal governors and compare their sensitivity
2. Estimate the Gyroscopic couple and its effect on a Precessing rotating member.
3. Determine the magnitude, location and orientation of a balancing mass required to balance the unbalance rotating system and verify the static and dynamic balancing.
4. Sketch the CAM profiles for different combinations of CAM and Follower and examine the operating speed limit for each combination.
5. Determine the time response of single and two-degree freedom systems with free and forced vibrations and evaluate the critical speed of the shaft.

List of Experiments
1. Centrifugal Governors: Experiment on Performance Characteristic Curves.
2. Estimation of Gyroscopic Couple & Understanding of Gyroscopic Effects on a rotating disc.
3. Static and Dynamic Balancing of Rotating Masses.
4. Determination of Moment of Inertia of Connecting Rod by compound pendulum method.
5. Damped and Undamped Torsional Vibrations of Single and Double Rotor System.
6. Single DOF (Degrees of Freedom) of Spring Mass Damper System. (Damped and Undamped Systems).
7. Free and Forced Vibration of Simply Supported Cantilever Beam.
8. Dunkerley Method to Find Fundamental Frequencies.
9. Critical Speed of Shaft Whirling.
10. Modal Analysis of Beam.
11. Cam Analysis of Cams.
12. Any Experiment explaining dynamic aspects of mechanical systems.
13. Determination of Moment of Inertia of Flywheel.
14. Experiment with Bifilar System.
15. Model analysis of disc.

Demonstration Experiments (Can't be allocated in final exams)
1. Velocity Ratios of Simple, Compound, Epicyclic and Differential Gear Trains.
2. Virtual Lab Experiment I – Governors.
3. Virtual Lab Experiment II – Natural Frequency of Cantilever beam.

Note: Minimum ten experiments should be conducted in the semester.

Suggested Reading:

1. S.S. Rattan, Theory of Machines, Tata McGraw Hill, 2010
2. John J.Uicker, J r. G o r d o n, R.Pennock, Joseph E.Shigley, Theory of Machines and Mechanisms, Oxford University Press, 2003.
3. Lab manual supplied by department.

FLUID MECHANICS & HYDRAULIC MACHINES LAB

PC457ME

Instruction: 2 periods per week *Duration of SEE: 3 hours*
CIE: 25 marks *SEE: 50 marks*
Credits : 1

Objectives:

Students able to understand
1. the working of pumps of different kinds and their behaviour.
2. the working of turbines of different kinds and their behaviour.
3. the theory of working of various flow measuring devices and their utility in industry.

Outcomes:

After completing this course, the student will be able to:
1. Practice and experiment on different types of turbines and analyse their performance at rated and off design conditions.
2. Investigate through experimentation different types of pump models and estimate their performance.
3. Apply the priniciple of different flow measuring instruments and their adoptability to the industry.
4. Develop the hydraulic circuits to cater the needs of the industry.

List of Experiments:
1. Performance and characteristic curves of Self Priming pump
2. Performance and characteristic curves of Centrifugal/ Submergible pump
3. Performance and characteristic curves of Reciprocating pump
4. Performance and characteristic curves of Gear pump
5. Impact of Jets on Vanes
6. Performance and characteristic curves of Pelton Wheel
7. Performance and characteristic curves of Francis Turbine
8. Performance and characteristic curves of Kaplan Turbine
9. To determine coefficient of discharge of venturi meter
10. To determine coefficient of discharge of orifice meter
11. Study of Hydraulic Circuits
12. Study of pneumatic Circuits