Scheme for Teaching & Examination											
B. Tech. - III (Mechanical) Fifth Semester											
Sr. No.	Course	Code	Teaching Scheme			Exam Scheme				Total Marks	Credits
						Theory		Tuto.	Pract.		
			L	T	P	Hrs.	Marks	Marks	Marks		
1	Dynamics of Machines	ME 301	3	1	2	2	100	25	50	175	5
2	Heat & Mass Transfer	ME 303	3	1	2	2	100	25	50	175	5
3	Fluid Machines	ME 305	3	1	2	2	100	25	50	175	5
4	Machining Processes	PR 301	3	1	2	2	100	25	50	175	5
5	Institute Elective – I*		3	0	0	2	100	-	-	100	3
	TOTAL		15	4	8		500	100	200	800	23
Total contact Hrs. per week (27) Total Credits =23 Total Marks = 800											

B. Tech. (MECHANICAL) Semester - 5	L	T	P	C
ME 301 DYNAMICS OF MACHINES	**3**	**1**	**2**	**5**

CO1	Understand the conditions of the static equilibrium and free body diagrams and analyze different types of governors
CO2	Utilize the knowledge of static and dynamic force analysis in existing mechanisms
CO3	Analyze and solve the effect of balancing for rotating unbalanced masses
CO4	Analyze and solve the effect of balancing for reciprocating unbalanced masses
CO5	Demonstrate the stability of automobile, naval ship and other related devices considering gyroscopic effect
CO6	Design and analysis of the flywheel considering turning moment diagram

- **INTRODUCTION** (**10 Hours)**
  Forces, couples, conditions of static equilibrium, free body diagrams, analysis of mechanisms, spur gears, worm gears.

- **DYNAMIC FORCE ANALYSIS** **(12 Hours)**
  Inertia forces, analysis of a floating link, rotation, method of virtual work. dynamic analysis of four-link mechanism, combined static and inertia force analysis of different mechanisms, turning – moment diagrams, fluctuation of energy, flywheels.

- **BALANCING** **(10 Hours)**
  Introduction, static balancing, dynamic balancing of several masses in different planes. Balancing of inline engines, V-engines, radial engines, balancing machines.

- **GOVERNORS** **(08 Hours)**
  Introduction, types of governors, sensitiveness of a governor, hunting, isochronisms, stability, effort and power of a governor, controlling force.

- **GYROSCOPE** **(05 Hours)**
  Angular velocity, angular acceleration, gyroscopic couple, gyroscopic effect on naval ships, stability of an automobile, stability of a two wheel vehicle.

(Total Lecture Hours: 45 + Tutorial Hrs: 15)

PRACTICALS

1. Slider crank mechanism
2. Four bar chain mechanism
3. Quick Return mechanism
4. Hooke's joint
5. Cam Mechanism
6. Balancing of rotors
7. Governors
8. Experiment on gear generation

BOOKS RECOMMENDED

1. Thomas Bevan, "Theory of Machines", CBS Publishers, New Delhi, 1984.
2. Rattan S.S., "Theory of Machines", Tata McGraw Hill, 2005.
3. Rao J. S. and Dukkipati R.V., "Mechanism and Machine Theory", Wiley Eastern, 1992.
4. Shigley J. E. and Uicker J.J., "Theory of Machines and Mechanisms", McGraw Hill, 1995.
5. Ballaney P. L., "Theory of Machines", Khanna Publishers, 1999.
6. Singh V. P., "Theory of Machines", Dhanpat Rai & Sons, 2001.

B. Tech. (MECHANICAL) Semester – 5	L	T	P	C
ME 303 HEAT & MASS TRANSFER	**3**	**1**	**2**	**5**

CO1	Apply appropriate mode of heat transfer while analyzing complex engineering problems.
CO2	Compute steady state and transient heat conduction problems in slab, cylindrical and spherical systems.
CO3	Explore various Nusselt number correlations for forced and free convection systems.
CO4	Calculate surface to surface radiative heat transfer in engineering systems.
CO5	Design the heat transfer equipment
CO6	Investigate the performance of heat exchanger using LMTD and NTU-effectiveness methods.

- **INTRODUCTION** **(02 Hours)**
  Modes of heat transfer, conduction, convection and radiation.

- **CONDUCTION** **(10 Hours)**
  Fourier's law. General three dimensional heat conduction equation in cartesion, cylindrical and spherical co-ordinates. One dimensional steady conduction through plane wall, cylinder and sphere. Heat source systems in plane wall and cylinder. Heat transfer from fins of uniform cross section. Two dimensional steady state conduction through plane wall. One dimensional unsteady state heat conduction.

- **CONVECTION** **(14 Hours)**
  Free and forced convection.
  - Forced Convection: Energy integral equation of the boundary layer on a flat plate and integral solution for evaluation of heat transfer from a fluid friction and heat transfer, Similarity conditions in heat transfer, processes, and dimensional analysis.
  - Free Convection from a vertical flat plate, Grashoff number, Empirical relations and their use. Fundamentals of boiling & condensation heat transfer.

- **RADIATION** **(08 Hours)**
  Thermal radiation, monochromatic and total emissive power. Basic laws of radiation. Radiation shape factors, black and grey surfaces, heat transfer in presence of re-radiating surfaces.

- **HEAT EXCHANGERS** **(06 Hours)**
  Basic types of heat exchangers, fouling factors, LMTD, Effectiveness – NTU methods of design.

- **MASS TRANSFER** **(05 Hours)**
  Fick's laws of diffusion, diffusion in dilute solutions in stationary media, one dimensional diffusion in gases with one component stationary. Convective mass transfer: Forced diffusion from a flat plate. Simulation of heat and mass transfer.

(Total Lecture Hours: 45 + Tutorial Hrs: 15)

PRACTICALS

1. Calibration of the thermocouple
2. Heat transfer through composite wall
3. Thermal conductivity of insulating powder
4. Heat transfer in Natural convection
5. Emissivity Measurement
6. Heat transfer in Force convection.
7. Determine the Stefan-Boltzmen constant
8. Heat transfer from pin fin
9. Determine LMTD, heat transfer rate and overall heat transfer coefficient of shell and tube type heat exchanger.

BOOKS RECOMMENDED

1. S.P. Sukhatme, “Heat Transfer”, Universities Press (India), 2005.
2. J.P. Holman, “Heat Transfer”, McGraw Hill, 2003.
3. E.R.G. Eckert and Robert M. Drake, “Heat and Mass Transfer”, McGraw Hill, 1996.
4. Chapman A.J., “Heat Transfer”, Macmillan, New York, 2000.
5. Kothandraman. C.P., “Fundamentals of Heat and Mass transfer”, New Age International, 2006.

B. Tech. (MECHANICAL) Semester – 5	L	T	P	C
ME 305 FLUID MACHINES	3	1	2	5

CO1	Illustrate selection and application of various hydraulic and steam turbines
CO2	Explain the working principles of hydraulic pumps, and predict performance curves
CO3	Describe the working principles of steam power cycles
CO4	Explain working principles of steam nozzle
CO5	Explore various steam condenser, and cooling towers
CO6	Describe basic principles of pumps, fans, blowers and compressor

- **IMPULSE TURBINES (08 Hours)**
  Working principle, impact of jet on vanes, construction details of Pelton wheel, classification, Specific speed, velocity triangles, various losses, performance characteristics curves, governing of impulse turbine, unit quantities and specific quantities.

- **REACTION TURBINES (07 Hours)**
  Working principle, construction details of Francis & Kaplan turbine, draft tube theory, cavitations, performance characteristic curves, governing of reaction turbine, unit quantities & specific quantities.

- **FLOW OVER THE IMMERSED BODIES (05 Hours)**
  Introduction, lift & drag, concept of stream line bodies & bluff bodies, flow over cylinder & aerofoil.

- **FANS AND BLOWERS (05 Hours)**
  Construction details, governing equation, losses, performance curves.

- **PUMPS (12 Hours)**
  Classification of different type of pump, principle of dynamic action & positive displacement type of pump, various parts of centrifugal pump & their function, theoretical analysis of energy transfer between fluid & rotor, losses, various efficiencies of the pump, performance characteristics, matching of pump & system characteristics, model analysis of centrifugal pump & specific speed, cavitation in pump & maximum suction lift, special purpose pumps

- **MISCELLANEOUS FLUID SYSTEMS (08 Hours)**
  Hydraulic accumulator, hydraulic intensifier, hydraulic crane, hydraulic ram, hydraulic lift, fluid coupling & torque converter.

(Total Lecture Hours: 45 + Tutorial Hrs: 15)

PRACTICALS

1. Performance test on Pelton Turbine
2. Performance test on Francis Turbine.
3. Performance test on Kaplan Turbine
4. Impact of jet on vanes
5. Performance test on centrifugal pump
6. Performance test on gear oil pump.
7. Performance test on jet pump
8. Performance test on hydraulic ram
9. Cavitation in fluid machines

BOOKS RECOMMENDED

1. Som S. K., Biswas. G., “Introduction to Fluid Mechanics and Fluid Machines”, McGraw Hill, 2006.
2. Lal Jagdish, “Hydraulic Machines”, Metropolitan, 2006.
3. Gupta Vijay and Gupta Santosh K., “Fluid Mechanics and its Applications”, New Age International, 2005.

4. Yahya S.M., “Turbines, Compressors and Fans”, Tata McGraw Hill, 2005.
5. Pillai Narayana N. and Ramakrishnan C. R. “Principles of Fluid Mechanics and Fluid Machines”, Universities Press (India), 2006.

B. Tech. (MECHANICAL) Semester – 5 (INST. ELECTIVE – I)	L	T	P	C
ME 309 APPLIED THERMODYNAMICS	3	0	0	3

CO1	Identify different steam power cycles and compute them.
CO2	Analyze different gas cycles and develop problem solving ability
CO3	Categories different refrigeration cycles and its performance
CO4	Implement exergy analysis for improving performance of system
CO5	Predict the combustion and its importance
CO6	Apply the thermodynamics relation to measure different parameters

- **STEAM POWER CYCLES (08 Hours)**
  Simple steam power cycle, Rankine cycle, Rankine cycle efficiency, Comparison of Rankine & Carnot cycles. Reheat cycle, Regenerative cycle, Reheat-regenerative cycle.

- **GAS POWER CYCLES (08 Hours)**
  Stiring cycle, Ericsson cycle, Otto Cycle, Diesel cycle, Dual Cycle, Brayton cycle, Air standard cycle for jet propulsions, Inter cooling, Reheating, Regeneration.

- **REFRIGERATION CYCLES (06 Hours)**
  Simple vapour compression cycle, Cycles with superheat & subcooling, Basic vapour absorption cycle.

- **EXERGY: A MEASURE OF WORK POTENTIAL (10 Hours)**
  Basic concepts, Available and unavailable energy for a cycle, Different form of exergy, Exergy balance for closed system and open system, Decrease of exergy principle, Difference between first law & second law efficiency, Second law efficiency for steady flow devices.

- **REACTIVE MIXTURE (COMBUSTION) (07 Hours)**
  Combustion equations, Stoichiometric air, Excess air, Air-fuel ratio by volume & weight, Enthalpy of formation, Enthalpy and internal energy of combustion, Adiabatic flame temperature, Equilibrium constants.

- **THERMODYNAMIC RELATIONS & EQUILIBRIUM (06 Hours)**
  The Maxwell relations, Clausis–clapeyron equation, Joule–Thomson coefficient, Relationships involving specific heats, enthalpy, entropy.

(Total Lecture Hours: 45)

BOOKS RECOMMENDED

1. Wylen Van, Sonnetag and Borgnakke, “Fundamental of Classical Thermodynamics”, John Wiley & sons, New York, 2005.
2. Cengel Yunus A. and Boles Michael A., “Thermodynamics”, Tata McGraw Hill, New Delhi, 2004.
3. Kothandaraman C.P., Khajuria P.R. and Domkundrar S., “A Course in Thermal Engineering”, Dhanpat Rai & Sons, 2004.
4. Dossat R.J., “Principles of Refrigeration”, John Wiley & Sons, 2003.
5. Ballaney P.L., “Thermal Engineering “, Khanna Publishers 2000.
6. Baukal C.E., “Heat Transfer in Industrial Combustion”, CRC Press, 2000.
7. Rogus & Lewis, “Combustion Technology”, Prentice Hall, 2000.
8. Kuo K. K., “Principles of Combustion”, CHIPS, Texas, 2005.

Scheme for Teaching & Examination											
B. Tech. - III (Mechanical) Sixth Semester											
Sr. No.	Course	Code	Teaching Scheme			Exam Scheme				Total Marks	Credits
						Theory		Tuto.	Pract.		
			L	T	P	Hrs.	Marks	Marks	Marks		
1	Machine Design-I	ME 302	3	1	2	2	100	25	50	175	5
2	Internal Combustion Engines & Automobile Engineering	ME 304	3	1	2	2	100	25	50	175	5
3	Refrigeration & Air Conditioning	ME 306	3	1	2	2	100	25	50	175	5
4	Tribology & Machine Dynamics	ME 308	3	1	2	2	100	25	50	175	5
5	Institute Elective-II*		3	0	0	2	100	-	-	100	3
	TOTAL		15	4	8		500	100	200	800	23
Total contact Hrs. per week (27) Total Credits =23 Total Marks = 800											

B. Tech. (MECHANICAL) Semester – 6	L	T	P	C
ME 302 MACHINE DESIGN – I	3	1	2	5

CO1	Understand stress and strain and apply the theories of failure to machine element.
CO2	Estimate the life of machine components subjected to fatigue load
CO3	Analyze the machine elements for transmitting torque, bending moment and axial loads.
CO4	Design the various type of joints and fasteners.
CO5	Design power screws, couplings, cylinders and I.C engine parts.
CO6	Evaluate the design of various types of mechanical springs.

- **INTRODUCTION**
  The design process, morphology of design, designing methods, concurrent engineering. **(03 Hours)**
- **DESIGN ANALYSIS** **(05 Hours)**
  Types of loads and stresses. Factor of safety types of failure, theories of failure, fatigue failure analysis, Soderberg and Goodman methods, estimation of life of a component. Wear failure, introduction to creep failure.
- **SELECTION OF MATERIAL** **(02 Hours)**
  Factors affecting material selection. Ferrous, non-ferrous metals and alloys, plastics for machine parts.
- **MACHINE COMPONENTS** **(06 Hours)**
  Parts subjected to tension, compression, shear, bending and torsion – such as tie rods, push rods, levers, axels etc. Parts subjected to combined loads. Design of helical compression and extension springs, leaf springs.
- **JOINTS AND CONNECTIONS** **(06 Hours)**
  Pin Joints and cottered joints, riveted connections, welded joints.
- **SCREWS AND THREADED FASTNESS** **(06 Hours)**
  Types of screw threads, Indian standard proportions, design of power screws, Threaded fastness types of bolts and connections, stresses and preloading of bolts. Flanged connections bolted connections.
- **SHAFTS** **(04 Hours)**
  Types of shafts, ASME code for design of shafts, deflection of shafts, critical speed, Design of keys and splines.
- **SIMPLE MACHINES** **(06 Hours)**
  Design of rigid and flexible couplings, screw jack, screw press, toggle jack, bearing puller, I.C. Engines connecting rod, I.C. engine valve gear.
- **THICK AND THIN CYLINDERS** **(04 Hours)**
  Shrink fitted and pressfitted connections.
- **MANUFACTURING CONSIDERATIONS** **(03 Hours)**
  Standardization, limits, fits and tolerance as per I.S. specification, factors to be considered in design of castings, forgings and welded components.

(Total Lecture Hours: 45 +Tutorial Hrs: 15)

PRACTICALS

1. Design and drawing of cotter joint
2. Design and drawing of Knuckle joint
3. Design and drawing of any type of coupling
   a. Flange coupling
   b. Bush –pin type coupling
   c. Rigid coupling
4. Design and drawing of screw jack
5. Design of Spring

6. Design of fasteners
7. Design of Levers
8. Design of transmission shaft

BOOKS RECOMMENDED

1. Bhandari V.B., “Design of Machine Elements”, Tata McGraw Hill, 1994.
2. Shigley Jospeh, “Mechanical Engineering Design”, McGraw Hill, 1989.
3. Patel R.C. and others, “Machine Design”, C. Jamnadas & Co., 1992.
4. Design Data (PSG College of Engg. & Tech.), DPV Printers, Coimbatore, 2000.
5. Nortan R.L., “Machine Design: An Integrated Approach”, Prentice Hall, 2005.

B. Tech. (MECHANICAL) Semester – 6	L	T	P	C
ME 304 INTERNAL COMBUSTION ENGINES & AUTOMOBILE ENGINEERING	3	1	2	5

CO1	Understand the air standard cycles, fuel air cycles and actual cycles
CO2	Explain the combustion phenomenon in SI and CI engine
CO3	Illustrate the various engine systems like cooling, fuel injection, and lubrication system
CO4	Evaluate the performance of SI and CI engine
CO5	Summarize the transmission system of automotive vehicle
CO6	Justify the selection of braking, suspension, steering and electrical system of an automotive vehicle

- **INTRODUCTION (02 Hours)**
  Introduction of I. C. Engines.
- **ANALYSIS OF AIR STANDARD CYCLES AND FUEL AIR CYLCES (07 Hours)**
  Air standard cycles, Ideal air standard cycles, Fuel air cycles, Characteristics of fuel - air mixtures, Variation of specific heat. Actual cycles and actual processes taking place in engines.
- **COMBUSTION IN I.C. ENGINE (07 Hours)**
  Combustion in S.I. Engine and C.I. Engines: Stages of combustion in S.I. Engine, Detonation and its Control of detonation. Stages of combustion in C.I. Engines, Delay period, Factors influencing delay period, Diesel knock, Control of diesel knock.
- **ELEMENTS OF FUEL SYSTEM IN S.I. ENGINE (07 Hours)**
  Requirements of a good carburetor, Simple carburetor, Complex carburetor, Calculation of air-fuel ratio for a simple carburetor. Electronic fuel injection in S.I. Engine.
- **ELEMENTS OF FUEL SYSTEM IN C.I. ENGINE (03 Hours)**
  Requirements of Diesel Injection System, Types of injection systems, Fuel pumps.
- **LUBRICATION AND COOLING SYSTEM (03 Hours)**
  Lubrication and cooling system of I. C. Engine: Functions and Types.
- **TESTING AND PERFORMANCE OF I. C. ENGINE (05 Hours)**
  Testing and performance of S. I. Engine & C. I. Engine
- **ENGINE EMISSIONS AND CONTROL (02 Hours)**
  Pollutants and their ill effects, Pollutants from Gasoline and Diesel Engines and their control.
- **MODERN DEVELOPMENTS IN I C ENGINES (02 Hours)**
  Alternate fueled engines, Alcohol, hydrogen etc.
- **TRANSMISSION SYSTEM OF AUTOMOTIVE VEHICLE (07 Hours)**
  Types & its components and Braking and Suspension system of automotive vehicle, Function of Steering systems and their types, Electrical systems of automotive vehicle, Chasis, Wheels, Types of tyres, Functions of tyres, Tread design etc.

(Total Lecture Hours: 45 +Tutorial Hrs: 15)

PRACTICALS

1. S. I. & C.I. Engine System
2. Valve Timing Diagram and Port Timing Diagram
3. Morse Test
4. A Constant Speed Load Test
5. Heat Balance Test on a 4-Stroke Diesel Engine
6. Transmission System of Automobile
7. Principle of Steering

8. Wheel Alignment and Wheel Balancing of automobile vehicle.
9. Ignition and brake system.

BOOKS RECOMMENDED

1. Ganeshan V., “Internal Combustion Engines”, McGraw Hill, New Delhi, 2007.
2. Heywood J.B., “Internal Combustion Engine Fundamentals” McGraw Hill, Singapore, 2002.
3. H.N. Gupta, “Fundamentals of Internal Combustion Engines”, Prentice Hall India, 2006.
4. Shyam K. Agrawal, “Internal Combustion Engines” New Age International Ltd., New Delhi, 2006.
5. Narang G.B.S., “Automobile Engineering”, Khanna Publishers, New Delhi, 2002.
6. Mathur M.L. and Sharma R.P., “A Course in Internal Combustion Engines”, Dhanpat Rai & Sons, 1992.

B. Tech. (MECHANICAL) Semester – 6	L	T	P	C
ME 306 REFRIGERATION & AIR CONDITIONING	3	1	2	5

CO1	Choose appropriate new eco-friendly refrigerants according to application in various types of refrigeration and air conditioning systems
CO2	Evaluate the gas cycle refrigeration system to improve its the performance
CO3	Evaluate the vapour compression refrigeration systems to improve the performance for various applications
CO4	Describe vapour absorption system and evaluate its performance for large cooling load application
CO5	Sketch psychometric processes and Calculate cooling/heating loads for summer and winter air conditioning systems
CO6	Analyze air distribution systems for air conditioning plants

- **GAS CYCLE REFRIGERATION (06 Hours)**
  Air refrigeration system, Bell Coleman air cycle, Boot strap system, Aircraft refrigeration systems, Actual cycle, Ramming, Compression and Turbine efficiencies, Coefficient of performance.

- **VAPOUR COMPRESSION REFRIGERATION (09 Hours)**
  Analysis of vapour compression cycle, Losses and efficiencies of components, Factors affecting the performance of a simple vapour compression system, Heat balance, Multistage vapour compression system with flash intercooler, Multi evaporation system, Cascade refrigeration system

- **ABSORPTION REFRIGERATION (06 Hours)**
  Desirable properties of refrigerants and solvents, Thermodynamics analysis of vapour absorption System, Comparison between vapour absorption and vapour compression system, Aqua-Ammonia and Lithium Bromide absorption system.

- **PSYCHROMETRY AND PSYCHROMETRIC PROCESSES (10 Hours)**
  Psychrometric properties, Psychrometers, Preparation of psychrometric charts, Enthalpy deviation, Psychrometric Processes - Mixing process, Sensible heating, Sensible cooling, Humidification, Dehumidification, Cooling and Dehumidification, Heating and humidification, Bypass factor, Apparatus dew point, Sensible heat factor, Air washer, Adiabatic humidification, Efficiency of humidification, Summer and Winter air conditioning system.

- **LOAD CALCULATION (08 Hours)**
  Calculation of summer and winter loads, Heat gain through walls, roofs, floors, windows, and doors.

- **AIR CONDITIONING SYSTEMS AND EQUIPMENTS (06 Hours)**
  Humidifiers, Air coolers, Dehumidifiers, Air cleaners, Impurities in air and air cleaners, Ducts, Pressure drop in ducts.

(Total Lecture Hours: 45 +Tutorial Hrs: 15)

PRACTICALS

1. To conduct performance test on vapour compression refrigeration system.
2. To study tools and instruments used in refrigeration and air conditioning
3. To determine psychrometric properties of air.
4. To conduct performance test on air conditioning system to find C.O. P and to determine the by pass factor of coil.
5. To conduct performance test on Ice plant.
6. To conduct performance test on Cold storage plant.
7. To conduct performance test on vapour absorption system - Electrolux- Domestic type.
8. To conduct performance test on desert cooler.
9. To study the domestic refrigerator.
10. To study the charging, testing, evacuating and pumping down to a refrigerant plant

BOOKS RECOMMENDED

1. Arora S.C. and Domkundwar S., “A Course in Refrigeration and Air Conditioning”, Dhanpat Rai & Sons, 2006.
2. Thrakeld J. L., “Thermal Environmental Engineering”, Prentice Hall, 2002.
3. Stoeaker W. F., “Refrigeration and Air conditioning”, Tata McGraw Hill, 2004.
4. Dossat R.J., “Principles of Refrigeration”, John Wiley and Sons, 2000.
5. Arora C. P., “Refrigeration and Air conditioning”, Tata McGraw Hill, 2004.
6. Ananthanarayanan P. N., “Basic Refrigeration and Air Conditioning”, Tata McGraw-Hill, 2005.

B. Tech. (MECHANICAL) Semester – 6	L	T	P	C
ME 308 TRIBOLOGY AND MACHINE DYNAMICS	**3**	**1**	**2**	**5**

CO1	Understand the basics & principles of Tribology.
CO2	Understand the concept about friction and wear in engineering applications.
CO3	Analyze the concept of hydrodynamic, hydrostatic, hydrostatic squeeze lubrications, hydrodynamic and thrust bearings.
CO4	Illustrate different methods to determine natural frequency of systems.
CO5	Evaluate natural frequencies for free damped linear and torsional systems.
CO6	Investigate the frequencies for forced vibration linear and rotational Systems.

- **INTRODUCTION** **(02 Hours)**
  Introduction to tribology and surface topography.
- **FRICTION & WEAR** **(04 Hours)**
  Theories of friction and wear and measurement techniques.
- **LUBRICANTS** **(04 Hours)**
  Properties and testing of lubricants.
- **REGIMES OF LUBRICATION** **(10 Hours)**
  Application of lubrication mechanism in bearing design. Basic concepts of hydrodynamic lubrication theory. Hydrostatic and boundary lubrication.
- **FUNDAMENTALS OF VIBRATIONS** **(01 Hours)**
  Introduction, definition, SHM, beats phenomenon, complex method of representing harmonic vibrations.
- **UNDAMPED FREE VIBRATIONS OF SINGLE DEGREE OF FREEDOM SYSTEM** **(06 Hours)**
  Introduction, deviation of differential equations and resolution, equivalent stiffness of spring combinations, Newton's method and energy method for problem solutions.
- **DAMPED FREE VIBRATIONS OF SINGLE DEGREE OF FREEDOM SYSTEM** **(06 Hours)**
  Different types of dampings, free vibrations with viscous dampers.
- **FORCED VIBRATION OF SINGLE DEGREE OF FREEDOM SYSTEMS** **(06 Hours)**
  Forced vibration with constant harmonic excitation, with rotating and reciprocating unbalance, due to the support, vibration isolation and transmissibility, measuring instruments, displacement, velocity, acceleration, frequency measuring instruments.
- **WHIRLING AND CRITICAL SPEED OF SHAFTS** **(02 Hours)**
  Introduction to multi degree of freedom system.
- **CAM DYNAMICS** **(04 Hours)**
  Forces in rigid systems, follower response by phase-plane method, jump and cross-over, Johnson's numerical method.

(Total Lecture Hours: 45 +Tutorial Hrs: 15)

PRACTICALS

1. Tuned rectilinear vibration absorber
2. Free damped vibration
3. Fixed free three rotor system
4. Semi definite system
5. Variable port opening dash pot
6. Rectilinear vibration of cantilever beam
7. Tuned torsional vibration absorber
8. Viscosity measurement

9. Wear measurement

BOOKS RECOMMENDED

1. Arnell R. D., Davies P.B., Halling J. and Whomes T.L., “Tribology – Principles and Design Application”, Springer – Verlag, 1991.
2. Majmudar B. C., “Introduction to Tribology of Bearings”, A.H. Wheeler and Co., 1986.
3. Cameron A., “Basic Lubrication Theory”, Wiley Eastern, 1987.
4. Grover G. K., “Mechanical Vibrations”, Nemchand & Bros. 1995.
5. Kelly Graham S., “Mechanical Vibrations”, McGraw Hill, 1995.
6. Shigley J.E., “Theory of Machines and Mechanism”, Tata McGraw Hill, 1992.

B. Tech. (MECHANICAL) Semester – 6 (INST. ELECTIVE- II)	L	T	P	C
ME 312 INDUSTRIAL ENGINEERING	3	0	0	3

CO1	Identify the factors influencing productivity in industrial engineering.
CO2	Classify the tools of method study and time study for creating the improved process and timing for doing a job.
CO3	Examine the factors affecting the plant layout and location decisions.
CO4	Explain qualitative and quantitative techniques for solving the problems of forecasting.
CO5	Compare deterministic and probabilistic inventory control models for evaluating the inventory level.
CO6	Develop an understanding of production systems and functions.

- **INDUSTRIAL ENGINEERING (01 Hour)**
  Introduction, history, activities & techniques of industrial engineering, Organization of industrial engineering department.

- **PRODUCTIVITY (03 Hours)**
  Production & productivity, factors influencing productivity – technological advancement & human factors, measurement of productivity (Productivity Index), causes of low productivity and techniques of their elimination, improving productivity by reducing work content & ineffective time.

- **WORK STUDY (11 Hours)**
  Work content, excess work content & ineffective time, Method study – objectives, steps, selection of job, process charts, micro-motion & memo-motion studies, principles of motion economy – Therbligs, Workplace layout, Work Measurement – objectives, steps, techniques, performance rating, allowances of standard time, techniques of work measurement, Work Sampling– confidence levels, methods of work sampling, Computation of machines utilization & standard time, Predetermined Motion Time Systems (PMTS), Work Factor System, Method Time measurement (MTM)- MTM basic motion elements, production study, physiological work measurement.

- **PRODUCT RESEARCH, DEVELOPMENT AND DESIGN (02 Hours)**
  Product life cycle, selection of a profitable product, product design & development, process, product analysis Tools for product development viz. standardization, simplification, diversification, specialization etc. concurrent design, Design for Manufacturing & Assembly (DFMA), Reverse engineering, Manufacturability, Ergonomic considerations in Product design, Process design.

- **MATERIALS MANAGEMENT & INVENTORY CONTROL (06 Hours)**
  Materials management, inventory, costs selective inventory control – ABC analysis, safety stock, inventory models such as basic EOQ model, inventory with planned shortages, inventory with quantity discount, inventory with finite replenishment, ideal & real inventory management systems, inventory control systems.

- **DEMAND (SALES) FORECASTING (06 Hours)**
  Quantitative forecasting techniques such as time series analysis, method of least squares, simple moving & weighted moving average regression & correlation; exponential smoothing methods, economic indicators method, qualitative forecasting techniques such as collective opinion method, Delphi technique etc., measures of forecast accuracy, selecting a forecasting method, costs and accuracy of forecasts.

- **VALUE ENGINEERING (04 Hours)**
  Value analysis & value engineering, reasons for unnecessary costs, Function Analysis System Technique (FAST), Techniques of value analysis & value engineering, value analysis procedure & questionnaire.

- **PRODUCT COST CONCEPTS & BREAK-EVEN ANYLSIS (02 Hours)**
  Costs of production, classification of costs, analysis of production costs, Break-even analysis – graphical as well as mathematical analysis, costs – volume – Profit (CVP) analysis, managerial uses of Break even chart, Applications of Break-even analysis.

- **ERGONOMICS (Human Factor Engineering) (03 Hours)**
  Objectives of human engineering, Ergonomics, productivity and working environment, man-machine systems, design of controls & information displays, working environment factors, Anthropometry, Human activities.

Biomechanics, nature of movements, expenditure of energy for movements, Layout of working space , seating arrangements for providing maximum comfort.

- **ADVANCED INDUSTRIAL ENGINEERING TECHNIQUES (07 Hours)**
  Total Quality Management (TQM), Business Process Reengineering (BPR), Just-in-time (JIT) manufacturing, Lean management, Total Productive Maintenance (TPM), World Class manufacturing (WCM) etc.

(Total Lecture Hours: 45)

BOOKS RECOMMENDED

1. Mahajan M., "Industrial Engineering and Production Management", Dhanpat Rai & Sons, Delhi, 2005.
2. Telsang M., "Industrial Engineering and Production Management", S. Chand & Co., New Delhi, 2005.
3. Sharma S.K. and Sharma Savita, "Work Study and Ergonomics", S.K. Kataria & Sons, Delhi, 2007.
4. Sharma S. K., Sharma Savita and Sharma Tushar, "Industrial Engineering and Operations Management", S.K. Kataria & Sons, New Delhi, 2004.
5. International Labour Organization, Geneva, "Introduction to Work Study", 2005.
6. Paneerselvam R., "Production and Operations Management", Prentice Hall India, 2005.

B. Tech. (MECHANICAL) Semester – 6 (INST. ELECTIVE- II)	L	T	P	C
ME 314 PLANT LAYOUT & MATERIAL HANDLING	**3**	**0**	**0**	**3**

CO1	Demonstrate the capabilities of selecting suitable plant location considering various criteria.
CO2	Demonstrate the knowledge of factory buildings used in industries and its importance.
CO3	Explain the various types of plant layouts used in industries
CO4	Analyze various types of plant layouts used in industries and solve the related problem using various evaluation techniques.
CO5	Evaluate the optimum layouts using optimization techniques.
CO6	Analyze and identify suitable material handling equipment used in industries as per the requirement.

- **INTRODUCTION** **(04 Hours)**
  Plant design, types of manufacturing process-plant design.

- **PLANT LOCATION** **(06 Hours)**
  Influence of location on plant layout-location factors-plant size selection guide-location theory and models.

- **INDUSTRIAL BUILDING** **(07 Hours)**
  Relationship between the building and layout, building design and construction – bays-floors-walls and windows-roots and ceiling. Types of building –single –story building and multi story building-constructional material.

- **PLANT LAYOUT PROBLEMS** **(08 Hours)**
  Why layout problems develop, classes of plant layout problems-objectives-classification of layout-product layout-process layout and fixed position layout-organization layout.
  Employee services-working conditions-the influence of organization and wage incentives-human relations

- **DATA COLLECTION** **(06 Hours)**
  Use of work study in plant layout-plant layout tools and techniques.

- **EVALUATION OF LAYOUT** **(06 Hours)**
  Measurement of effectiveness-systematic evaluation-optimizing evaluation.

- **MATERIAL HANDLING** **(08 Hours)**
  Types of material handling equipments, hoists, different types hand and power drives, different types of conveyers, elevators, etc.

(Total Lecture Hours: 45)

BOOKS RECOMMENDED

1. Joseph S. Martinich, “Production and Operation Management”, John Wiley and Sons, 2002.
2. Adams E.E., and Ebert R.J., “Production and Operation Management”, Prentice Hall India, 2000.
3. Mahapatra P.B., “Computer Aided Production Management, Prentice Hall India, 2001.
4. Manocha R.C., “Production and Operation Management”, Excel books, New Delhi, 2003.
5. Allegr Thodore H., “Material Handling, Principles and Practice”, CBS Publishers, New Delhi, 1987.

B. Tech. (MECHANICAL) Semester – 6 (INST. ELECTIVE- II)	L	T	P	C
ME 316 MICROPROCESSOR & APPLICATIONS	**3**	**0**	**0**	**3**

CO1	Assess and solve basic binary math operations using the microprocessor and explain the microprocessors and Microcontroller's internal architecture and its operation within the area of manufacturing and performance.
CO2	Apply knowledge and demonstrate programming proficiency using the various addressing modes and data transfer instructions of the target microprocessor and microcontroller
CO3	Compare accepted standards and guidelines to select appropriate Microprocessor (8085) and Microcontroller to meet specified performance requirements.
CO4	Analyze assembly language programs; select appropriate assemble into machine a cross assembler utility of a microprocessor and microcontroller.
CO5	Design electrical circuitry to the Microprocessor I/O ports in order to interface the processor to external devices.
CO6	Evaluate assembly language programs and download the machine code that will provide solutions real-world control problems.

- **INTRODUCTION** **(07 Hours)**
  Microprocessors and microcomputers, review of digital logic, Boolean algebra and numbering systems.

- **COMBINATIONAL AND SEQUENTIAL LOGIC** **(10 Hours)**
  Boolean functions of two, three and four variables, karnaugh maps, elementary ideas about logic circuits of interest such as half and full adder, magnitude comparator, decoders, encoders, multiplexers, demultiplexers, flip-flops, counters and timers.

- **8085 MICROPROCESSOR ARCHITECTURE** **(10 Hours)**
  Memory interfacing, interfacing of input-output devices, microcomputer system based on 8085.

- **8051 MICROCONTROLLER ARCHITECTURE** **(10 Hours)**
  Assembly language programming for 8051, instruction set, addressing modes, peripherals of 8051, embedded 'C' programming for 8051.

- **APPLICATIONS OF MICROPROCESSORS AND MICROCONTROLLERS** **(08 Hours)**
  Applications in mechanical and production engineering such as motion control, data acquisition systems, process control, etc.

(Total Lecture Hours: 45)

BOOKS RECOMMENDED

1. Gaonkar R.S., "Microprocessor Architecture, Programming and Applications with the 8085", Penram International, Mumbai, 2007.
2. Malvino A.P. and Leach D.P., "Digital Principles and Applications", Tata McGraw Hill, New Delhi, 1991.
3. Mazidi M.A., "8051 Microcontroller and Embedded Systems", Pearson Education, 2003.
4. Ayala K., "The 8051 Microcontroller", Thomson Delmar Learning, 2005.
5. Kent Stiffler A., "Design with Microprocessors for Mechanical Engineers", Mc Graw Hill, 1992.

B. Tech. (MECHANICAL) Semester – 6 (INST. ELECTIVE- II)	L	T	P	C
ME 318 CORROSION ENGINEERING	**3**	**0**	**0**	**3**

CO1	Describe importance of corrosion and various terminology associated with corrosion.
CO2	Identify various types of corrosion, significance, causes and remedies.
CO3	Interpret corrosion issues of various grades of materials.
CO4	Analyze effect of different environments and conditions on corrosion behavior.
CO5	Predict and test corrosion rate of materials from available data.
CO6	Explain design guidelines and preventive methods to minimize corrosion of materials.

- **INTRODUCTION TO CORROSION (05 Hours)**
  Cost of corrosion, Corrosion damage, Corrosion rate expressions, electrochemical corrosion of metals, origin of Pourbaix diagram. NACE Terminology Importance of corrosion control.

- **CORROSION & ITS CONTOL (08 Hours)**
  General corrosion, galvanic corrosion, crevice corrosion, pitting corrosion, intergranular corrosion, selective leaching, erosion corrosion, stress corrosion, overview of hydrogen cracking. High temperature corrosion.

- **CORROSION OF VARIOUS MATERIALS (07 Hours)**
  Corrosion of Steels, Stainless steels, Aluminium alloys, Copper alloys, Nickel and Titanium alloys, Corrosion of polymers, Ceramics and composite materials and their control.

- **CORROSION IN SELECTED ENVIRONMENTS & ITS CONTROL (09 Hours)**
  Atmospheric Corrosion, Corrosion of Automobiles, Corrosion of Steel in Concrete, Corrosion in Sea water, Microbiologically Induced Corrosion, overview of corrosion in body, overview of corrosion in aircraft, Corrosion in the Petrochemical Industry, Corrosion in Paper and pulp industry and its control.

- **CORROSION TESTING (08 Hours)**
  Purpose Importance of testing, laboratory, semi-plant and field tests, ASTM standards for testing, stress corrosion cracking and pitting, sequential procedure for laboratory and on-site corrosion investigations.

- **CORROSION PREVENTION (08 Hours)**
  Purification & alloying of metal, Material selection, Alteration of Environment, Design modification, Cathodic and Anodic protection, Coatings (metallic, inorganic, non metallic and organic)

(Total Lecture Hours: 45)

BOOKS RECOMMENDED

1. Fontana G., "Corrosion Engineering ", McGraw-Hill, 1985.
2. Schweitzer P.A., "Corrosion Engineering Hand Book ", Marcel Decker, 1996.
3. Winston Revie and R, Uhlig, "Corrosion Hand Book ", John Wiley, 2000.
4. Raj Narayan, “An Introduction to Metallic Corrosion and its Prevention”, Oxford and IBH, 1983.
5. ASM International, “Metals Handbook", 1996.