UNIVERSITY OF LUCKNOW

FACULTY OF ENGINEERING & TECHNOLOGY

Evaluation Scheme for B. Tech.

Branch : Mechanical Engineering

SEMESTER – V

S. No.	Subject Code	Subject Name	L-T-P	Evaluation					Credit
				Sessional			ESE	Grand Total	
				CT	TA	Total			
	Theory								
01.	ME - 501	Machine Design - I	**3--1--0**	**20**	**10**	**30**	**70**	**100**	**4**
02.	ME – 502	Manufacturing Science and Engineering - II	**3--1--0**	**20**	**10**	**30**	**70**	**100**	**4**
03.	ME – 503	Heat and Mass Transfer	**3--1--0**	**20**	**10**	**30**	**70**	**100**	**4**
04.	ME – 504	Fluid Machinery	**3--0--0**	**20**	**10**	**30**	**70**	**100**	**3**
05.	ME – 505	Industrial Engineering	**3--0--0**	**20**	**10**	**30**	**70**	**100**	**3**
	Practical								
06.	ME - 551	Machine Design Lab	**0--0--3**	-	**40**	**40**	**60**	**100**	2
07.	ME – 552	Manufacturing Science and Engineering Lab – II	**0--0--3**	-	**40**	**40**	**60**	**100**	2
08.	ME – 553	Heat and Mass Transfer Lab	**0--0--2**	-	**20**	**20**	**30**	**50**	**1**
09.	ME – 554	Fluid Machinery Lab	**0--0--2**	-	**20**	**20**	**30**	**50**	**1**
10.	GP - 501	**General Proficiency**				50		50	
Total			**15-3-10**					**800**	**24**

Abbreviations : CT - Class Test TA - Teacher's Assessment
ESE - End Semester Examination

UNIVERSITY OF LUCKNOW

FACULTY OF ENGINEERING & TECHNOLOGY

Evaluation Scheme for B. Tech.

Branch : Mechanical Engineering

SEMESTER - VI

S. No.	Subject Code	Subject Name	L-T-P	Evaluation					Credit
				Sessional			ESE	Grand Total	
				CT	TA	Total			
	Theory								
01.	ME - 601	I.C. Engines	3--1--0	20	10	30	70	100	4
02.	ME – 602	Dynamics of Machines	3--1--0	20	10	30	70	100	4
03.	ME – 603	Machine Design - II	3--1--0	20	10	30	70	100	4
04.	ME – 604	Power Plant Engineering	3--0--0	20	10	30	70	100	3
05.	ME – 605	Any one from the list (DE – 1)	3--0--0	20	10	30	70	100	3
	Practical								
06.	ME - 651	I.C. Engines Lab	0--0--2	-	20	20	30	50	1
07.	ME – 652	Theory of Machines Lab	0--0--2	-	20	20	30	50	1
08.	ME – 653	Mini Project	0--0--3	-	40	40	60	100	2
09.	ME – 654	Seminar	0--0--3	-	40	40	60	100	2
10.	GP - 601	General Proficiency				50		50	
Total			**15-3-10**					**800**	**24**

Abbreviations : CT - Class Test TA - Teacher's Assessment
ESE - End Semester Examination DE - Departmental Elective

Note: Students have to undergo Industrial Training for a period of six weeks during summer vacation. The report of Industrial Training will be submitted to the Head of the Department in the beginning of seventh semester.

Departmental Elective – 1 :-

ME – 6051	Operations Research
ME – 6052	Mechanical System Design
ME – 6053	Six Sigma
ME – 6054	Industrial Ergonomics
ME – 6055	Robotics and Automation

ME - 501
MACHINE DESIGN - I

L	T	P
3	1	0

UNIT I

Introduction : Definition, Design requirements of machine elements, Design procedure, Standards in design, Selection of preferred sizes, Indian Standards designation of carbon & alloy steels, Selection of materials for static and fatigue loads.

Design against Static Load : Modes of failure, Factor of safety, Principal stresses, Stresses due to bending and torsion, Theory of failure. **09**

UNIT II

Design against Fluctuating Loads : Cyclic stresses, Fatigue and endurance limit, Stress concentration factor, Stress concentration factor for various machine parts, Notch sensitivity, Design for finite and infinite life, Soderberg, Goodman & Gerber criteria

Riveted Joints : Riveting methods, materials, Types of rivet heads, Types of riveted joints, Caulking and Fullering, Failure of riveted joint, Efficiency of riveted joint, Design of boiler joints, Eccentric loaded riveted joint. **09**

UNIT III

Shafts : Cause of failure in shafts, Materials for shaft, Stresses in shafts, Design of shafts subjected to twisting moment, bending moment and combined twisting and bending moments, Shafts subjected to fatigue loads, Design for rigidity. **07**

UNIT IV

Keys and Couplings : Types of keys, splines, Selection of square & flat keys, Strength of sunk key, Couplings- Design of rigid and flexible couplings

Mechanical Springs : Types, Material for helical springs, End connections for compression and tension helical springs, Stresses and deflection of helical springs of circular wire, Design of helical springs subjected to static and fatigue loading. **08**

UNIT V

Power Screws : Forms of threads, multiple threads, Efficiency of square threads, Trapezoidal threads, Stresses in screws, Design of screw jack. **07**

Note: Design data book is allowed in the examination

Text books :

1. J. E. Shigley, Mechanical Engineering Design, Tata McGrow Hill.
2. V.B Bhandari, Design of Machine Elements, McGraw Hill.

Reference books :

1. M.F. Spots, Design of M/C Elements, Pearson
3. Sadhu Singh, Machine Design, Khanna Publishers
4. Sharma & Agarwal, S. K., Machine Design, Kataria & Sons
5. Mahadevan, Design Data Handbook, CBS Publishers & Distributors.
6. Design Data Book, PSG College of Technology

ME-502
MANUFACTURING SCIENCE AND ENGINEERING - II

L	T	P
3	1	0

UNIT I

Metal Cutting : Mechanics of metal cutting.Geometry of tool and nomenclature. ASA system Orthogonal vs. oblique cutting. Mechanics of chip formation, types of chips.
Shear angle relationship. Merchant's force circle diagram. Cutting forces, power required. Cutting fluids/lubricants.Tool materials. Tool wear and tool life. Machinability.Dynamometer.Brief introduction to machine tool vibration and surface finish.Economics of metal cutting. **08**

UNIT II

Machine Tools :

a. Lathe: Principle, construction, types, operations, Turret/capstan, semi/Automatic, Tool layout.
b. Shaper, slotter, planer : Construction, operations & drives.
c. Milling : Construction, Milling cutters, up & down milling. Dividing head & indexing. Max chip thickness & power required.
d. Drilling and boring : Drilling, boring, reaming tools. Geometry of twist drills. **08**

UNIT III

Grinding & Super finishing :

(i) Grinding: Grinding wheels, abrasive& bonds, cutting action. Grinding wheel Specification. Grinding wheel wear - attritions wear, fracture wear. Dressing and Truing. Max chip thickness and Guest criteria. Surface and Cylindrical grinding. Centerless grinding.
(ii) Super finishing : Honing, lapping, polishing. Standardization & Interchangeability, Limits, Fits & Tolerance and Surface roughness: Introduction to Standardization & Interchangeability Limits, Fits, Tolerances and IS standards, Limit-gauges, and surface-roughness. **08**

UNIT IV

Metal Joining (Welding) : Survey of welding and allied processes.Gas welding and cutting, process and equipment.Arc welding : Power sources and consumables. TIG & MIG processes and their parameters. Resistance welding - spot, seam projection etc.Other welding processes such as atomic hydrogen, submerged arc, electroslag, friction welding. Soldering & Brazing.
Thermodynamic and Metallurgical aspects in welding and weld, Shrinkage/residual stress in welds. Distortions & Defects in welds and remedies. Weld decay in HAZ. **08**

UNIT V

Introduction to Un-conventional Machining and Welding : Need & benefits, application and working principle of EDM, ECM, LBM, EBM, USM. AJM, WJM. Similarly, non-conventional welding applications such as LBW, USW, EBW, Plasma-arc welding, Diffusion welding, Explosive welding/cladding. **08**

Textbooks :

1. Ghosh and Mallik, Manufacturing science, Prentice Hall PTR
2. Degarmo's, Materials and Processes in Manufacturing, John Wiley & Sons

Reference books :

1. Boothroyd, Fundamentals of Metal Cutting and Machine tools, CRC Press
2. R.K. Jain, Production Technology, Khanna Publishers
3. P.C. Pandey, Production Engineering Science, Standard Publishers.
4. P.C. Pandey & H.S. Shan, Modern Machining Processes, Tata McGraw-Hill Education
5. Juneja, Shekhon & Seth, Fundamentals of metal cutting & machine tools, New Age Publ.
6. M.C. Shaw, Metal Cutting Principles, M.I.T. Press.

ME-503
HEAT & MASS TRANSFER

L	T	P
3	1	0

UNIT I

Introduction to Heat Transfer : Concepts of the mechanisms of heat flows; Conduction, convection and radiation; Effect of temperature on thermal conductivity of materials; Introduction to combined heat transfer mechanism.

Conduction : One-dimensional general differential heat conduction equation in the rectangular, cylindrical and spherical coordinate systems; Initial and boundary conditions.

Steady State one-dimensional Heat conduction : Composite Systems in rectangular, cylindrical and spherical coordinates with and without energy generation; Thermal resistance concept; Analogy between heat and electricity flow; Thermal contact resistance; Critical thickness of insulation. **09**

UNIT II

Fins : Heat transfer from extended surfaces, Fins of uniform cross-sectional area; Errors of measurement of temperature in thermometer wells.

Transient Conduction : Transient heat conduction; Lumped capacitance method; Time constant; Unsteady state heat conduction in one dimension only, Heisler charts. **07**

UNIT III

Forced Convection : Basic concepts; Hydrodynamic boundary layer; Thermal boundary layer; Approximate integral boundary layer analysis; Analogy between momentum and heat transfer in turbulent flow over a flat surface; Mixed boundary layer; Flow over a flat plate; Flow across a single cylinder and a sphere; Flow inside ducts; Empirical heat transfer relations; Relation between fluid friction and heat transfer; Liquid metal heat transfer.

Natural Convection : Physical mechanism of natural convection; Buoyant force; Empirical heat transfer relations for natural convection over vertical planes and cylinders, horizontal plates and cylinders, and sphere ; Combined free and forced convection. **09**

UNIT IV

Thermal Radiation : Basic radiation concepts; Radiation properties of surfaces; Black body radiation Planck's law, Wein's displacement law, Stefan Boltzmann law, Kirchoff's law; ; Gray body; Shape factor; Black-body radiation; Radiation exchange between diffuse non black bodies in an enclosure; Radiation shields; Radiation combined with conduction and convection; Absorption and emission in gaseous medium; Solar radiation; Green house effect. **07**

UNIT V

Heat Exchanger : Types of heat exchangers; Fouling factors; Overall heat transfer coefficient; Logarithmic mean temperature difference (LMTD) method; Effectiveness-NTU method; Compact heat exchangers.

Condensation and Boiling : Introduction to condensation phenomena; Heat transfer relations for laminar film condensation on vertical surfaces and on outside & inside of a horizontal tube; Effect of non-condensable gases; Dropwise condensation; Heat pipes; Boiling modes, pool boiling; Hysteresis in boiling curve; Forced convective boiling.

Introduction to Mass Transfer : Introduction; Fick's law of diffusion; Steady state equimolar counter diffusion; Steady state diffusion though a stagnant gas film. **08**

Textbooks :

1. J.P. Holman, Heat Transfer, McGraw-Hill Internationa l edition.
2. Cengel & Ghazar, Heat and Mass Transfer, TMH

Reference books :

1. Bayazitouglu & Ozisik, Elements of Heat transfer, McGraw-Hill Book Company.
2. Pitts & Sisson, Schaum's Outline of Heat Transfer, McGraw-Hill International edition.
3. Frank Kreith, Principles of Heat Transfer, McGraw-Hill Book Co.
4. James R. Welty; Fundamentals of Momentum, Heat and Mass Transfe, John Wiley & Sons(Pvt). Ltd.

ME – 504
FLUID MACHINERY

L	T	P
3	0	0

UNIT I

Introduction : Classification of Fluid Machines & Devices, Application of momentum and momentum equation to flow through hydraulic machinery, Euler's fundamental equation.

Impact of jet: Introduction to hydrodynamic thrust of jet on a fixed and moving surface (flat & curve), Effect of inclination of jet with the surface.

Hydraulic Turbines : Classification of turbines, Impulse turbines, Constructional details, Velocity triangles, Power and efficiency calculations, Governing of Pelton wheel. **10**

UNIT II

Reaction Turbines : Francis and Kaplan turbines, Constructional details, Velocity triangles, Power and efficiency calculations, Degree of reaction, Draft tube, Cavitation in turbines, Principles of similarity, Unit and specific speed, Performance characteristics, Selection of water turbines. **08**

UNIT III

Centrifugal Pumps : Classifications of centrifugal pumps, Vector diagram, Work done by impellor, Efficiencies of centrifugal pumps, Specific speed, Model testing, Cavitation & separation and their control, Performance characteristics. **07**

UNIT IV

Positive Displacement Pumps : Reciprocating pump theory, Slip and coefficient of discharges, Indicator diagram, Effect and acceleration, Work saved by fitting air vessels, Comparison of centrifugal and reciprocating pumps, Positive rotary pumps, Gear and Vane-pumps, Performance characteristics. **08**

UNIT V

Other Machines : Hydraulic accumulator, Special duty pumps, Intensifier, Hydraulic press, Lift and cranes, Theory of hydraulic coupling and torque converters, Performance characteristics.

Water Lifting Devices : Hydraulic ram, Jet pumps, Air lift pumps. **07**

Text books :

1. R.K. Bansal, A Textbook of Fluid Mechanics and Hydraulic Machines, Laxmi Publications
2. R K Rajput, Fluid Mechanics & Hydraulic Machines, S.ChandLtd.

Reference books :

1. V.P. Vasandhani, Hydraulic Machines: Theory & Design, Khanna Publishers.
3. D S Kumar, Thermal and Hydraulic Machines, Kataria & Sons.
4. V.P. Gupta, Alam Singh, Manish Gupta, Fluid Mechanics, Fluid Machines & Hydraulics, CBS Publishers & Distributors.

ME- 505
INDUSTRIAL ENGINEERING

L	T	P
3	0	0

UNIT I

Introduction, engineering economy and costing, cost analysis, methods of depreciation, productivity concepts and measurements, job evaluation, methods of job evaluation, merit rating, wage incentive plan, types of wage incentive plans. **08**

UNIT II

Work measurement, time study, pre-determined motion and time study(PMTS), work sampling, method study, micro motion study, principles of motion economy. **07**

UNIT III

Plant location, Types of Layout, Principles of Facility Layout, Objective Functions, Steps in PPC, Planning, Routing, Scheduling, Loading, Despatching, Effectiveness of PPC. **08**

UNIT IV

PERT, CPM, Resource Allocation and GERT- Program Evaluation and Review Technique (PERT),Critical Path Method (CPM), Scheduling with Resource Constraints. Introduction to quality management, Ergonomics. **08**

UNIT V

High Volume Production Systems- Transfer Devices, Feeder classification, Construction and Applications, Automated Flow lines, Analysis of Automated Flow lines for Reliability and Efficiency, Assembly Systems, Robot Technology, Flexible Manufacturing Systems (FMS). **09**

Textbooks :

1. M.S. Mahajan, Industrial Engineering, Dhanpatai and Co. (P) Ltd.
2. S.K. Saha, Introduction to Robotics, Tata Magraw Hill

Reference Books :

1. Turner W.C. et Al., Introduction to Industrial System Engineering, Prentice Hall
2. Ralph M. Barnes, Motion and Time Study, Design and Measurement of Work, Wiley Publishers
3. John M Nicholas, Project Management for Business and Technology, PHI
4. Robotics by John M Nicholas, Pearson Education

ME - 551
MACHINE DESIGN LAB

L	T	P
0	0	3

Note :- At least **ten** experiments are to be conducted from the following list.

1. Design & drawing of Cotter joint.
2. Design & drawing of Knuckle joint
3. Design of machine components subjected to combined steady and variable loads.
4. Design of eccentrically loaded riveted joint
5. Design of boiler riveted joint
6. Design of shaft for combined constant twisting and bending loads
7. Design of shaft subjected to fluctuating loads
8. Design and drawing of flanged type rigid coupling
9. Design and drawing of flexible coupling
10. Design and drawing of helical spring
11. Design and drawing of screw jack

ME - 552
MANUFACTURING SCIENCE AND ENGINEERING LAB – II

L	T	P
0	0	3

Note :- At least **ten** experiments are to be conducted from the following list.

1. To determine Shear-angle (using formula) for the case of tube cutting (for orthogonal) on lathe machine.
2. To make thread on bolt using lathe machine.
3. To perform tool grinding (to provide tool angles) on tool-grinder machine.
4. To cut gear on milling machine.
5. To machine a block on shaper machine.
6. To perform finishing operation of a surface on surface-grinding machine.
7. To drill holes on drilling machine and to study twist-drill.
8. To study different types of tools and its angles & materials.
9. To perform an experiment to determine tool life.
10. To perform spot welding operation.
11. To perform resistance welding experiment.
12. To perform soldering & brazing operation.
13. To perform TIG/MIG Welding.

ME - 553
HEAT & MASS TRANSFER LAB

L	T	P
0	0	2

Note :- At least **ten** experiments are to be conducted from the following list.

1. To determine temperature gradient along a composite wall.
2. To determine heat transfer rate through composite cylinder.
3. To determine critical heat flux and different boiling regimes of pool boiling.
4. To determine heat transfer coefficient for tube under natural convection.
5. To determine temperature distribution along the length of the heat pipe.
6. To determine temperature distribution along the fin for natural convection.
7. To determine the temperature distribution along tube/fine for forced convection.
8. Any experiment on Stefan's Law, on radiation determination of emissivity, etc.
9. To determine LMTD, U and heat transfer coefficient in a parallel flow heat exchanger.
10. To determine LMTD, U and heat transfer coefficient in a counter flow heat exchanger.
11. Determination of thermal conductivity of solid/fluid.

ME - 554
FLUID MACHINERY LAB

L	T	P
0	0	2

Note :- At least **ten** experiments are to be conducted from the following list.

1. To determine the force of impact of Jet.
2. To draw characteristics curves of Pelton wheel turbine.
3. To draw characteristics curves of Francis turbine.
4. To draw characteristics curves of Kaplan turbine.
5. To draw characteristics curves of Reciprocating pump.
6. To draw characteristics curves of centrifugal pump.
7. To determine the efficiency of Hydraulic Ram.
8. Study through detailed visit of any water pumping station/plant.
9. To study models of different types of pump impellers.
10. To determine the efficiency of Reciprocating Compressor with 2-stage intercooling.
11. To determine drag and lift on aerofoil in wind tunnel.
12. To draw characteristics curves of Gear oil Pump.

ME - 601
I. C. ENGINES

L T P
3 1 0

UNIT I

Introduction to I.C Engines : Engine classification, Air standard cycles, Otto cycle, Diesel cycle, Dual cycle, Comparison of Otto, Diesel and Dual cycles, Sterling cycle, Ericsson cycles, Actual cycle analysis, Two and four stroke engines, SI and CI engines, Valve timing diagram, Rotary engines, stratified charge engine.

Fuels : Fuels for SI and CI engine, Important qualities of SI and CI engine fuels, Rating of SI engine and CI engine fuels, Vegetable oils, Biodiesel, Gaseous fuels, LPG, CNG, Biogas, Producer gas, Dopes, Additives, Alternative fuels for IC engines. **09**

UNIT II

SI Engines : Combustion in SI engine, Flame speed, Ignition delay, Abnormal combustion and it's control, combustion chamber design for SI engines; Carburetion, Mixture requirements, Carburetor types, Theory of carburetor, MPFI; Ignition system requirements, Magneto and battery ignition systems, ignition timing and spark plug, Electronic ignition. **07**

UNIT III

CI Engines : Combustion in CI engines, Ignition delay, Knock and it's control, Combustion chamber design of CI engines; Fuel injection in CI engines, Requirements, Types of injection systems, Fuel pumps, Fuel injectors, Injection timings; Scavenging in 2 Stroke engines. **07**

UNIT IV

Engine Cooling : Different cooling systems, Radiators and cooling fans.

Lubrication : Engine friction, Lubrication principle, Type of lubrication, Lubrication oils, Crankcase ventilation.

Supercharging : Effect of altitude on power output, Types of supercharging.

Testing and Performance : Basic measurements, Optical measurement techniques, Laser Doppler anemometry, Testing of SI and CI engines. **09**

UNIT V

Air Pollution from IC engines : IC engine emissions, Mufflers, Silencers, EGR, Effect of pollutants, Pollution measurement, Emission control in SI and CI engines, Pollution from I.C. Engines and its control, Emission legislations and standards. **08**

Textbooks:

1. Mathur & Sharma, A Course in International Combustion Engines, Dhanpat Rai & Sons.
2. Ganeshan, I.C Engines, McGraw Hill Publishers.

Reference books:

1. Gill, Smit & ,Ziurs, Fundamentals of Internal Combustion Engine Oxford IBH Publ.Co.
2. Rogowsky, IC Engines, International Book Co.
3. R. Yadav, I.C Engine, Central Publishing House, Allahabad

ME – 602
DYNAMICS OF MACHINES

L	T	P
3	1	0

UNIT I

Introduction of cam and follower, Terminology, classification, types of follower motion, Analysis of cam and follower motion. **07**

UNIT II

Introduction to gyroscope, precisional motion and Gyroscopic couple, Effect of gyroscope couple in aero plane, effect of gyroscopic couple on naval ship during steering, pitching and rolling, Stability of Four wheel and two-wheel vehicle during turning. **08**

UNIT III

Flywheels: Fluctuation of energy and speed, Application of flywheel to various operations and mechanisms of machine; Governor: Terminology, Classification of governors, function, analysis of various types of governors viz. Wald's, Proel, Hartnell. **08**

UNIT IV

Velocity and acceleration of Slider crank mechanism, Analytical method for velocity and acceleration of the piston, angular velocity and acceleration of connecting rod. Force analysis of reciprocating engine mechanism and inertia torque calculations; Balancing of rotating and reciprocating masses: methods of balancing the primary and secondary unbalanced forces, partial balancing, field balancing. **09**

UNIT V

Introduction to Mechanical Vibration: SHM, 1D and 2D problems of free, damped and forced vibrations. Vibration isolation, transmissibility, critical speed of shaft. Vibration measuring instruments. Exact and approximate numerical methods in vibrations. Raleigh, Dunkerlay, Stodola methods. **08**

Text books:

1. S. S. Rattan, Theory of Machines, McGraw Hill.
2. Grover, G.K., Mechanical Vibrations, Nem Chand Publishers.

Reference books:

1. Thomas Beven, Theory of Machines by Longmans
2. J. Lal, Theory of Mechanisms &Machines, Metropolitan Book Company
3. R.S. Khurmi, J.K. Gupta, Theory of Machinesm, S. Chand, Limited

ME – 603
MACHINE DESIGN - II

L	T	P
3	1	0

UNIT I

Spur Gears : Tooth forms, System of gear teeth, contact ratio, Standard proportions of gear systems, Interference in involute gears, Backlash, Selection of gear materials, Gear manufacturing methods, Design considerations, Beam strength of gear tooth, Dynamic tooth load, Wear strength of gear tooth, Failure of gear tooth, Design of spur gears, AGMA and Indian standards. **08**

UNIT II

Helical Gears : Terminology, Proportions for helical gears, Beam strength and wear strength of helical gears, herringbone gears, crossed helical gears, Design of helical gears.

Worm Gears : Types of worms, Terminology, Gear tooth proportions, Efficiency of worm gears, Heat dissipation in worm gearing, Strength and wear tooth load for worm gears, Design of worm gearing. **09**

UNIT III

Sliding Contact Bearing : Types, Selection of bearing, Plain journal bearing, Hydrodynamic lubrication, Properties and materials, Lubricants and lubrication, Hydrodynamic journal bearing, Heat generation, Design of journal bearing, Thrust bearing-pivot and collar bearing, Hydrodynamic thrust bearing. **08**

UNIT IV

Rolling Contact Bearing : Advantages and disadvantages, Types of ball bearing, Thrust ball bearing, Types of roller bearing, Selection of radial ball bearing, Bearing life, Selection of roller bearings, Dynamic equivalent load for roller contact bearing under constant and variable loading, Reliability of Bearing, Selection of rolling contact bearing, Lubrication of ball and roller bearing, Mounting of bearing. **08**

UNIT V

I.C Engine Parts : Selection of type of I.C engine, General design considerations, Design of Cylinder and cylinder head; Design of piston, piston ring and gudgeon pin; Design of connecting rod; Design of centre crankshaft. **07**

Text books:

1. J. E. Shigley, Mechanical Engineering Design, Tata McGraw Hill
2. V.B Bhandari, Design of Machine Elements, McGraw Hill.

Reference books:

1. P.C. Sharma & D.K. Agarwal, S. K., Machine Design, Kataria & Sons
2. Black and Adames, Machine Design, McGraw-Hill
3. Valance & Doughtie, Design of Machine Members, McGraw-Hill
4. Khurmi & Gupta, Machine Design, Eurasia Publishing House.
5. Stephen P. Radzevich, Dudley's Handbook of Practical Gear Design and Manufacture, CRC Press
6. Design Data book (PSG) for practical class, PSG College of Technology
7. Sadhu Singh, Machine Design, Khanna Publishers

ME – 604
POWER PLANT ENGINEERING

L	T	P
3	0	0

UNIT I

Introduction : Power and energy, sources of energy, review of thermodynamic cycles related to power plants, fuels and combustion calculations. Load estimation, load curves, various terms and factors involved in power plant calculations. Effect of variable load on power plant operation, Selection of power plant units.

Power plant economics and selection : Effect of plant type on costs, rates, fixed elements, energy elements, customer elements and investor's profit; depreciation and replacement, theory of rates. Economics of plant selection, other considerations in plant selection. **09**

UNIT –II

Steam power plant : General layout of steam power plant, Power plant boilers including critical and super critical boilers. Fluidized bed boilers, boilers mountings and accessories, Different systems such as coal handling system, pulverizers and coal burners, combustion system, draft, ash handling system, Dust collection system, Feed water treatment and condenser and cooling towers and cooling ponds, Turbine auxiliary systems such as governing, feed heating, reheating, flange heating and gland leakage. Operation and maintenance of steam power plant, heat balance and efficiency, Site selection of a steam power plant. **09**

UNIT III

Diesel power plant : General layout, Components of Diesel power plant, Performance of diesel power plant, fuel system, lubrication system, air intake and admission system, supercharging system, exhaust system, diesel plant operation and efficiency, heat balance, Site selection of diesel power plant, Comparative study of diesel power plant with steam power plant.

Gas turbine power plant : Layout of gas turbine power plant, Elements of gas turbine power plants, Gas turbine fuels, cogeneration, auxiliary systems such as fuel, controls and lubrication, operation and maintenance, Combined cycle power plants, Site selection of gas turbine power plant. **07**

UNIT IV

Nuclear power plant : Principles of nuclear energy, Lay out of nuclear power plant, Basic components of nuclear reactions, nuclear power station, Nuclear waste disposal, Site selection of nuclear power plants.

Hydro electric station : Hydrology, Principles of working, applications, site selection, classification and arrangements, hydroelectric plants, run off size of plant and choice of units, operation and maintenance, hydro systems, interconnected systems.

08

UNIT V

Electrical system : Generators and generator cooling, transformers and their cooling, bus bar, etc. Instrumentation Purpose, classification, selection and application, recorders and their use, listing of various control rooms.

Non Conventional Power Plants : Introduction to non-conventional power plants (Solar, wind, geothermal, tidal, Fuel cell based power plants etc.

Pollution : Pollution due to power generation. **07**

Textbooks:

1. P.K. Nag, Power Plant Engineering, Tata McGraw Hill.
2. R.Yadav, Steam & Gas Turbines & Power Plant Engineering, Central Pub.House.

Reference books:

1. F.T. Morse, Power Plant Engineering, Affiliated East-West Press Pvt. Ltd,.
2. Mahesh Verma, Power Plant Engineering, Metropolitan Book Company Pvt. Ltd.
3. M.M. El-Wakil, Power Plant Technology by McGraw Hill.

ME - 651
I. C. ENGINES LAB

L	T	P
0	0	2

Note :- At least **ten** experiments are to be conducted from the following list.

1. To determine Indicated H.P. of I.C. Engine by Morse Test.
2. To determine performance parameters and to draw heat balance of a S.I Engine.
3. To determine performance parameters and to draw heat balance of a C.I Engine
4. To study fuel injection system of C.I. Engine
5. To study different types of carburettors.
6. To determine volumetric efficiency of reciprocating compressor (2 stage with intercooling)
7. To analyze exhaust gas of an engine.
8. To study different components of I.C. Engine.
9. To study valve timing diagram of I.C. Engine.
10. To study the variation of performance parameters using alternate fuel in S.I. engine.
11. To study the variation of performance parameters using alternate fuel in C.I. engine.

ME – 652
THEORY OF MACHINES LAB

L	T	P
0	0	2

Note :- At least **ten** experiments are to be conducted from the following list.

1. To study simple linkage models/mechanisms
2. To study inversions of four bar linkage.
3. To study inversions of single/double slider crank mechanisms
4. To study gears tooth profile, interference etc.
5. To determine gear ratio for gear train.
6. To determine performance parameters for free vibrations.
7. To determine performance parameters for forced vibration.
8. To draw the characteristics curves for dead weight type governor.
9. To draw the characteristics curves for spring controlled governor.
10. To determine the critical speed of shaft.
11. To find out gyroscopic torque.
12. To perform experiment on static/dynamic balancing.

ME – 6051
OPERATIONS RESEARCH

L	T	P
3	0	0

UNIT-I

Introduction : Basic of Operation Research, Origin & development of Operation Research, Applications.

Linear Programming: Introduction & Scope, Problem formulation, Graphical Method, Simplex methods, primal and dual problem sensitivity analysis. **08**

UNIT-II

Transportation Problem : Methods of obtaining initial and optimum solution, degeneracy in transportation problems, unbalanced Transportation Problem.

Assignment Problem : Methods of obtaining optimum solution, Maximization problem, travelling salesman problem. **08**

UNIT-III

Game Theory : two person Zero sum game, Solution with/without saddle point, dominance rule, Different methods like Algebraic, Graphical and game problem as a special case of Linear Programming.

Sequencing : Basic assumptions, n Jobs through 2-3 machines, 2 Jobs on m machines. **08**

UNIT-IV

Stochastic inventory models : Single & multi period models with continuous & discrete demands, Service level & reorder policy.

Simulation : Use, advantages & limitations, Monte-carlo simulation, Application to queuing, inventory & other problems. **08**

UNIT-V

Queuing models : Characteristics of Queuing Model, M/M/1 and M/M/S system, cost consideration.

Project management : Basic Concept of network Scheduling, Rules for drawing network diagram, Applications of CPM and PERT techniques in Project planning and control; crashing of operations; resource allocation. **08**

Text Books:

1. Ravindran, Phillipsn & Solberg, Operations Research: Principles and Practice, Wiley & Sons.
2. Harvey M. Wagner, Principal of Operation Research, Prentice Hall.
3. Prem Kumar Gupta & D.S. Hira, Problems in Operations Research, S. Chand.
4. Yadav & Malik, Operation Research, Oxford University Press
5. Hamdy A. Taha, Operations Research - An Introduction, Pearson India.

Reference Books:

1. Gillett, Introduction to Operation Research, McGraw Hill.
2. Wayne L. Winston, Operation Research, Thomsan Learning.
3. Wayne L Winston, Operation Research Application and Algorithms, Duxbury Press.
4. Pradeep Jha, Operations Research, McGraw Hill.
5. Panneerselvam, Operations Research, PHI, India

ME – 6052
MECHANICAL SYSTEM DESIGN

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UNIT I

Engineering process and System Approach : Basic concepts of systems, Attributes characterizing a system, types of system, Application of system concepts, Advantages of system approach, Problems concerning systems, Concurrent engineering, A case study-Viscous lubrication system in wire drawing.

Problem Formulation : Nature of engineering problems, Need statement, hierarchical nature of systems, hierarchical nature of problem environment, problem scope and constraint, A case study: heating duct insulation system, high speed belt drive system. **08**

UNIT-II

System Theories : Introduction, System Analysis, Black box approach, state theory approach, component integration approach, Decision process approach, A case study- automobile instrumentation panel system.

System modelling : Introduction, Model types and purpose, linear systems, mathematical modeling, concepts, A case study compound bar system. **08**

UNIT-III

Graph Modeling and Analysis : Graph Modeling and analysis process, path problem, Network flow problem, A case study: Material handling system.

Optimization Concepts : Optimization processes, Selection of goals and objectives-criteria, methods of optimization, analytical, combinational, subjective. A case study: aluminium extrusion system. **08**

UNIT-IV

System Evaluation : Feasibility assessment, planning horizon, time value of money, Financial analysis, A case study: Manufacture of maize starch system.

Calculus Method for Optimization : Model with single decision variable, model with two decision variables, model with equality constraints, model with inequality constraints, A case study: Optimization of an insulation system. **08**

UNIT-V

Decision Analysis : Elements of a decision problem, decision making, under certainty, uncertainty risk and conflict probability, density function, Expected monetary value, Utility value, Baye's theorem, A case study: Installation of machinery.

System Simulation : Simulation concepts, simulation models, computer application in simulation, spread sheet simulation, Simulation process, problem definition, input model construction and solution, limitation of simulation approach, A case study: Inventory control in production plant. **08**

Text Books:

1. D D Meredith, K W Wong, R W Woodhead, and R H Wortman, Design and Planning of Engineering systems, Prentice Hall Inc
2. Dieter & Schmidt, Engineering Design, McGraw Hill
3. J R Dixon, Design Engineering, TMH, New Delhi
4. V Gupta and PN Murthy, An Introduction to Engineering Design Method, TMH

References Books:

1. Robert Matousck, Engineering Design: A Systematic Approach, London: Blackie
2. S S Rao, Engineering Optimization: Theory and Practice, John Wiley & Sons
3. Devid I Cleland, William R King, System Analysis and Project Management, McGraw Hill.

ME – 6053
SIX SIGMA

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UNIT I

Quality Perception; Quality in Manufacturing, Quality in Service Sector; Differences between Conventional and Six Sigma concept of quality; Six Sigma success stories. Statistical foundation and methods of quality improvement. Descriptive statistics: Data Type, Mean, Median, Mode, Range, Variation, Standard Deviation, Skewness, Kurtosis. Probability Distribution: Normal, Binomial, Poisson Distribution. **08**

UNIT II

Basics of Six Sigma: Concept of Six Sigma, Defects, DPMO, DPU, Attacks on X'S, Customer focus, Six Sigma for manufacturing, Six Sigma for service. Z score, Understanding Six Sigma organization, Leadership council, Project sponsors and champions, Master Black Belt, Black Belt, Green Belts. **08**

UNIT III

Methodology of Six Sigma, DMAIC, DFSS, Models of Implementation of Six Sigma, Selection of Six Sigma Projects. **08**

UNIT IV

Six Sigma Tools: Project Charter, Process mapping, Measurement system analysis, Hypothesis Testing, Quality Function deployment, Failure mode effect analysis, Design of Experiments. **08**

UNIT V

Sustenance of Six Sigma, Communication plan, Company culture, Reinforcement and control, Introduction to softwares for Six Sigma, Understanding Minitab, Graphical analysis of Minitab plots. **08**

Text Books :

1. Henderson, G. R, Six Sigma Quality Improvement with MINITAB, Wiley
2. Thomas Pyzdek & Paul Keller, The Six Sigma Handbook, McGraw Hill

References Books:

1. N A Siddiqui, Abhishek Dwivedi, Introduction to Six Sigma, New Age International Private Limited
2. William Truscott, Six Sigmaby Routledge.

ME – 6054
INDUSTRIAL ERGONOMICS

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UNIT I

Introduction : Importance applications and principles of occupational ergonomics. Physiological Principles: Muscular work, Nervous control of movements, Improving working efficiency. Optimal use of muscle strength. /Guidelines for work layout. Skilled work: Acquiring skill, control of skilled movements. Design of tools and equipments for skilled work. **08**

UNIT II

Heavy work : Energy consumption, Efficiency, Heart rate as a measure of workload. Work-station Design: Anthropometric data, Reach and clearance dimensions. Percentiles to be accommodated.**07**

UNIT III

Working Heights : Comfortable working postures. Room to grasp or move things, and operate controls. Sedentary work. Its advantages, disadvantages and limitation. Sedentary workplace design. Design of VDT workstations, Design of Key board. Handling Lads: The Human spine, back troubles associated with industrial work, Inter-vertebral disc, disc pressure, slip of disc, Bio-mechanical models of lower back.

Recommendations for handling loads. Man-Machine System: Display equipment, Controls, Relation between control and display instruments, Mental activity, Fatigue, Occupational stress, Job design in monotonous task. **09**

UNIT IV

Human Visual System : Accommodation, Aperture of the pupil, Adaptation of reline, eye movements Visual capacity, Visual strain, Physiology of reading. Ergonomic Principles of Lighting: Light sources, measurement, physiological requirements of artificial lighting, arrangement of light. Light for fine work and for VDT offices. **08**

UNIT V

Noise and Work Environment : Sound perception, Noise load, damage to hearing, physiological and psychological effects of noise. Protection against noise, Vibrations and their effect on performance. Working Environment: Thermo-regulation in human body, comfort indoors, Air quality and its dryness, Air pollution and ventilation. Heat in industry Recommendations for comfort indoors. Daylight, colours and music for pleasant work environment. **08**

Text Books :

1. E. Grandjean, Fitting The Task to the Man: A Textbook of Occupational Ergonomics, Taylor and Francis.
2. Helander, M., A guide to the Ergonomics of Manufacturing, CRC Press LLC.
3. Sanders, M.S., and McCormik, E.J., Human Factor in Engineering and Design, McGraw. Hill

References Books:

1. Babur Mustafa Pulat & David C. Alexander, Industrial Ergonomics: Case Studies, Inst of Industrial Engineers.
2. Gavriel Salvendy, Handbook of Human Factors and Ergonomics, Wiley.
3. Pamela McCauley-Bush, Ergonomics: Foundational Principles, Applications, and Technologies (Ergonomics Design & Mgmt. Theory & Applications), CRC Press

ME – 6055
ROBOTICS AND AUTOMATION

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UNIT I

Automation : History of Automation, Reasons for automation, Disadvantages of automation, Automation systems, Types of automation – Fixed, Programmable and Flexible automation, Automation strategies. Automated Manufacturing Systems: Components, classification and overview of manufacturing Systems, Flexible Manufacturing Systems (FMS), Types of FMS, Applications and benefits of FMS. **08**

UNIT II

Robotics : Definition of Robot, History of robotics, Robotics market and the future prospects, Robot Anatomy, Robot configurations: Polar, Cartesian, cylindrical and Jointed-arm configuration. Robot motions, Joints, Work volume, Robot drive systems, Precision of movement – Spatial resolution, Accuracy, Repeatability, End effectors – Tools and grippers. **08**

UNIT III

Controllers and Actuators : Basic Control System concepts and Models, Transfer functions, Block diagrams, characteristic equation, Types of Controllers: on-off, Proportional, Integral, Differential, P-I, P-D, P-I-D controllers. Control system and analysis. Robot actuation and feedback components, Position sensors – Potentiometers, resolvers, encoders, velocity sensors. Actuators - Pneumatic and Hydraulic Actuators, Electric Motors, Stepper motors, Servomotors, Power Transmission systems. **08**

UNIT IV

Robot Sensors and Machine vision system : Sensors in Robotics - Tactile sensors, Proximity and Range sensors, use of sensors in robotics.

Machine Vision System : Introduction to Machine vision, the sensing and digitizing function in Machine vision, Image processing and analysis, Training and Vision systems. **08**

UNIT V

Robots Technology of the future : Robot Intelligence, Advanced Sensor capabilities, Telepresence and related technologies, Mechanical design features, Mobility, locomotion and navigation, the universal hand, system integration and networking.

Artificial Intelligence : Goals of AI research, AI techniques – Knowledge representation, Problem representation and problem solving, LISP programming, AI and Robotics, LISP in the factory. **08**

Text Books

1. M.P. Groover, Automation, Production Systems and Computer Integrated Manufacturing Prentice Hall
2. M.P. Groover, Weiss & Nagel, Industrial Robotics, Technology, Programming and Applications, McGraw Hill.
3. Appu Kuttan K. K., Robotics, I. K. International Pvt Ltd

Reference Books

1. Fu, Lee and Gonzalez, Robotics, Control Vision and Intelligence, McGraw Hill International.
2. Klafter, Chmielewski and Negin, Robotic Engineering - An Integrated approach, Prentice Hall.