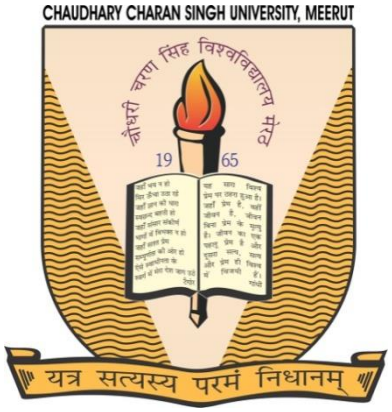
SIR CHOOTU RAM INSTITUTE OF ENGINEERING & TECHNOLOGY
CH. CHARAN SINGH UNIVERSITY, MEERUT



Program: B.TECH
Course :(Mechanical Engineering)

Session: 2017-18

Program: B.TECH

Course (Mechanical Engineering)
Program Code:
Year of Implementation:

Program Outcomes:

After successful completion of B.Tech(ME) program, the students would be able -

PO1-Establish a career in Mechanical and interdisciplinary areas.

PO2- Evolve engineering solution to the problems of Design, Manufacturing, Thermal and Industrial engineering domains.

PO3- Apply the acquired knowledge in Mechanical Engineering for the betterment of society.

PO4- Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PO5- Identify, formulate research literature and analyze complex engineering problems reaching sustainable conclusions using first principles of mathematics, natural sciences and engineering sciences.

PO6- Design solutions for complex engineering problems and design components or processes that meet specified needs with appropriate consideration for public health and safety, and cultural, societal and environmental considerations

PO7-Use research based – knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions

PO8- Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

	SESSION 2017-18		
Semester	**Course Code**	**Course**	**Course Outcome**
SEMESTER III	BT-314	Thermodynamics	CO 1-After completing this course, the students will be able to apply energy balance to systems andcontrol volumes, in situations involving heat and work teractions. CO2-Students can evaluate changes in thermodynamic properties of substances. CO3-The students will be able to evaluate the performance of energy conversion devices. CO4-The students will be able to differentiate between high grade and low-grade energies.
	BT-312	Materials Science	CO1-students will be able to identify crystal structure and defects in crystal structure CO2-Understand how to tailor material properties of ferrous and non-ferrous alloys. CO3-How to quantify mechanical integrity and failure in materials.
	BT-313	Strength Of Material	CO1-Understand the concept of stress and strain under different conditions of loading CO2-Determine the principal stresses and strains in structural members CO3-Determine the stresses and strains in the members subjected to axial, bending and torsional loads CO4-Apply the concepts of stresses and strain in solving problems related to springs, column and pressure vessels Calculate the slope, deflection and buckling of loaded members
	BT-322	Environmental Science	CO1-Gaining in-depth knowledge on natural processes that sustain life and govern economy. CO2-Predicting the consequences of human actions on the web of life, global economy and quality of human life. CO3-Developing critical thinking for shaping strategies (scientific, social, economic and legal) for environmental protection and conservation of biodiversity, social equity and sustainable development. CO4- Acquiring values and attitudes towards understanding complex environmentaleconomic-social challenges, and participating actively in solving current environmental problems and preventing the future ones. CO5-Adopting sustainability as a practice in life, society and industry.
	BT-311	Fluid Mechanics	CO1-Upon completion of this course, students will be able to mathematically analyze simple flowsituations.
	BT-305	Maths III	CO1-The objective of this course is to familiarize the students with partial differential equation, their application and statistical techniques. It aims to present the students with standard concepts and tools at an intermediate to superior level that will provide them well towards undertaking a variety of problems in the discipline.
	BT-363	Machine Drawing Lab	CO1- Upon completion of this course, the students can use computer and CAD software formodelling mechanical components.

	BT-361	Fluid Mechanics Lab	CO1- The students who have undergone the course will be able to measure various properties of fluids andcharacterize the performance of fluid/thermal machinery.
	BT-362	Material Science Lab	CO1- Students will study the crystal structure of the materials CO2-Understand the different types of defects
SEMESTER V	BT-519	Heat and Mass Transfer	CO1-Understand the fundamentals of heat and mass transfer. CO2-Apply the concept of steady and transient heat conduction. CO3-Apply the concept of thermal behavior of fins. CO4-Apply the concept of forced and free convection. CO5-Apply the concept of radiation for black and non black bodies. CO6-Conduct thermal analysis of heat exchangers.
	BT-569	Heat and Mass Transfer Lab	CO1 Conduct experiments on conduction, convection and radiation of heat; collect data, perform analysis and interpret results to draw valid conclusions through standard test procedures CO2 Determine thermal properties and performance of heat exchanger, vapour compression refrigerator and air conditioner
	BT-520	Internal Combustion Engine	CO1-Explain the working principle, performance parameters and testing of IC Engine. CO2-Understand the combustion phenomena in SI and CI engines and factors influencing combustion chamber design. CO3-Understand the essential systems of IC engine and latest trends and developments in IC Engines. CO4-Understand the effect of engine emissions on environment and human health and methods of reducing it. CO5-Apply the concepts of thermodynamics to air standard cycle in IC Engines CO6-Analyze the effect of various operating parameters on IC engine performance.
	BT-518	MANUFACTURING SCIENCE II	CO1-Student will be able to choose machining processing to manufacture any component CO2-Student will be able to Estimate machining time for milling and drilling process. CO3-Student will be able to understand finishing processes CO4-Student will be able to calculate forces during orthogo0l metal cutting. CO5-Student will be able to explain principle and applications of advanced machining processes
	BT-516	MACHINE DESIGN I	CO1- Recall the basic concepts of Solid Mechanics to understand the subject. CO2- Classify various machine elements based on their functions and applications CO3- Apply the principles of solid mechanics to machine elements subjected to staticand fluctuating loads. CO4- Design the machine elements to meet the required specification.

	BT-501	MANAGERIAL ECONOMICS	CO1-Apply the knowledge of the mechanics of supply and demand to explain working of markets CO2-Describe how changes in demand and supply affect markets Understand the choices made by a rational consumer CO3-Explain relationships between production and costs CO4-Define key characteristics and consequences of different forms of markets
	BT-566	MACHINE DESIGN LAB	CO1-Creation of part drawings and 3D models using CAD techniques. CO2-Ability to utilize experimental, statistical and computational methods and tools necessary for engineering practice.
	BT-568	Manufacturing Technology II LAB	CO1- Understand the casting process CO2- Perform different types of welding processes-gas welding,arc welding ,spot welding
VII SEMESTER	BT-701	OPERATION RESEARCH	CO1-Formulate and solve problems as networks and graphs. CO2-Develop linear programming (LP) models for shortest path, maximum flow, minimal spanning tree, critical path, minimum cost flow, and transshipment problems. CO3-Solve the problems using special solution algorithms.
	BT-723	COMPUTER AIDED DESIGN	CO1-Creation of part drawings and 3D models using CAD techniques. CO2- Generation of part programs for industrial components using CAM techniques.
	BT-721	COMPUTER AIDED MANUFACTURING	CO1-Skills to program and operate CNC machines. CO2- Ability to develop a product from conceptualization to reality.
	BT-722	MECHANICAL SYSTEM DESIGN	CO1-Students will understand how to prepare a needs-assessment for a given project 2. Students will learn how to define a deliverable and make a budget for a project 3. Students will learn successful group interaction for a project
	BT-724	AUTOMOBILE ENGINEERING	CO1-Know the different types of automobiles, basic structure of automobile CO2-Understand the basic engine system working CO3-Understand the transmission of power in automobile. CO4-Familiarise with fuel supply to automobile and understand the cooling system CO5-Explain the steering and braking system employed in automobiles CO6-Explain the different suspension system of an automobile and selection of tyre for an automobile CO7-Explain the Electrical and ignition system employed in Automobil
	BT-771	AUTOMOBILE ENGINEERING LAB	CO1- Understand the Construction, working and other details about Internal Combustion Engines used in automobiles CO2- Identify Construction, working, preventive maintenance, trouble shooting and diagnosis of various Automobile Systems

	BT-773	CAD/CAM LAB	CO1-To study design of machine components CO2- Understanding and use of 3-D Modelling Software CO3- To study the characteristic features of CNC machine.
	BT-772	INDUSTRIAL TRAINING	CO1-Student is able to understand management of manufacturing CO2-Student is able to apply work improvement techniques in an organization where he undergoes for in-plant training. CO3-Student is able to find out and reduce work content of the job.
	BT-774	PROJECT	CO1-Identify, visualize, formulate and solve engineering problems in the field of mechanical Engineering. CO2-Use the techniques, skills, and modern engineering tools necessary for engineering practice with appropriate considerations for societal, and environmental constraints. CO3-Apply their fundamental field skills towards the understanding of the impact of engineering solutions on the society in a global and social context.
IV SEMESTER	BT-404	NANO SCIENCE	CO1-Explain the fundamental principles of nanotechnology and their application to engineering. CO2-Apply engineering and physics concepts to the nano-scale and non-continuum domain. CO3-Identify and compare state-of-the-art nanofabrication methods and perform a critical analysis of the research literature. CO4-Design processing conditions to engineer functional nanomaterials
	BT-414	APPLIED THERMODYNAMICS	C01-After completing this course, the students will get a good understanding of various practicalpower cycles and heat pump cycles. CO2-They will be able to analyze energy conversion in various thermal devices such as combustors,air coolers, nozzles, diffusers, steam turbines and reciprocating compressors. CO3-They will be able to understand phenomena occurring in high speed compressible flows.
	BT-413	MANUFACTURING PROCESS I	CO1-Upon completion of This course, students will be able to understand the different conventionaland unconventional manufacturing methods employed for making different products
	BT-463	MANUFACTURING PROCESS LAB	CO1-The studend will practice different manufacturing processes i.e drilling,millng,shaping,turning CO2- learn to work on lathe machine
	BT-426	UNIVERSAL HUMAN VALUE	CO1-The students become sensitive towards human values. CO2-They understand commitment and responsibility. CO3-They gain the ability to bring harmony to the society they live.

	BT-405	MATHS	CO1-The objective of this course is to familiarize the students with partial differential equation, their application and statistical techniques. It aims to present the students with standard concepts and tools at an intermediate to superior level that will provide them well towards undertaking a variety of problems in the discipline.
	BT-412	MEASUREMENT AND METALLURGY	CO1 - Understand the methods of measurement and selection of measuring instruments ,standards of measurement CO2 - Identify and apply various measuring instruments CO3 - Explain tolerance, limits of size, fits, geometric and position tolerances and gauge design CO4 - Recommend the Quality Control Techniques and Statistical Tools appropriately CO5 - Analyze the Data collected CO6 - Develop an ability of problem solving and decision making by identifying and analyzing the cause for variation and recommend suitable corrective actions for quality improvement
	BT-462	MEASUREMENT AND METALLURGY LAB	C01-To apply the methods of measurement and selection of measuring instruments ,standards of measurement
	BT-464	MACHINE DRAWING LAB	CO1-Upon completion of this course, the students can use computer and CAD software formodellingmechanical components

VI SEMESTER	BT-621	Refregeration and Airconditioning	CO1 - Illustrate the fundamental principles and applications of refrigeration and air conditioning system CO2 - Obtain cooling capacity and coefficient of performance by conducting test on vapour compression refrigeration systems CO3 - Present the properties, applications and environmental issues of different refrigerants CO4 - Calculate cooling load for air conditioning systems used for various CO5 - Operate and analyze the refrigeration and air conditioning systems.

	BT-622	Machine Design II	CO1-Classify various machine elements based on their functions and applications. CO2-Apply the principles of solid mechanics to machine elements subjected to staticand fluctuating loads. CO3-Analyze forces, bending moments, twisting moments and failure causes in various machine elements to be designed. CO4-Design the machine elements to meet the required specification.
	BT-623	Theory Of Machine II	CO1-Determine the kinematic chain and mobility, and perform the kinematic analysis of a given mechanism, CO2-Apply the fundamental principles of statics and dynamics to machinery, CO3- Understand and avoid/suppress certain common dynamical problems a machine may undergo, CO4- Understand the fundamentals of machine design for desired kinematic or dynamic performance. CO5-Understand the fundamentals of mechanical vibrations.
	BT-673	THEORY OF MACHINE LAB	CO1- Perform the experiments to Understand the fundamentals of machine design for desired kinematic or dynamic performance. CO5-Understand the fundamentals of mechanical vibrations.
	BT-601	INDUSTRIAL MANAGMENT	CO1: Understand the concepts related to Business. CO2: Demonstrate the roles, skills and functions of management. CO3: Analyze effective application of PPM knowledge to diagnose and solve organizational problems and develop optimal managerial decisions. CO4: Understand the complexities associated with management of human resources in the organizations and integrate the learning in handling these complexities.
	BT-624	MECHATRONICS	CO1 - Identification of key elements of mechatronics system and its representation in terms of block diagram CO2 - Understanding the concept of signal processing CO3 - Interfacing of Sensors, Actuators
	BT-620	FLUID MACHINERY	CO1-Student will be able to understand the working of different types of turbine CO2- Student will be able to understand the working of different types of pump
	BT-670	FLUID MACHINERY LAB	CO1-Student will perform experiments tounderstand the working of different types of turbine CO2- Student will perform experiments tounderstand the working of different types of turbine
VIII SEMESTER	BT-822	PLANT LAYOUT AND MATERIAL HANDLING	CO1- Students will be able to use appropriate tools to generate and evaluate layout alternatives during the facilities planning process. CO2- Students will be able to solve facility location problems using relevant techniques. CO3- Students will be able to design and analyze material handling systems. CO4- The students will be able to understand how changes in one facilities planning and material handling system impact the integrated production system

	BT-801	NON CONVENTIONAL ENERGY RESOURCES	Co1-Understand of renewable and non-renewable sources of energy CO2-Gain knowledge about working principle of various solar energy systems CO3- Understand the application of wind energy and wind energy conversion system. CO4- Develop capability to do basic design of bio gas plant. CO5-Understand the applications of different renewable energy sources like ocean thermal, hydro, geothermal energy etc.
	BT-824	QUALITY CONTROL	CO1. To realize the importance of significance of quality CO2. Manage quality improvement teams CO3. Identify requirements of quality improvement programs
	BT-871	SEMINAR	CO1-Students will be able to show competence in identifying relevant information, defining and explaining topics under discussion. CO2-They will demonstrate depth of understanding, use primary and secondary sources; they will demonstrate complexity, insight, cogency, independent thought, relevance, and persuasiveness. CO3-They will be able to evaluate information and use and apply relevant theories. CO4-Students will be able to show competence in working with a methodology, structuring their oral work, and synthesizing information.
	BT-872	PROJECT	CO1-Identify, visualize, formulate and solve engineering problems in the field of mechanical Engineering. CO2-Use the techniques, skills, and modern engineering tools necessary for engineering practice with appropriate considerations for societal, and environmental constraints. CO3-Apply their fundamental field skills towards the understanding of the impact of engineering solutions on the society in a global and social context

TEACHING SCHEME AND EXAMINATIONS MARKS FOR : 3rd SEMESTER **YEAR -: 2017-18**

Branch: - Mechanical Engineering

S. No.	Subject Name	Subject Code	L – T - P	ESE Marks	Sessional		Total	Credit
					CT	TA		
1.	Fluid Mechanics	BT – 311	3-0-0	70	20	10	100	3
2.	Material Science	BT – 312	3-0-0	70	20	10	100	3
3.	Mechanics of Solids	BT – 313	3-0-0	70	20	10	100	3
4.	Thermodynamics	BT – 314	3-1-0	70	20	10	100	4
5.	Science Based Open Elective/ Mathematics – III	BT – / BT – 305	3-1-0	70	20	10	100	4
6.	Universal Human Values & Professional Ethics / Environment & Ecology	BT – 326 / BT – 322	3-0-0	70	20	10	100	3
7.	Fluid Mechanics Lab	BT – 361	0-0-2	50	30	20	100	1
8.	Material Science & Testing Lab	BT – 362	0-0-2	50	30	20	100	1
9.	Computer Aided Machine Drawing – I Lab	BT – 363	0-0-2	50	30	20	100	1
10.	Thermodynamics Lab	BT – 364	0-0-2	50	30	20	100	1
11.	Elements of Mechanical Engineering*	BT – 106*	3-1-0	70	20	10	100*	-
12.	Computer Aided Engineering Graphics*	BT – 158*	0-0-3	50	30	20	100*	-
	Total						**1000**	**24**

CT : Class Test **TA** : Teacher Assessment **L/T/P** : Lecture / Tutorial / Practical

***Science Based Open Electives:**

1. Neno Science - BT – 325
2. Polymer Science & Technology - BT – 321

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TEACHING SCHEME AND EXAMINATIONS MARKS FOR: 4th SEMESTER **YEAR -: 2017-18**

Branch: - Mechanical Engineering

S. No.	Subject Name	Subject Code	L – T - P	ESE Marks	Sessional		Total	Credit
					CT	TA		
1.	Electrical Machines & Controls	BT – 411	3-0-0	70	20	10	100	3
2.	Measurement and Metrology	BT – 412	3-0-0	70	20	10	100	3
3.	Manufacturing Science & Technology – I	BT – 413	3-0-0	70	20	10	100	3
4.	Applied Thermodynamics	BT – 414	3-1-0	70	20	10	100	4
5.	Science Based Open Elective/ Mathematics – III	BT – / BT – 405	3-1-0	70	20	10	100	4
6.	Universal Human Values & Professional Ethics / Environment & Ecology	BT – 426 / BT – 422	3-0-0	70	20	10	100	3
7.	Electrical Machines & Controls Lab	BT – 461	0-0-2	50	30	20	100	1
8.	Measurement and Metrology Lab	BT – 462	0-0-2	50	30	20	100	1
9.	Manufacturing Science & Technology - I Lab	BT – 463	0-0-2	50	30	20	100	1
10.	Computer Aided Machine Drawing - II Lab	BT – 464	0-0-2	50	30	20	100	1
11.	Elements of Mechanical Engineering*	BT – 206*	3-1-0	70	20	10	100*	-
12.	Computer Aided Engineering Graphics*	BT – 258*	0-0-3	50	30	20	100*	-
	Total						**1000**	**24**

CT : Class Test **TA** : Teacher Assessment **L/T/P** : Lecture / Tutorial / Practical

***B. Tech IInd year lateral entry students belonging to B. Sc. Stream, shall clear the subjects BT-158/BT-258 and BT-106/BT-206 of the first year Engineering Programme along with the second year subjects.**

NOTE: Practical summer training – 1 of 4-weeks after IV semester or Minor fabrication project will be evaluated in VII semester.

***Science Based Open Electives:**

1. Neno Science - BT – 425
2. Polymer Science & Technology - BT – 421

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TEACHING SCHEME AND EXAMINATIONS MARKS FOR: Vth SEMESTER **YEAR -: 2017-18**

Branch: - Mechanical Engineering

S. No.	Subject	Code No.	Theory			Code No.	Practical		
		Theory	Max. Marks	External	Internal	Practical	Max. Marks	External	Internal
1.	Engineering Economics	BT – 501	75	50	25	-	-	-	-
2.	Machine Design – I	BT – 516	75	50	25	-	-	-	-
3.	Kinematics of Machines	BT – 517	150	100	50	-	-	-	-
4.	Manufacturing Science & Technology – II	BT – 518	150	100	50	-	-	-	-
5.	Heat & Mass Transfer	BT – 519	150	100	50	-	-	-	-
6.	I. C. Engines & Compressors	BT – 520	150	100	50	-	-	-	-
7.	Machine Design – I Lab	-	-	-	-	BT – 566	50	30	20
8.	Manufacturing Technology - II Lab	-	-	-	-	BT – 568	50	30	20
9.	Heat & Mass Transfer Lab	-	-	-	-	BT – 569	50	30	20
10.	Seminar	-	-	-	-	BT – 570	50	-	50
11.	General Proficiency	-	-	-	-	GP	50	-	50

Grand Total of Theory & Practical = 1000

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TEACHING SCHEME AND EXAMINATIONS MARKS FOR: VIth SEMESTER **YEAR -: 2017-18**

Branch: - Mechanical Engineering

S. No.	Subject	Code No.	Theory			Code No.	Practical		
		Theory	Max. Marks	External	Internal	Practical	Max. Marks	External	Internal
1.	Industrial Management	BT – 601	75	50	25	-	-	-	-
2.	**Departmental Elective – II** Fluid Machinery	BT –620	75	50	25	-	-	-	-
3.	Refrigeration & Air-conditioning	BT – 621	150	100	50	-	-	-	-
4.	Machine Design – II	BT – 622	150	100	50	-	-	-	-
5.	Dynamics of Machines	BT – 623	150	100	50	-	-	-	-
6.	**Departmental Elective – I** Mechatronics	BT – 624	150	100	50	-	-	-	-
7.	Fluid Machinery Lab	-	-	-	-	BT – 670	50	30	20
8.	Refrigeration & Air-conditioning Lab	-	-	-	-	BT – 671	50	30	20
9.	Machine Design – II Lab	-	-	-	-	BT – 672	50	30	20
10.	Theory of Machines Lab	-	-	-	-	BT – 673	50	30	20
11.	General Proficiency	-	-	-	-	GP	50	-	50

Grand Total of Theory & Practical = 1000

Examination Controller

TEACHING SCHEME AND EXAMINATIONS MARKS FOR: VIIth SEMESTER **YEAR -: 2017-18**

Branch: - Mechanical Engineering

S. No.	Subject	Code No.	Theory			Code No.	Practical		
		Theory	Max. Marks	External	Internal	Practical	Max. Marks	External	Internal
1.	Operation Research	BT – 701	150	100	50	-	-	-	-
2.	Computer Aided Manufacturing	BT – 721	150	100	50	-	-	-	-
3.	Mechanical System Design	BT – 722	150	100	50	-	-	-	-
4.	CAD	BT – 723	150	100	50	-	-	-	-
5.	Automobile Engineering	BT – 724	150	100	50	-	-	-	-
6.	CAD/CAM Lab	-	-	-	-	BT – 773	50	30	20
7.	I. C. Engine And Automobile Lab	-	-	-	-	BT – 771	50	30	20
8.	Industrial Training	-	-	-	-	BT – 772	50	-	50
9.	Project	-	-	-	-	BT – 774	50	-	50
10.	General Proficiency	-	-	-	-	GP	50	-	50

Grand Total of Theory & Practical = 1000

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TEACHING SCHEME AND EXAMINATIONS MARKS FOR : VIIIth SEMESTER **YEAR -: 2017-18**

Branch: - Mechanical Engineering

S. No.	Subject	Code No.	Theory			Code No.	Practical		
		Theory	Max. Marks	External	Internal	Practical	Max. Marks	External	Internal
1.	Non-Conventional Energy Resources **Open Elective – II ****	BT – 801	150	100	50	-	-	-	-
2.	Advance Welding Technology **Departmental Elective – V**	BT – 821	150	100	50	-	-	-	-
3.	Plant Layout and Material Handling **Departmental Elective – VI**	BT – 822	150	100	50	-	-	-	-
4.	Quality Control	BT – 824	150	100	50	-	-	-	-
5.	Seminar	-	-	-	-	BT – 871	50	-	50
6.	Project	-	-	-	-	BT – 872	300	200	100
7.	General Proficiency	-	-	-	-	GP	50	-	50

Grand Total of Theory & Practical = 1000

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ME-III SEM Session: 2017-18

FLUID MECHANICS

UNIT I

Fluid and continuum, Physical properties of fluids, Rheology of fluids. Pressure-densityheight relationship, manometers, pressure transducers, pressure on plane and curved surfaces, centre of pressure, buoyancy, stability of immersed and floating bodies, fluid masses subjected to linear acceleration and uniform rotation about an axis.

UNIT II

Types of fluid flows: Continuum & free molecular flows. Steady and unsteady, uniform and non-uniform, laminar and turbulent flows, rotational and irrotational flows, compressible and incompressible flows, subsonic, sonic and supersonic flows, sub-critical, critical and supercritical flows, one, two and three dimensional flows, streamlines, continuity equation for 3D and 1D flows, circulation, stream function and velocity potential.

UNIT III

Potential Flow: source, sink, doublet and half-body. Equation of motion along a streamline and its integration, Bernoulli's equation and its applications- Pitot tube, orifice meter, venturimeter and bend meter, notches and weirs, momentum equation and its application to pipe bends. resistance to flow, Minor losses in pipe in series and parallel, power transmission through a pipe, siphon, water hammer, three reservoir problems and pipe networks.

UNIT IV

Equation of motion for laminar flow through pipes, Stokes' law, transition from laminar to turbulent flow, turbulent flow, types of turbulent flow, isotropic, homogenous turbulence, scale and intensity of turbulence, measurement of turbulence, eddy viscosity, mixing length concept and velocity distribution in turbulent flow over smooth and rough surfaces, Boundary layer thickness, boundary layer over a flat plate, laminar boundary layer, application of momentum equation, turbulent boundary layer, laminar sub-layer, separation and its control.

UNIT V

Drag and lift, drag on a sphere, a two dimensional cylinder, and an aerofoil, Magnus effect. Similarity Laws: geometric, kinematics and dynamic similarity, undistorted and distorted model studies, Dimensional analysis, Buckingham's Pi theorem, important dimensionless numbers and their significance.

References :

1. Hibbler, "Fluid Mechanicsin SI Units" 1/e Pearson Education, Noida.
2. Fox & Donald, "Introduction to Fluid Mechanics" John Wiley &Sons Pvt Ltd,
3. Cengel & Cimbala, "Fluid Mechanics" TMH, New Delhi.
4. Katz, "Introductory Fluid Mechanics" Cambridge University Press
5. Pnueli & Gutfinger, "Fluid Mechanics" Cambridge University Press
6. Modi & Seth "Hydraulics & Fluid Mechanics" Standard Publications.
7. Gupta, "Fluid Mechanics & Hydraulic Machines" Pearson Education, Noida
8. Graebel, "Engineering Fluid Mechanics", CRC Press Taylor & Francis Group.
9. Janna, "Introduction to Fluid Mechanics" 4/e, CRC Press Taylor & Francis Group.
10. AK Jain "Fluid Mechanics" Khanna Publication.
11. White,F.M. "Fluid Mechanics" TMH, New Delhi.
12. Munsen et al , "Fundamental of Fluid Mechanics" Wiley Newyork Ltd
13. Garde, R.J., " Fluid Mechanics", SciTech Publications Pvt. Ltd
14. I.H. Shames, "Mechanics of Fluids", McGraw Hill, Int. Student.
15. RK Bansal "Fluid Mechanics and Hydraulic Machines" Laxmi Publication
16. Jagdish Lal "Fluid Mechanics"
17. N Narayan Pillai " Principles of Fluid Mechanics & Fluid Machines" Universities Press.
18. Esposito, Fluid Power & Applications" 7/e Pearson Education, Noida.
19. DR Malhotra & Malhotra, "Fluid Mechanics Hydraulics & Hydraulic Machines" Satya Prakashan, New Delhi.

ME-III SEM Session: 2017-18

MATERIAL SCIENCE

UNIT I

Introduction: Importance of materials, historical perspective, Future aspects of engg. materials.Crystal Structure: brief on BCC, FCC and HCP Structures, coordination number and atomic packing factors. Bravais lattices, Miller indices, crystal imperfections-point line and surface imperfections. Atomic Diffusion: Phenomenon, Ficks laws of diffusion, factors affectingdiffusion.

Ferrous and non- ferrous materials: Properties, Composition and uses of Grey cast iron, malleable iron, SG iron and steel, copper alloys-brasses and bronzes, Aluminium alloys. Introduction to BIS & ASTM codes and practice on material and testing.

UNIT II

Mechanical Behaviour: Stress-strain diagram showing ductile and brittle behaviour ofmaterials, mechanical properties in plastic range, yield strength off set yield strength, ductility, ultimate tensile strength, toughness, Plastic deformation of single crystal by slip and twinning, Hardness Tests. Fracture Creep Fatigue: Fracture: Type I, Type II and Type III. Creep: Description of the phenomenon with examples. Three stages of creep, creep properties, stress relaxation. Fatigue: Types of fatigue loading with examples, Mechanism of fatigue, fatigue properties, fatigue testing and S-N diagram.

UNIT III

Solidification: Mechanism of solidification, Homogenous and Heterogeneous nucleation, crystal growth, cast metal structures. Phase Diagram I: Solid solutions Hume Rothary rule, substitutional and interstitial solid solutions, intermediate phases, Gibbs phase rule. Phase Diagram: Construction of equilibrium diagrams involving complete and partial solubility, lever rule. Iron carbon equilibrium diagram description of phases, solidification of steels and cast irons, invariant reactions.

UNIT IV

Heat Treating of Metals: TTT curves, continuous cooling curves, annealing and its types. Normalizing, hardening, tempering, mastempering, austempering, hardenability, surface hardening methods like carburizing, cyaniding, nitriding, flame hardening and induction hardening, age hardening of aluminium-copper alloys. Comparative study of microstructure of various Ferrous, nonferrous metals and alloys.

UNIT V

Composite materials: Definition, classification, types of matrix materials & reinforcements, fundamentals of production of FRP's and MMC's advantages and application of composites.
Ceramics: Structure types and properties and applications of ceramics. Mechanical/ Electricalbehavior and processing of Ceramics.
Plastics: Various types of polymers/ plastics and its applications. Mechanical behaviour and processing of plastics, Future of plastics. Introduction to Smart materials & Nano-materials and their potential applications.

Books and References:

1. Callisters Materials Science and Engineering, by William D. Callister, Jr, (Adopted by R. Balasubramaniam), Wiley India Pvt. Ltd
2. Elements of Material Science & Engineering by Van Vlack, Pearson
3. Material Science and Engineering by Smith, Hashemi and Prakash, MCGRAW HILL INDIA
4. The Science and Engineering of materials, by Askeland & Balani, Cengage Larning
5. Introduction to Materials Science for Engineers by Shackelford, Pearson
6. Material Science by Narula, MCGRAW HILL INDIA.
7. Materials Science and Engineering - A First Course by Raghavan, PHI
8. Material Science and Engineering Properties by Gilmore, Cengage Learning
9. Material Science for Engineering Students by Fischer, Academic Press
10. Technology of Engineering materials by Philip and Bolton, Butterworth-Heinamann

ME-III SEM Session: 2017-18

MECHANICS OF SOLIDS

UNIT I

Compound stress and strains: Introduction, normal stress and strain, shear stress and strain, stresses on inclines sections, strain energy, impact loads and stresses, state of plane stress, principal stress and strain, maximum shear stress, Mohr's stress circle, three dimensional stateof stress & strain, equilibrium equations, generalized Hook's law, theories of failure. Thermal Stresses.

UNIT II

Stresses in Beams: Pure Bending**,** normal stresses in beams, shear stresses in beams due to transverse and axial loads, composite beams.

Deflection of Beams: Equation of elastic curve, cantilever and simply supported beams, Macaulay's method, area moment method, fixed and continuous beams

Torsion: Torsion, combined bending & torsion of solid & hollow shafts, torsion of thinwalled tubes.

UNIT III

Helical and Leaf Springs: Deflection of springs by energy method, helical springs under axial load and under axial twist (respectively for circular and square cross sections) axial load and twisting moment acting simultaneously both for open and closed coiled springs, laminated springs.

Columns and Struts: Buckling and stability, slenderness ratio, combined bending and direct stress, middle third and middle quarter rules, struts with different end conditions, Euler's theory for pin ended columns, effect of end conditions on column buckling, Ranking Gordon formulae, examples of columns in mechanical equipments and machines.

UNIT IV

Thin cylinders & spheres: Introduction, difference between thin walled and thick walled pressure vessels, Thin walled spheres and cylinders, hoop and axial stresses and strain,volumetric strain.

Thick cylinders:

Radial, axial and circumferential stresses in thick cylinders subjected to internal or external pressures, compound cylinders, stresses in rotating shaft and cylinders, stresses due to interference fits.

UNIT V

Curved Beams: Bending of beams with large initial curvature, position of neutral axis for rectangular, trapezoidal and circular cross sections, stress in crane hooks, stress in circular rings subjected to tension or compression.

Unsymmetrical Bending: Properties of beam cross-section, slope of neutral axis, stress and deflection in unsymmetrical bending, determination of shear center and flexural axis (for symmetry about both axis and about one axis) for I-section and channel section.

Books and References:

1. Mechanics of Materials by Hibbeler, Pearson.
2. Mechanics of material by Gere, Cengage Learning
3. Mechanics of Materials by Beer, Jhonston, DEwolf and Mazurek, MCGRAW HILLINDIA
4. Strength of Materials by Pytel and Singer, Harper Collins
5. Strength of Materials by Ryder, Macmillan.
6. Strength of Materials by Timoshenko and Yσungs, East West Press.
7. Introduction to Solid Mechanics by Shames, Pearson
8. Mechanics of material by Pytel, Cengage Learning
9. An Introduction to Mechanics of Solids by Crandall, MCGRAW HILL INDIA
10. Strength of Materials by Jindal, Pearson Education
11. Strength of Material by Rattan, MCGRAW HILL INDIA
12. Strength of Materials by Basavajaiah and Mahadevappa, University Press.

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THERMODYNAMICS

UNIT I

Review of Fundamental Concepts and Definitions: Introduction- Basic Concepts: System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Exact & Inexact Differentials, Cycle Reversibility Quasi – static Process, Irreversible Process, Causes of Irreversibility Energy and its forms, Work and heat (sign convention), Gas laws, Ideal gas, Real gas, Law of corresponding states, Dalton's law, Amagat's law, Property of mixture of gases. **Zeroth law of thermodynamics:** Concept of Temperature and its' measurement, Temperature scales.

First law of thermodynamics: Thermodynamic definition of work, Displacement work and flow work, Displacement work for various non flow processes, Joules' experiment, First law analysis for closed system (non flow processes), Internal energy and enthalpy. Limitations of first law of thermodynamics, PMM-I. Steady flow systems and their analysis, Steady flow energy equation, Boilers, Condensers, Turbine, Throttling process, Pumps etc. Analysis of unsteady processes such as filling and evacuation of vessels with and without heat transfer.

UNIT II

Second law of thermodynamics: Thermal reservoirs, Energy conversion, Heat engines, Efficiency, Reversed heat engine, Heat pump, Refrigerator, Coefficient of Performance, Kelvin Planck and Clausius statement of second law of thermodynamics, Equivalence of the two statements. Reversible and irreversible processes, Carnot cycle and Carnot engine, Carnottheorem and it's corollaries, Thermodynamic Temperature Scale, PMM-II.

Entropy : Clausius inequality, Concept of Entropy, Entropy change of pure substance in different thermodynamic processes, Tds equation, Principle of entropy increase, T-S diagram, Statement of the third law of thermodynamics.

UNIT III

Availability and Irreversibility: Available and unavailable energy, Availability and Irreversibility, Second law efficiency, Helmholtz & Gibb's function.
Thermodynamic relations: Conditions for exact differentials. Maxwell relations, Clapeyron equation, Joule-Thompson coefficient and Inversion curve. Coefficient of volume expansion, Adiabatic and Isothermal compressibility.

UNIT IV

Properties of steam and Rankine cycle: Pure substance, Property of Pure Substance (steam), Triple point, Critical point, Saturation states, Sub-cooled liquid state, Superheated vapour state, Phase transformation process of water, Graphical representation of pressure, volume and temperature, P-T, P-V and P-h diagrams, T-S and H-S diagrams, use of property diagram, Steam-Tables &Mollier chart, Dryness factor and it's measurement, processes involving steam in closed and open systems. Simple Rankine cycle.

Air-water vapour mixture and Psychrometry: Psychometric terms and their definitions, Psychometric chart, Different Psychometric processes and their representation on Psychometric chart.

UNIT V

Refrigeration Cycles: Reversed Carnot Cycle for gas and vapour. Refrigeration capacity,unit of refrigeration.Air Refrigeration cycles; Reversed Brayton Cycle and Bell Coleman Cycle. Vapour compression refrigeration cycle; simple saturated cycle and actual vapour compression refrigeration cycle. Analysis of cycles, effect of superheating, sub-cooling and change in evaporator and condenser pressure on performance of vapour compression refrigeration cycle. Refrigerants; their classification and desirable properties. Vapour absorption refrigeration system.

Books and References:

1. Basic and Applied Thermodynamics by PK Nag, MCGRAW HILL INDIA
2. Thermodynamics for Engineers by Kroos & Potter, Cengage Learning
3. Thermodynamics by Shavit and Gutfinger, CRC Press.
4. Thermodynamics- An Engineering Approach by Cengel, MCGRAW HILL NDIA.
5. Basic Engineering Thermodynamics, Joel, Pearson.
6. Fundamentals of Engineering Thermodynamics by Rathakrishnan, PHI.
7. Engineering Thermodynamics by Dhar, Elsevier.
8. Engineering Thermodynamics by Onkar Singh, New Age International.
9. Engineering Thermodynamics by CP Arora.
10. Engineering Thermodynamics by Rogers, Pearson.
11. Fundamentals of Engineering Thermodynamics by Moran, Shapiro, Boettner, &Bailey, John Wiley.
12. Engineering Thermodynamics by Mishra, Cengage Learning
13. Refrigeration and Air Conditioning by C P Arora, MCGRAW HILL IN

ME-III SEM Session: 2017-18

Mathematics-III

UNIT–I: Function of Complex variable: Analytic function, C-R equations, Harmonic Functions, Cauchy's integral theorem, Cauchy's integral formula, Derivatives of analytic functions, Taylor's and Laurent's series, Singularities, Zeroes and Poles, Residue theorem, Evaluation of real integrals of the type $\int ff(\cos\theta\theta, \sin\theta\theta)dddd\ aaaaaa \int ff(xx)dddd$.

UNIT–II: Statistical Techniques: Moments, Moment generating functions, Skewness, Kurtosis, Curve fitting, Method of least squares, Fitting of straight lines, Polynomials, Exponential curves, Correlation, Linear, non–linear and multiple regression analysis, Binomial, Poisson and Normal distributions, Tests of significations: Chi-square test, t-test.

UNIT–III: Numerical Techniques–I: Zeroes of transcendental and polynomial equations using Bisection method, Regula-falsi method and Newton-Raphson method, Rate of convergence of above methods. Interpolation: Finite differences, Newton's forward and backward interpolation, Lagrange's and Newton's divided difference formula for unequal intervals.

UNIT–IV: Numerical Techniques–II: Solution of system of linear equations, Matrix Decomposition methods, Jacobi method, Gauss- Seidel method. Numerical differentiation, Numerical integration, Trapezoidal rule, Simpson's one third and three-eight rules, Solution of ordinary differential equations (first order, second order and simultaneous) by Euler's, Picard's and fourth-order Runge- Kutta methods.

UNIT–V: [This unit contains two parts. Students have to read only one part of this unit as question paper will contain questions from both the parts with choice.] Numerical Techniques-III: Boundary Value Problem, Finite Difference Method, Eigen Value Problems, Condition Number, Polynomial Method, Power Method, Numerical solution of partial differential equations, Elliptic, parabolic and Hyperbolic equations.

OR

Integral Transforms: Fourier integral, Complex Fourier transform, Inverse Transforms, Convolution Theorems, Fourier sine and cosine transform, Applications of Fourier transform to simple one dimensional heat transfer equations, wave equations and Laplace equations, Z- transform and its application to solve difference equations.

Test Books:

1. Peter V. O'Neil, Advance Engineering Mathematics Thomson (Cengage) Learning, 2007.
2. Jain, Iyenger & Jain, Numerical Methods for Scientific and Engineering Computation, New Age International, New Delhi.
3. JN Kapur, Mathematical Statistics, S. Chand & company Ltd.
4. BS Grewal, Higher Engineering Mathematics, Khanna Publishers.

Reference Books:

1. RK Jain & SRK Iyenger, Advance Engineering Mathematics, Narosa Publication House.
2. Chandrika Prasad, Advanced Mathematics for Engineers, Prasad Mudralaya, 1996.
3. S. S. Sastry, Introductory Methods of Numerical Analysis, PHI Learning Pvt. Limited, New Delhi
4. E. Balagurusamy, Numerical Methods, Tata McGraw-Hill Publishing Company Limited, New Delhi
5. T. Veerajan& T. Ramchandrandran, Theory & Problems in Numerical Methods, TMH, New Delhi.

ENVIRONMENT & ECOLOGY

ME-III SEM Session: 2017-18

UNIT-I: Oeflnit loo, Soope & Importance, Need For Publk Awarene:ss• Environment definition, Eco system - Balanced ecosystem, Human activities - Food, Shelter, Eco.nomic and social Security. Effects or hum.an activities on envlronment·Agriculture, Housing, Industry, Mining nd Transportation activities, Bask$ of Environmental Impact As.sessment. Sustainable Development.

UNIT-II: Natural Resources• Water Resources· Availablhty ond Quality aspects. Water borne diseases, Water Induced diseases, Fluoride problem indrinking water. Mineral Resources, Fore$1 Wealth, Material cyycles-- Carbon, Nitroogen and Sulphur Cydes.Energy - Oifferent types of energy, Elec.tro•ma&netic radiation. Conventional and Non-Conventional sources - Hydro Electric, Fossil Fuet based, Nudear, Solar, Biomass and Bio.gas. H'ydrogen as an alternative future sou rce of Energy.

UNIT-III: Environmental Pollutlon and their effects. Water pollution, Land pollution. Noke pollution, Public Health aspec.ts, Air Pollution, SOiid waste management, e-waste management Current Environmental Issues of Importance: Population Growth, Climate Change and Global warming- Efretts, Urbaniution, Automobile pollution.
Acid Rain Ozone Layer depletion, Animal Husbandry,

UNIT-IV: Environmental Pollutlon and their effects. Water pollution, Land pollution. Noke pollution, Public Health aspec.ts, Air Pollution, SOiid waste management, e-waste management Current Environmental Issues of Importance: Population Growth, Climate Change and Global warming- Efretts, Urbaniution, Automobile pollution. Acid Rain Ozone Layer depletion, Animal Husbandry.

Text Books

1.Environmental Studies -Benny Joseph- Tata McgrawHiU-200S
2.Environme,H-al Studies- Or. D.l. Manjunath, Pearson Education-2006.
3.Envlronmental studies - R, Rajagop-illan -Oxford Pubtioti,on • 200S.
4.Text book of Environmental S<::ience & Techno\ogy- M. Anji Reddy- US Publication .

Reference Books

l.P,iociples ot Environmental SC It-nee and Engineer'l'lg -P. Venugoplan Rao, Pteritlce Hall of India.
2.E nvlron 1\,ental Sc ience and Engi neering **Mecoa kshi,** Prentice Hall In dia

ME-III SEM **Session: 2017-18**

FLUID MECHANICS LAB

Note: Ensure to conduct at least 10 experiments from the list:

1. To verify the momentum equation using the experimental set-up on impact of jet.
2. To determine the coefficient of discharge of an orifice of a given shape. Also to determine the coefficient of velocity and the coefficient of contraction of the orifice mouth piece.
3. To calibrate an orifice meter and study the variation of the co-efficient of discharge with the Reynolds number.
4. To calibrate a Venturimeter and study the variation of the co-efficient of discharge with the Reynolds number.
5. To calibrate a bend meter and study the variation of the co-efficient of discharge with the Reynolds number.
6. To draw a flow-net using Electrical Analogy Method.
7. To study the transition from laminar to turbulent flow and to determine the lower critical Reynolds number.
8. To study the velocity distribution in a pipe and also to compute the discharge by integrating the velocity profile.
9. To study the variation of friction factor, 'f' for turbulent flow in commercial pipes.
10. To study the boundary layer velocity profile over a flat plate and to determine the boundary layer thickness.
11. To determine Meta-centric height of a given ship model.
12. To determine the head loss for a sudden enlargement
13. To determine the head loss for a sudden Contraction.

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MATERIALS SCIENCE AND TESTING LAB

(A). Experiments on Material Science (at least 5 of the following):

1. Preparation of a plastic mould for small metallic specimen.
2. Preparation of specimen for micro structural examination-cutting, grinding,polishing, etching.
3. Determination of grain size for a given specimen.
4. Comparative study of microstructures of different specimens of different materials(mild steel, gray C.I., brass, copper etc.)
5. Experiments on heat treatment such as annealing, normalizing, quenching, casehardening and comparison of hardness before and after heat reatment.
6. Material identification of, say, 50 common items kept in a box.
7. Experiment on Faraday's law of electrolysis.
8. Study of corrosion and its effects.
9. Study of microstructure of welded component and HAZ. Macro & microexamination of the welded specimen.
10. Study of Magnetic/ Electrical/Electronic materials.

(B) Experiments on Material Testing (at least 5 of the following):

1. Strength test of a given mild steel specimen on UTM with full details and stressversus strain plot on the machine.
2. Other tests such as shear, bend tests on UTM.
3. Impact test on impact testing machine like Charpy, Izod or both.
4. Hardness test of given specimen using Rockwell and Vickers/Brinell testingmachines.
5. Spring index test on spring testing machine.
6. Fatigue test on fatigue testing machine.
7. Creep test on creep testing machine.
8. Experiment on deflection of beam, comparison of actual measurement of deflectionwith dial gauge to the calculated one, and or evaluation of young's modulus of beam.
9. Torsion test of a rod using torsion testing machine.
10. Study of NDT (non-destructive testing) methods like magnetic flaw detector,ultrasonic flaw detector, eddy current testing machine, dye penetrant tests.

ME-III SEM **Session: 2017-18**

COMPUTER AIDED MACHINE DRAWING-I LAB

Introduction (1 drawing sheets)

Introduction, classification of machine drawings, principles of drawing, conventional representation of machine components and materials, lines, types of lines, dimensioningtypes, lines and rules of dimensioning.

Orthographic Projections (3 drawing sheets)

Introduction to orthographic projection, concept of first angle and third angle projection, drawing of simple machine elements in first angle projection, missing line problems, principleof visualization of objects, sectional views, full and half sectional views, auxiliary views.

Fasteners (2 drawing sheets)

Temporary and permanent fasteners, thread nomenclature and forms, thread series,designation, representation of threads, bolted joints, locking arrangement of nuts, screws, washers, foundation bolts etc., keys, types of keys, cotter and knuckle joints.

Riveted joints (1 drawing sheet)

Introduction, rivets and riveting, types of rivets, types of riveted joints, drawing of boilerjoints etc.

Assembly drawing (2 drawing sheets)

Introduction to assembly drawing, drawing assembly drawing of simple machine elements like rigid or flexible coupling, muff coupling, plummer block, footstep bearing, bracket etc.

Free hand sketching (1 drawing sheet**)**

Introduction, Need for free hand sketching, Free hand sketching of foundation bolts, studs, pulleys, couplings etc.

Computer aided drafting (1 drawing**)**

Introduction to computer aided drafting; advantages and applications of CAD, concepts of computer aided 2D drafting using any drafting software like AutoCAD, Solid Edge, Draft Sight etc., basic draw and modify commands, making 2D drawings of simple machine parts.

Books and References:

1. Fundamentals of Machine Drawing by Sadhu Singh & Shah, PHI
2. Engineering Drawing by Bhat, & Panchal, Charotar Publishing House
3. Machine Drawing with AutoCAD by Pohit and Ghosh, Pearson
4. Machine Drawing-KL Narayana, P Kannaiah, KV Reddy, New Age
5. Machine Drawing, N. Siddeshswar, P Kannaiah, VVS Shastry, Tata McGraw Hill
6. Engineering Drawing, Pathak, Wiley
7. Textbook of Machine Drawing, K C John, PHI
8. AutoCAD 2014 for Engineers & Designers, Bhatt, WILEY
9. Engineering Graphics with AutoCAD, Bethune, PHI

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THERMODYNAMICS LAB

Minimum 10 experiments out of following;

1. Study of Fire Tube boiler
2. Study of Water Tube boiler
3. Study and working of Two stroke petrol Engine
4. Study and working of Four stroke petrol Engine
5. Determination of Indicated H.P. of I.C. Engine by Morse Test
6. Prepare the heat balance sheet for Diesel Engine test rig
7. Prepare the heat balance sheet for Petrol Engine test rig
8. Study and working of two stroke Diesel Engine
9. Study and working of four stroke Diesel Engine.
10. Study of Velocity compounded steam turbine
11. Study of Pressure compounded steam turbine
12. Study of Impulse & Reaction turbine
13. Study of steam Engine model.
14. Study of Gas Turbine Model
15. Any other suitable experiment(s) on thermodynamics

ME-IV SEM Session: 2017-18

ELECTRICAL MACHINES & CONTROLS

UNIT I

Single phase Transformer: Efficiency Voltage regulation, O.C.& S.C. Tests. **Three Phase Transformer:** Three phase transformer connections, 3-phase to 2-phase or 6-phase connections and their applications. **Auto Transformer:** Volt- Amp relations, efficiency,advantages & disadvantages, applications. **D.C. Motors:** Concept of starting, speed control, losses and efficiency.

UNIT II

Three phase Induction Motor: Construction, equivalent circuit, torque equation and torque- slip characteristics, speed control. **Alternator:** Construction, e.m.f. equation, Voltage regulation and its determination by synchronous impedance method. **Synchronous Motor:** Starting, effect of excitation on line current (V-curves), synchronous condenser. **Servo Motor:** Two phase A.C. servo motor & its application.

UNIT III

Modeling of Mechanical System: linear mechanical elements, force-voltage and force current analogy, electrical analog of simple mechanical systems; concept of transfer function & its determination for simple systems. **Control System:** Open loop & closed loop controls, servo mechanisms; concept of various types of system. **Signals:** Unit step, unit ramp, unit impulse and periodic signals with their mathematical representation and characteristics**.**

UNIT IV

Time Response Analysis: Time response of a standard second order system and response specifications, steady state errors and error constants. **Stability:** Concept and types of stability, Routh Hurwitz Criterion and its application for determination of stability, limitations; Polar plot, Nyquist stability Criterion and assessment of stability.

UNIT V

Root Locus Techniques: Concept of root locus, construction of root loci. **Frequency Response Analysis:** Correlation between time and frequency responses of a second order system; Bode plot, gain margin and phase margin and their determination from Bode and Polar plots. **Process control:** Introduction to P, PI and PID controllers their characteristics, representation and applications.

Text and Reference Books:

1. IJ Nagrath & D. P. Kothari, “Electrical machines” Tata McGraw Hill.
2. BR Gupta & Vandana Singhal, “Fundamentals of Electrical Machines”, New AgeInternational.
3. K. Ogata, “Modern Control Engineering” Prentice Hall of India.
4. BC Kuo, “Automatic Control systems.” Wiley India Ltd.
5. Irvin L. Kosow, “Electric Machinery and Transformers” Prentice Hall of India.
6. D. Roy Choudhary, “Modern Control Engineering” Prentice Hall of India.
7. M. Gopal, Control Systems: Principles and Design” Tata McGraw Hill.

ME-V SEM Session: 2017-18

MACHINE DESIGN-I

- CO1- Recall the basic concepts of Solid Mechanics to understand the subject.
- CO2- Classify various machine elements based on their functions and applications
- CO3- Apply the principles of solid mechanics to machine elements subjected to staticand fluctuating loads.
- CO4- Design the machine elements to meet the required specification

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 for Static Load

Modes of failure, Factor of safety, Principal stresses, Stresses due to bending and torsion, Theory of failure.

UNIT II

Design for 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.

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.

UNIT IV

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.

UNIT V

Keys and Couplings

Types of keys, splines, Selection of square & flat keys, Strength of sunk key, Couplings, Design of rigid andflexible couplings.

Power Screws

Forms of threads, multiple threads, Efficiency of square threads, Trapezoidal threads, Stresses in screws,Design of screw jack

Note: Design data book is allowed in the examinationBooks and References:

1. Design of Machine Elements,V.B. Bhandari, Tata McGraw Hill Co.
2. Machine Design-Sharma and Agrawal, S.K. Kataria& Sons.
3. Machine Design, U C Jindal, Pearson Eductaion.
4. Design of Machine Elements, Sharma and Purohit, PHI.
5. Design of Machine Elements-M.F. Spott, Pearson Eductaion
6. Machine Design-Maleev and Hartman, CBS Publishers.
7. Mechanical Engineering Design, 9e – Joseph E. Shigely, McGraw Hill Education.
8. Elements of Machine Component Design, Juvinal&Marshek, John Wiley & Sons.

ME-V SEM Session: 2017-18

HEAT & MASS TRANSFER

UNIT-1

Introduction to Heat Transfer:

Thermodynamics and Heat Transfer. Modes of Heat Transfer: Conduction, convection and radiation. Effectof temperature on thermal conductivity of materials; Introduction to combined heat transfer mechanism.

Conduction :

General differential heat conduction equation in the rectangular, cylindrical and spherical coordinatesystems.Initial and boundary conditions.

Steady State one-dimensional Heat conduction :

Simple and Composite Systems in rectangular, cylindrical and spherical coordinates with and without energy generation; Concept of thermal resistance.Analogy between heat and electricity flow; Thermal contact resistance and over all heat transfer coefficient; Critical radius of insulation.

UNIT-2 Fins:

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

Transient Conduction:

Transient heat conduction; Lumped capacitance method; Time constant; Unsteady state heat conduction inone dimension only, Heisler charts.

UNIT-3

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; Thermal entrance region, Empirical heat transfer relations; Relation between fluid friction and heat transfer;Liquid metal heat transfer.

5

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.

5

3

UNIT-4

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.

8

UNIT-5

Heat Exchanger :

Types of heat exchangers; Fouling factors; Overall heat transfer coefficient; Logarithmic mean temperaturedifference (LMTD) method; Effectiveness-NTU method; Compact heat exchangers.

3

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 convection boiling.

3

Introduction to Mass Transfer:

Introduction; Fick's law of diffusion; Steady state equimolar counter diffusion; Steady state diffusionthough a stagnant gas film.

Books:

1. Fundamentals of Heat and Mass Transfer, by Incroperra& DeWitt, John Wiley and Sons
2. Heat and Mass Transfer by Cengel, McGraw-Hill
3. Heat Transfer by J.P. Holman, McGraw-Hill
4. Heat and Mass Transfer by Rudramoorthy and Mayilsamy, Pearson Education
5. Heat Transfer by Ghoshdastidar, Oxford University Press
6. A text book on Heat Transfer, by Sukhatme, University Press.
7. Heat Transfer by Venkateshan, Ane Books Pvt Ltd
8. Schaum's outline of Heat Transfer by Pitts & Sisson McGraw-Hill
9. Heat and Mass Transfer by R Yadav, Central Publishing House

ME-V SEM Session: 2017-18

MANUFACTURING SCIENCE& TECHNOLOGY-II

CO1-Student will be able to choose machining processing to manufacture any component
CO2-Student will be able to Estimate machining time for milling and drilling process. CO3-Student will be able to understand finishing processes CO4-Student will be able to calculate forces during orthogo0l metal cutting.
CO5-Student will be able to explain principle and applications of advanced machining processes

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. Heat generation and cutting tool temperature, 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.

9

Unit-II *Machine Tools*

(i) Lathe: Principle, construction, types, operations, Turret/capstan, semi/Automatic, Tool layout

2

(ii) Shaper, slotter, planer: Construction, operations & drives.

1

(iii) Milling: Construction, Milling cutters, up & down milling. Dividing head & indexing. Max chipthickness & power required.

2

(iv) Drilling and boring: Drilling, boring, reaming tools. Geometry of twist drills.

2

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

4

(ii) Super finishing: Honing, lapping and polishing.

1

Limits, Fits & Tolerance and Surface roughness:

Introduction to Limits, Fits, Tolerances and IS standards, Limit-gauges, and surface-roughness.

3

Unit-IV

B. 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, frictionwelding. Soldering & Brazing. Adhesive bonding.
Thermodynamic and Metallurgical aspects in welding and weld, Weldability, Shrinkage/residual stress in welds. Distortions & Defects in welds andremedies.
Weld decay in HAZ

Unit-V

C. Introduction to Unconventional 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. Introduction to Hybrid machining processes

Books and References:

1. Manufacturing Science – A. Ghosh and A.K. Mallik,Affiliated East-West Press
2. Fundamentals of Metal Machining and Machine Tools – Geoffrey Boothroyd, CRC Press
3. Production Technology - R.K. Jain Khanna Publishers.
4. Introduction to Manufacturing Processes – John A. Schey ,McGraw-Hill
5. Production Engineering Science - P.C. Pandey,Standard Publishers Distributors,
6. Modern Machining Processes - P.C. Pandey& H.S. Shan, McGraw-Hill
7. Degarmo's Materials and Processes in Manufacturing - Ernest P. De Garmo, J. T. Black,Ronald A. Kohser, Wiley
8. Fundamentals of Metal Cutting & Machine Tools – B.L. Juneja& G.S. ShekhonWiley
9. Process &Materials of Manufacturing – R.A. Lindburg, Pearson Eductaion
10. Advanced Machining Process - VK Jain ,Allied Publishers
11. Manufacturing Engineering & Technology, -Kalpakjian, Pearson
12. Manufacturing Technology Part I and Part II,-Rao,PN, McGraw-Hill

ME-V SEM Session: 2017-18

I C ENGINES & COMPRESSORS

CO1-Explain the working principle, performance parameters and testing of IC Engine.

CO2-Understand the combustion phenomena in SI and CI engines and factors

influencing combustion chamber design.

CO3-Understand the essential systems of IC engine and latest trends and developments in IC Engines.

CO4-Understand the effect of engine emissions on environment and human health and methods of reducing it.

CO5-Apply the concepts of thermodynamics to air standard cycle in IC Engines CO6-Analyze the effect of various operating parameters on IC engine performance.

Unit-1

Introduction to I.C Engines: Engine classification and basic terminology, Two and four stroke engines,SI and CI engines, Valve timing diagram.
Thermodynamic analysis of Air standard cycles, Otto cycle, Diesel cycle, Dual cycle, Stirling cycle,Ericsson cycles, Comparison of Otto, Diesel and Dual cycles
Fuel air cycle, factors affecting the fuel air cycle, Actual cycle.

8

Unit–II

SI Engines: Combustion in SI engine, Flame speed, Ignition delay, Abnormal combustion and it'scontrol, combustion chamber design for SI engines.
Carburetion, Mixture requirements, Carburetors and fuel injection system in SI Engine
Ignition system requirements, Magneto and battery ignition systems, ignition timing and spark plug,Electronic ignition, Scavenging in 2 Stroke engines, Supercharging and its effect

9

Unit–III

CI Engine: Combustion in CI engines, Ignition delay, Knock and it's control, Combustion chamberdesign of CI engines.
Fuel injection in CI engines, Requirements, Types of injection systems, Fuel pumps, Fuel injectors,Injection timings
Exhaust emissions from SI engine and CI engine and it's control

9

Unit-IV

Engine Cooling and Lubrication: Different cooling systems, Radiators and cooling fans, Engine friction, Lubrication principle, Type of lubrication, Lubrication oils, Crankcase ventilation.
Fuels: Fuels for SI and CI engine , Important qualities of SI and CI engine fuels, Rating of SI engine and CI engine fuels, Dopes, Additives, Gaseous fuels, LPG, CNG, Biogas, Producer gas, Alternative fuels for IC engines.
Testing and Performance: Performance parameters, Basic measurements, Blow by measurement, Testing of SI and CI engines

9

Unit V

Compressors: Classification, Reciprocating compressors, Single and Multi stage compressors,Intercooling, Volumetric efficiency.
Rotary compressors, Classification, Centrifugal compressor , Axial compressors, Surging and stalling,Roots blower, Vaned compressor.

7

BOOKS:

1. Fundamentals of Internal Combustion Engine by Gill, Smith,Ziurs, Oxford & IBH Publishing CO.
2. Fundamentals of Internal Combustion Engines by H.N. Gupta, Prentice Hall of India
3. A Course in International Combustion Engines, by Mathur& Sharma, DhanpatRai& Sons.

4. I.C Engine Analysis & Practice by E.F Obert.
5. I.C Engine, by Ganeshan, Tata McGraw Hill Publishers.
6. I.C Engine, by R. Yadav, Central Publishing House, Allahabad
7. Reciprocating and Rotary Compressors, by Chlumsky, SNTI Publications, Czechoslovakia
8. Turbines, Compressors and Fans, by S.M.Yahya, Tata McGraw Hill Pub.
9. Engineering Fundamentals of Internal Combustion Engines by W.W. Pulkrabek,,Pearson Eductaion

ME-V SEM Session: 2017-18

Design and Simulation - Lab I

CO1-Creation of part drawings and 3D models using CAD techniques.
CO2-Ability to utilize experimental, statistical and computational methods and tools necessary for engineering practice.

Minimum eight experiments out of the following are to be performed.
Students are advised to use design data book for the design. Drawing shall be made wherevernecessary on small drawing sheets

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

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HEAT & MASS TRANSFER – LAB

CO1 Conduct experiments on conduction, convection and radiation of heat; collect data, perform analysis and interpret results to draw valid conclusions through standard test procedures

CO2 Determine thermal properties and performance of heat exchanger, vapour compression refrigerator and air conditioner

Minimum eight experiment of the following

1. Conduction – Experiment on Composite plane wall
2. Conduction – Experiment on Composite cylinder wall
3 Conduction - Experiment on critical insulation thickness
4. Conduction – Experiment on Thermal Contact Resistance
5. Convection - Pool Boiling experiment
6. Convection - Experiment on heat transfer from tube-(natural convection).
7. Convection - Heat Pipe experiment.
8. Convection - Heat transfer through fin-(natural convection) .
9. Convection - Heat transfer through tube/fin-(forced convection).
10 Convection - Determination of thermal conductivity of fluid
11 Experiment on Stefan's Law, on radiation determination of emissivity, etc.
12 Experiment on solar collector, etc.
13. Heat exchanger - Parallel flow experimentHeat exchanger - Counter flow experiment

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MANUFACTURING TECHNOLOGY-II – LAB

CO1- Understand the casting process
CO2- Perform different types of welding processes-gas welding, arc welding, spot welding

Mini**mum eight experiments out of the following along-with study of the machines / processes**

1. Shear-angle determination (using formula) with tube cutting (for orthogonal) on lathe machine.
2. Bolt (thread) making on Lathe machine
3. Tool grinding (to provide tool angles) on tool-grinder machine.
4. Gear cutting on Milling machine.
5. Machining a block on shaper machine.
6. Finishing of a surface on surface-grinding machine.
7. Drilling holes on drilling machine and study of twist-drill.
8. Study of different types of tools and its angles & materials.
9. Experiment on tool wear and tool life.
10. Experiment on jigs/Fixtures and its uses
11. Gas welding experiment
12. Arc welding experiment
13. Resistance welding experiment.
14. Soldering & Brazing experiment

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FLUID MACHINERY

UNIT-I

Introduction: Impulse of Jet and Impulse Turbines:

Classification of Fluid Machines & Devices, Application of momentum and moment of momentum equation to flow through hydraulic machinery, Euler's fundamental equation. Introduction to hydrodynamic thrust of jet on a fixed and moving surface (flat &curve), Classification of turbines, Impulse turbines, Constructional details, Velocitytriangles, Power and efficiency calculations, Governing of Pelton wheel

8

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.

8

UNIT-III

CentrifugalPumps:

Classifications of centrifugal pumps, Vector diagram, Work done by impellor, Efficiencies ofcentrifugal pumps, Specific speed, Cavitation & separation, Performance characteristics.

8

UNIT-IV

Positive Displacement and other Pumps:

Reciprocating pump theory, Slip, Indicator diagram, Effect of acceleration, air vessels,Comparison of centrifugal and reciprocating pumps, Performance characteristics.

UNIT-V

Hydraulic accumulator, Hydraulic intensifier, Hydraulic Press, hydraulic crane, hydraulic lift,hydraulic Ram,hydraulic coupling, hydraulic torque converter, air lift pump, jet pump.

Spoken Tutorial (MOOCs):

Spoken Tutorial MOOC, 'Course on OpenFOAM', IIT Bombay(http://spoken-tutorial.org/)**BOOKS:**

1. Hydraulic Machines by Jagdish Lal, Metropolitan book co. pvt ltd.
2. Hydraulic Machines by K Subramanya, Tata McGraw Hill
3. Fluid Mechanics and Machinery by C.S.P.Ojha, R. Berndtsson, P.N. Chandramouli,Oxford University Press
4. Fluid Mechanics and Fluid Power Engineering by D S Kumar, S K Kataria& Sons
5. Fluid Mechanics and Turbo machines by Das, PHI
6. Fluid Power with Applications, by Esposito, Pearson
7. Fluid Mechanics and hydraulic machines by Modi& Seth, Standard Book House
8. Fundamentals of Turbomachinery by Venkanna B.K., PHI
9. Hydraulic Machines: Theory & Design, V.P.Vasandhani, Khanna Pub.
10. Fluid Mechanics and Hydraulic Machines by SukumarPati, Tata McGraw Hill

ME-VI SEM Session: 2017-18

THEORY OF MACHINES

Unit I

Introduction, mechanisms and machines, kinematics and kinetics, types of links, kinematic pairs and their classification, types of constraint, degrees of freedom of planar mechanism, Grubler's equation, mechanisms, inversion of four bar chain, slider crank chain and double slider crank chain.

Velocity analysis:

Introduction, velocity of point in mechanism, relative velocity method, velocities in four bar mechanism, instantaneous center .

Acceleration analysis:

Introduction, acceleration of a point on a link, acceleration diagram, Corioli's component of acceleration, crank and slotted lever mechanism,.

Unit II

Cams

Introduction, classification of cams and followers, cam profiles for knife edge, roller and flat facedfollowers for uniform velocity, uniform acceleration,

Gears and gear trains

Introduction, classification of gears, law of gearing, tooth forms and their comparisons, systems of gear teeth, length of path of contact, contact ratio, minimum number of teeth on gear and pinion to avoid interference, simple, compound, reverted and planetary gear trains, sun and planet gear train.

Unit III

Force analysis:

Static force analysis of mechanisms, D'Alembert's Principle, dynamics of rigid link in plane motion, dynamic force analysis of planar mechanisms, piston force and crank effort. Turning

moment on crankshaft due to force on piston, Turning moment diagrams for single cylinder double acting steam engine, four stroke IC engine and multi-cylinder engines, Fluctuation of speed, Flywheel.

Unit IV

Balancing:**Introduction,static balance, dynamic balance, balancing of rotating masses,two planebalancing,**

graphical and analytical methods, balancing of reciprocating masses,

Governors:

Introduction, types of governors, characteristics of centrifugal governors, gravitycontrolledand spring controlled centrifugal governors, hunting of centrifugal governors, inertia

governors. Effort and Power of governor

Unit V

Brakes and dynamometers:

Introduction, Law of friction and types of lubrication, types of brakes, effect of braking on rear and front wheels of a four wheeler, dynamometers, belt transmission dynamometer, torsion dynamometer, hydraulic dynamometer

Text/Reference Books:

1. Kinematics and dynamics of machinery: Wilson and Sadler, Third edition, Pearson.
2. Theory of Mechanisms and Machines: AmitabhaGhosh and Ashok kumarMallik, ThirdEdition
3. Affiliated East-West Press.
4. Theory of Machines and Mechanisms: Joseph Edward Shigley and John JosephUicker, Jr.
5. Oxford University Press
6. Kinematics and dynamics of machinery: R L Norton, McGraw Hill
7. Theory of Machines: S.S. Rattan, McGraw Hill
8. Theory of Machines: Thomas Bevan, CBS Publishers.

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MACHINE DESIGN-II

CO1-Classify various machine elements based on their functions and applications.

CO2-Apply the principles of solid mechanics to machine elements subjected to staticand fluctuating loads.

CO3-Analyze forces, bending moments, twisting moments and failure causes in variousmachine elements to be designed.

CO4-Design the machine elements to meet the required specification.

UNIT I

Principle of transmission and conjugate action**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.

6

Helical Gears

Terminology, Proportions for helical gears, Forces components on a tooth of helical gear, Virtual number of teeth, Beam strength& wear strength of helical gears, Dynamic load on helical gears, Design of helical gears.

UNIT II Bevelgears

Terminology of bevel gears, Force analysis, Virtual number of teeth, Beam strength and wear strengthof bevel gears,Effective load of gear tooth, Design of a bevel gear system.

4

Worm Gears

Types of worms, Terminology, Gear tooth proportions, Efficiency of worm gears, Heat dissipation inworm gearing, Strength and wear tooth load for worm gears, Design of worm gearing system.

4

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,

6

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

6

UNIT V

IC ENGINE parts,

Selection of type of IC engine, General design considerations, Design of cylinder and cylinder head; Design of piston and its parts like piston ring and gudgeon pin etc.; Design of connecting rod; Design ofcrankshaft

Note: Design data book is allowed in the examination

Books and References:

1. Design of Machine Elements-V.B. Bhandari, Tata McGraw Hill Co.
2. Machine Design-Sharma and Agrawal, S.K. Kataria& Sons.
3. Machine Design, U C Jindal, Pearson Eductaion.
4. Design of Machine Elements, Sharma and Purohit, PHI.
5. Design of Machine Eesign-M.F. Spott, Pearson Eductaion
6. Machine Design-Maleev and Hartman, CBS Publishers.
7. Mechanical Engineering Design, 9e – Joseph E. Shigely, McGraw Hill Education.
9. Elements of Machine Component Design, Juvinal&Marshek, John Wiley & Sons.

ME-VI SEM Session: 2017-18

REFRIGERATION & AIR CONDITIONING

Unit-1

Refrigeration:Introduction to refrigeration system, Methods of refrigeration, Carnot refrigeration cycle,

Unit ofrefrigeration, Refrigeration effect & C.O.P.

Air Refrigeration cycle:

Open and closed air refrigeration cycles, Reversed Carnot cycle, Bell Coleman or Reversed Joule air refrigeration cycle, Aircraft refrigeration system, Classification of aircraft refrigeration system. Boot strap refrigeration, Regenerative, Reduced ambient, Dry air rated temperature (DART).

8

Unit-2

Vapour Compression System:

Single stage system, Analysis of vapour compression cycle, Use of T-S and P-H charts, Effect of change in suction and discharge pressures on C.O.P, Effect of sub cooling of condensate & superheating of refrigerant vapour on C.O.P of the cycle, Actual vapour compression refrigeration cycle, Multistage vapour compression system requirement, Removal of flash gas, Intercooling, Different configuration of multistage system, Cascade system.

8

Unit-3

Vapour Absorption system;

Working Principal of vapour absorption refrigeration system, Comparison between absorption & compression systems, Elementary idea of refrigerant absorbent mixtures, Temperature – concentration diagram & Enthalpy – concentration diagram , Adiabatic mixing of two streams, Ammonia – Water vapour absorption system, Lithium- Bromide water vapour absorption system, Comparison. Three fluid system.

5

Refrigerants:

Classification of refrigerants, Nomenclature, Desirable properties of refrigerants, Common refrigerants, Secondary refrigerants and CFC free refrigerants. Ozone layer depletion and global warming considerations of refrigerants

3

Unit-4

Air Conditioning:

Introduction to air conditioning, Psychometric properties and their definitions, Psychometric chart, Different Psychometric processes, Thermal analysis of human body, Effective temperature and comfort chart, Cooling and heating load calculations, Selection of inside & outside design conditions, Heat transfer through walls & roofs, Infiltration & ventilation, Internal heat gain, Sensible heat factor (SHF), By pass factor, Grand Sensible heat factor (GSHF), Apparatus dew point (ADP). Air Washers, Cooling towers & humidifying efficiency.

9

Unit-5

Refrigeration Equipment & Application:

Elementary knowledge of refrigeration & air conditioning equipmentse.g compressors, condensers, evaporators & expansion devices, Food preservation, Cold storage, Refrigerates Freezers, Ice plant, Water coolers, Elementary knowledge of transmission and distribution of air through ducts and fans, Basic difference between comfort and industrial air conditioning.

7

Books:

1. Refrigeration and Air conditioning by C.P Arora, McGraw-Hill
2. Refrigeration and Air conditioning, by Manohar Prasad, New Age International (P) Ltd.Pub.
3. Refrigeration and Air conditioning by R. C. Arora, PHI
4. Principles of Refrigeration by Roy J. Dossat. Pearson Education
5. Refrigeration and Air conditioning by stoecker& Jones. McGraw-Hill
7. Refrigeration and Air conditioning by Arora&Domkundwar. DhanpatRai
7. Thermal Environment Engg. byKuhen, Ramsey &Thelked.

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FLUID MACHINERY Lab

Minimum ten experiments out of the following along with study of the machines and processes

1. Impact of Jet experiment.
2. Experiment on Pelton wheel.
3. Experiment on Francis turbine.
4. Experiment on Kaplan turbine.
5. Experiment on Reciprocating pump.
6. Experiment on centrifugal pump.
7. Experiment on Hydraulic Jack/Press
8. Experiment on Hydraulic Brake
9. Experiment on Hydraulic Ram
10. Study through visit of any water pumping station/plant
11. Any other suitable experiment/test rig such as comparison & performance of different typesof pumps and turbines.
12. Experiment on Compressor
13. Experiment for measurement of drag and lift on aerofoil in wind tunnel

ME-VI SEM Session: 2017-18

THEORY OF MACHINES LAB

CO1- Perform the experiments to Understand the fundamentals of machine design for desired kinematic or dynamic performance.

CO5-Understand the fundamentals of mechanical vibrations.

Minimum eight experiments out of the following:

1. Study of simple linkage models/mechanisms
2. Study of inversions of four bar linkage
3. Study of inversions of single/double slider crank mechanisms
4. Experiment on Gears tooth profile, interference etc.
5. Experiment on Gear trains
6. Experiment on longitudinal vibration
7. Experiment on transverse vibration
8. Experiments on dead weight type governor
9. Experiment on spring controlled governor
10. Experiment on critical speed of shaft
11. Experiment on gyroscope
12. Experiment on static/dynamic balancing
13. Experiment on Brake
14. Experiment on clutch

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Design And Simulation - Lab II **L T P**

0 0 2

A. Computer and Language :students are required to learn the basics of computer language such as Cand C++ so that they should be able to write the computer programme (*3practical turns*)

B. Writing Computer programme for conventional design: Students are required to write computerprogram and validate it for the design of machine components done in theory subject (*5practical turns*)

C. Mini Project: Each **s**tudent will be given a real life problem for the complete design of asubsystem/system using either manual calculation with the help of design handbook or through computer programme, if needed. This will be done as home assignment to be submitted at the end of the semester.

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REFRIGERATION & AIR CONDITIONING Lab

Minimum eight experiments out of the following:

1. Experiment on refrigeration test rig and calculation of various performance parameters.
2. Study of different types of expansion devices used in refrigeration system.
3. Study of different types of evaporators used in refrigeration systems.
4. To study basic components of air-conditioning system.
5. Experiment on air-conditioning test rig & calculation of various performance parameters.
6. Experiment on air washers
7. Study of window air conditioner.
8. Study & determination of volumetric efficiency of compressor.
9. Visit of a central air conditioning plant and its detailed study.
10. Visit of cold-storage and its detailed study.
11. Experiment on Ice-plant.
12. Experiment on two stage Reciprocating compressor for determination of volumetric efficiency ,PV diagram and effect of intercooling.
13. Study of Hermetically sealed compressor.
14. Experiment on Desert coolers.

ME-VI SEM Session: 2017-18

MECHATRONICS AND MICROPROCESSOR

CO1 - Identification of key elements of mechatronics system and its representation in terms of block diagram
CO2 - Understanding the concept of signal processing
CO3 - Interfacing of Sensors, Actuators

Unit 1

Introduction, synergy of systems, definition of mechatronics, applications of mechatronics in design and modeling, actuators and sensors, intelligent controls, robotics, manufacturing etc., objectives,advantages and disadvantages of mechatronics, examples of mechatronics systems in industry.

Mechanical components in mechatronics, force, friction and lubrication, materials, mechanical behavior of materials, mechanisms used in mechatronics, lever and four bar mechanisms, bearing, belt, chain, cam, slider crank, clutches etc.

8

Unit II

Electronics elements in mechatronics, conductors, insulators and semiconductors, passive electrical components, resistors, capacitor and inductor, transformer, active elements, semiconductor devices, transistors and integrated circuits, digital electronics components like logic gates, flip-flops, shiftregister, multiplexer and counter.

Computing elements in mechatronics, analog computer, timer, analog to digital converter, digital to analog converter, digital computer, microprocessor and its architecture, micro-controllers, programming logic controllers, their basic structures, mnemonics.

8

Unit III

System modeling and analysis, control system concepts, transfer function of physical systems, block diagrams representation of systems, transfer function of a system, standard input signals, time response of a first and second order systems to a step input, frequency response analysis, automatic control systems, digital control systems.

Motion control devices, actuator types & application areas, hydraulic and pneumatic actuators, electrical actuators, DC servomotor, AC servomotor and stepper servomotor, micro-actuators, drive selection and applications.

8

Unit IV

Sensors and transducers, their static and dynamic performance characteristics, internal sensors, external sensors and micro-sensors, sensors for displacement, position and proximity; velocity, motion, force, fluid pressure, liquid flow, liquid level, temperature, light sensors, selection of Sensors.

Stages in designing mechatronics systems, traditional and mechatronic design, possible design solutions, case studies of mechatronics systems, pick and place robot, automatic car park systems, engine management systems etc.

8

Unit V

Mechatronics in industry, autotronics, bionics and avionics and their various applications, mechatronics in manufacturing, features of mechatronics in manufacturing, flexible manufacturing systems, manufacturing automatic protocol, computer integrated manufacturing, just in time production systems, CNC machines, adaptive control machine system, CNC machine operations, challenges in mechatronics production units.

BOOKS & REFERENCES:

1. A Kuttan, "Introduction to Mechatronics, Oxford University Press, 2010.
2. Alciatore&Histand, "Introduction to Mechatronics & Measurement Systems, 4e", McGraw-Hill Education, 2014.
3. M Jouaneh, "Fundamentals of Mechatronics", Cengage Learning, 2013.
4. W. Bolton, "Mechatronics", Pearson Education, Second Edition, 1999.
5. Bradley D. A., Dawson D., Buru N.C. and. Loader A.J, "Mechatronics", Chapman and Hall,1993.
6. Dan Necsulesu, "Mechatronics", Pearson Education Asia, 2002 (Indian Reprint).
7. NitaigourPremchandMahadik, "Mechatronics", McGraw-Hill Education, 2015.
8. Lawrence J. Kamm, "Understanding Electro – Mechanical Engineering, An Introduction toMechatronics", Prentice – Hall of India Pvt., Ltd., 2000.
9. Ramachandran K. P., Vijayaraghavan G. K., Balasundaram M.S. "Mechatronics: IntegratedMechanical Electronic Systems", Wiley

ME-VII SEM Session: 2017-18

COMPUTER AIDED DESIGN (CAD)

UNIT-I

Introduction: Introduction to CAD/CAED/CAE, Elements of CAD, Essential requirements of CAD, Concepts of integrated CAD/CAM, Necessity & its importance, Engineering Applications Computer Graphics-I CAD/CAM systems,

Computer Graphics-I Graphics Input devices-cursor control Devices, Digitizers, Keyboard terminals, Image scanner, Speech control devices and Touch, panels, Graphics display devices- Cathode Ray Tube, Random & Raster scan display, Color CRT monitors, Direct View Storage Tubes, Flat Panel display, Hard copy printers and plotters

8

UNIT-II

Computer Graphics-II Graphics standards, Graphics Software, Software Configuration, Graphics Functions, Output primitives- Bresenham's line drawing algorithm and Bresenham's circle generating algorithm Geometric Transformations: World/device Coordinate Representation, Windowing and clipping, 2 D Geometric transformations-Translation, Scaling, Shearing, Rotation & Reflection Matrix representation, Composite transformation, 3 D transformations, multiple transformation .

8

UNIT-III

Curves: Curves representation, Properties of curve design and representation, Interpolation vs approximation, Parametric representation of analytic curves, Parametric continuity conditions, Parametric representation of synthetic curves-Hermite cubic splines-Blending function formulation and its properties, Bezier curves-Blending function formulation and its properties, Composite Bezier curves, B-spline curves and its properties, Periodic and non-periodic B-spline curves

8

UNIT-IV

3D Graphics: Polygon surfaces-Polygon mesh representations, Quadric and Superquadric surfaces and blobby objects; Solid modeling-Solid entities, Fundamentals of Solid modeling-Set theory, regularized set operations; Half spaces, Boundary representation, Constructive solid geometry, Sweep representation, Color models. Basic application commands for 2d drafting software like AutoCAD/Draftsight (any one)&3d solid modeling software Solidworks/Autodesk Inventor/PTC Creo /Catia (Any one)etc.

8

UNIT-V

Finite Element Analysis: Basic concept of the finite element method, comparison of FEM with direct analytical solutions; Steps in finite element analysis of physical systems, Finite Element analysis of 1-D problems like spring, bar, truss and beam elements formulation by direct approach; development of elemental stiffness equations and their assembly, solution and its post processing.

8

Books and References:

1. Computer Graphics, by Hearn & Baker, Prentice Hall of India
2. CAD/CAM, by Groover and Zimmers, Prentice Hall India Ltd.
3. CAD/CAM :Theory and Practice, by Zeid, McGraw Hill
4. CAD/CAM: Computer Aided Design and Manufacturing, by Groover, Pearson India
5. Mathematical Elements for Computer Graphics, buy Rogers and Adams, McGraw Hill
6. Finite Element Method By S S Rao
7. FE Analysis Theory and Programming, by Krishnamoorthy, Tata McGraw Hill

ME-VII SEM Session: 2017-18

AUTOMOBILE ENGINEERING

CO1-Know the different types of automobiles, basic structure of automobile
CO2-Understand the basic engine system working
CO3-Understand the transmission of power in automobile.
CO4-Familiarise with fuel supply to automobile and understand the cooling system
CO5-Explain the steering and braking system employed in automobiles
CO6-Explain the different suspension system of an automobile and selection of tyre for an automobile
CO1-Know the different types of automobiles, basic structure of automobile
CO2-Understand the basic engine system working
CO3-Understand the transmission of power in automobile.
CO4-Familiarise with fuel supply to automobile and understand the cooling system
CO5-Explain the steering and braking system employed in automobiles
CO6-Explain the different suspension system of an automobile and selection of tyre for an automobile
CO7-Explain the Electrical and ignition system employed in Automobile

UNIT-I

Introduction:

Basic concepts of Automobile Engineering and general configuration of an automobile, Power and Torque characteristics. Rolling, air and gradient resistance. Tractive effort. Gear Box. Gear ratio determination.

6

UNIT-II

Transmission System:

Requirements. Clutches. Toque converters. Over Drive and free wheel, Universal joint. Differential Gear Mechanism of Rear Axle. Automatic transmission, Steering and Front Axle. Castor Angle, wheel camber & Toe-in, Toe-out etc.. Steering geometry. Ackerman mechanism, Understeer and Oversteer.

8

UNIT-III

Braking System:

General requirements, Road, tyre adhesion, weight transfer, Braking ratio. Mechanical brakes,Hydraulic brakes. Vacuum and air brakes. Thermal aspects.

5

Chasis and Suspension System:

Loads on the frame, Strength and stiffness, Independent front & rear suspension, Perpendicular arm type, Parallel arm type, Dead axle suspension system, Live axis suspension system,Air suspension & shock absorbers.

5

UNIT-IV

Electrical System :

Types of starting motors, generator & regulators, lighting system, Ignition system, Horn, Batteryetc.

5

Fuel Supply System:

Diesel & Petrol vehicle system such as Fuel Injection Pump, Injector & Fuel Pump, Carburetoretc. MPFI.

4

UNIT-V

Emission standards and pollution control :

Indian standards for automotive vehicles-Bharat I and II, Euro-I and Euro-II norms, fuel quality standards, environmental management systems for automotive vehicles, catalytic converters, fueladditives and modern trends in automotive engine efficiency and emission control.

Maintenance system: Preventive maintenance, break down maintenance and over hauling.

2

Books and References:

1. Automotive Engineering- Hietner
2. Automobile Engineering - Kripal Singh.
3. Automobile Engineering - Narang.
4. Automobile Engineering –TTTI, Pearson India
5. Automotive Mechanics- Crouse
6. Automobile Engineering - Newton and Steeds.
7. Automobile Engineering –Ramakrishna, PHI, India

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-751:CAD/CAM LAB

Total TEN Experiments are to carried out. FIVE Experiments each from CAD and CAM.

A. CAD Experiments

1. Line Drawing or Circle Drawing experiment: Writing and validation of computerprogram.
2. Geometric Transformation algorithm experiment for translation/rotation/scaling: Writingand validation of computer program.
3. Design of machine component or other system experiment: Writing and validation ofcomputer program.
4. Understanding and use of any 3-D Modeling Software commands.
5. Pro/E/Idea etc. Experiment: Solid modeling of a machine component
6. Writing a small program for FEM for 2 spring system and validation of program or usinga FEM Package
7. Root findings or curve fitting experiment: Writing and validation of computer program.
8. Numerical differentiation or numerical integration experiment: Writing and validation ofcomputer program.

B. CAM Experiments

1. To study the characteristic features of CNC machine
2. Part Programming (in word address format) experiment for turning operation (includingoperations such as grooving and threading) and running on CNC machine
3. Part Programming (in word address format or ATP) experiment for drilling operation(point to point) and running on CNC machine
4. Part Programming (in word address format or ATP) experiment for milling operation(contouring) and running on CNC machine
5. Experiment on Robot and programs
6. Experiment on Transfer line/Material handling
7. Experiment on difference between ordinary and NC machine, study or retrofitting
8. Experiment on study of system devices such as motors and feed back devices
9. Experiment on Mecatronics and controls

ME-VII SEM Session: 2017-18

I.C. ENGINES AND AUTOMOBILE LAB

CO1- Understand the Construction, working and other details about Internal Combustion Engines used in automobiles

CO2- Identify Construction, working, preventive maintenance, trouble shooting and diagnosis of various Automobile Systems

Experiments: Say minimum 10 experiments out of following in depth and details.

1. Performance Analysis of Four stroke S.I. Engine- Determination of indicated and brakethermal efficiency, specific fuel consumption at different loads, Energy Balance.
2. Determination of Indicated H.P. of I.C. Engine by Morse Test.
3. Performance Analysis of Four stroke C.I. Engine- Determination of indicated and brakethermal efficiency, specific fuel consumption at different loads, Energy Balance.
4. Study & experiment on Valve mechanism.
5. Study & experiment on Gear Box.
6. Study & experiment on Differential Gear Mechanism of Rear Axle.
7. Study & experiment on Steering Mechanism.
8. Study & experiment on Automobile Braking System.
9. Study & experiment on Chassis and Suspension System.
10. Study & experiment on Ignition system of I.C. Engine.
11. Study & experiment on Fuel Supply System of S.I. Engines- Carburetor, Fuel InjectionPump and MPFI.
12. Study & experiment on Fuel Supply System of C.I. Engines- Injector & Fuel Pump.
13. Study & experiment on Air Conditioning System of an Automobile.
14. Comparative study of technical specifications of common small cars (such as MarutiSwift, Hyundai i20, Cheverlet Aveo, Tata Indica, Ford Fusion etc.
15. Comparative study & technical features of common scooters & motorcycles available inIndia.
16. Visit of an Automobile factory.
17. Visit to a Modern Automobile Workshop.
18. Experiment on Engine Tuning.
19. Experiment on Exhaust Gas Analysis of an I.C. Engine.

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COMPUTER AIDED MANUFACTURING (CAM)

CO1-Skills to program and operate CNC machines.

CO2- Ability to develop a product from conceptualization to reality.

UNIT-I

Introduction to Automation: Automated Manufacturing system; Need of automation, Basic elements of automation, Levels of automation, Automation Strategies, Advantages & disadvantages of automation, Historical development and future trends.

8

UNIT-II

Fundamental of Numerical Control, elements of NC machine tools, classification of NC machinetools, Advantages, suitability and limitations of NC machine tools, Application of NC system.

Definition and designation of control axes, Constructional details of Numerical Control MachineTools, MCU structure and functions, Methods of improving accuracy and productivity using NC.

8

UNIT -III

Computer Numerical Control (CNC) : Features of CNC, Elements of CNC machines, the machine control unit for CNC , Direct Numerical Control(DNC) and Adaptive Controls.

System Devices: Drives, Feedback devices, Counting devices, DAC and ADCs, Interpolator systems, Control loop circuit elements in PTP system, Contouring system, Incremental and absolute systems.

8

UNIT -IV

NC Part Programming- (a) Manual (word address format) programming Examples Drilling,Turning and Milling; canned cycles, Subroutine, and Macro.

(b) Computer Assisted Part programming (APT) Geometry, Motion and Additional statements,Macro- statement.

8

UNIT-V

Computer Integrated manufacturing system , Group Technology, Flexible Manufacturing System, Computer aided process planning-Retrieval and Generative System. Types and generations of Robots, Structure and operation of Robot, Robot applications.

8

Books and References :

1. Automation, Production System and Computer Integrated Manufacturing, by Mikell P. Grover, PrenticeHall of India Pvt Ltd.
2. CAD/CAM – Theory and Practice, by Ibrahim Zeid, McGraw Hill
3. Computer Aided Manufacturing, by Cheng, Pearson India
4. CAD/CAM: Principles and Oerations, by P. N. Rao, McGraw Hill
5. CAD/CAM: Computer Aided Design and Manufacturing, by M. Groover, Pearson India.
6. CAD/CAM: Concepts and Applications by Alavala, PHI India
7. Computer Aided Manufacturing, by Srinivas, Oxford University Press.

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OPERATIONS RESEARCH

UNIT-I

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

Linear Programming: Introduction & Scope, Problem formulation, Graphical Method, Simplexmethods, primal and dual problem sensitivity analysis.

UNIT-II

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

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

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.**4**

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

UNIT-IV

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

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

UNIT-V

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

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

Books and References:

1. Operations Research: Principles and Practice, by- Ravindran, Phillips, Solberg, John Wiley & Sons.
2. Principal of Operation Research, by- Harvey M. Wagner, Prentice Hall.
3. Introduction to Operation Research, by- Gillett, McGraw Hill.
4. Operations Research - An Introduction, by- Hamdy A. Taha, Pearson India.
5. Operation Research, by- Wayne L. Winston, Thomsan Learning.
6. Problems in Operations Research by- Prem Kumar Gupta & D.S. Hira, S. Chand.
7. Operation Research Application and Algorithms, by- Wayne L Winston, Duxbury Press.
8. Operations Research, by Jha, McGraw Hill.
9. Operation Research, by Yadav & Malik Oxford University Press
10. Operations Research, by Panneerselvam, PHI, India

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MECHANICAL SYSTEM DESIGN

CO1-Students will understand how to prepare a needs-assessment for a given project
CO2. Students will learn how to define a deliverable and make a budget for a project
CO3. Students will learn successful group interaction for a project

UNIT-I

Engineering process and System ApproachBasic 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.

UNIT-II

System Theories: Introduction, System Analysis, Black box approach, state theory approach,component integration approach, Decision process approach, A case study-automobileinstrumentation panel system.
System modelingIntroduction, Model types and purpose, linear systems, mathematical modeling, concepts, A case study compound bar system.

UNIT-III

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

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

UNIT-IV

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

Calculus Method for OptimizationModel 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.

UNIT-V

Decision AnalysisElements 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.

Books and References:

1. Design and Planning of Engineering systems-DD Reredith, KV Wong, RW Woodhead, and RR Worthman, Prentice Hall Inc., Eaglewood Cliffs, New Jerse
2. Engineering Design, by Dieter, McGraw Hill
3. Design Engineering-JR Dixon, TMH, New Delhi
4. An Introduction to Engineering Design Method-V Gupta and PN Murthy, TMH, New Delhi
5. Engineering Design-Robert Matousck, Blackie and son ltd. Glasgow
6. Optimization Techniques-SS Rao
7. System Analysis and Project Management-Devid I Cleland, William R King, McGraw Hill.

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ADVANCED WELDING TECHNOLOGY

UNIT-I

Introduction: Welding as compared with other fabrication processes,Importance and application of welding, classification of welding processes, Health & safety measures in welding.

3

Welding Power Sources: Physics of welding Arc**,** Basic characteristics of power sources forvarious arc welding processes, Transformer, rectifier and generators.

3

Physics of Welding Arc: Welding arc, arc initiation, voltage distribution along the arc, arc characteristics, arc efficiency, heat generation at cathode and anode, Effect of shielding gas on arc, isotherms of arcs and arc blow.

4

Metal Transfer: Mechanism and types of metal transfer in various arc welding processes.

3

UNIT-II

Welding Processes: Manual Metal Arc Welding (MMAW), TIG, MIG, Plasma Arc, Submerged Arc Welding, Electrogas and Electroslag, Flux Cored Arc Welding, Resistance welding, Friction welding, Brazing, Soldering and Braze welding processes, Laser beam welding, Electron beam welding, Ultrasonic welding, Explosive welding, Friction Stir Welding,Underwater welding & Microwave welding.

11

UNIT-III

Heat Flow Welding: Calculation of peak temperature; Width of Heat Affected Zone (HAZ); cooling rate and solidification rates; weld thermal cycles; residual stresses and their measurement; weld distortion and its prevention.

5

UNIT-IV

Repair & Maintenance Welding: Hardfacing, Cladding, Surfacing, Metallizing processes andReclamation welding.

2

Weldability: Effects of alloying elements on weld ability, welding of plain carbon steel, CastIron and aluminium. Micro & Macro structures in welding.

UNIT-V

Weld Design : Types of welds & joints, Joint Design, Welding Symbols, weld defects, Inspection/testing of welds, Introduction to Welding Procedure Specification & Procedure Qualification Record.

5

Books and References:

1. Welding and Welding Technology, by- Richard L. Little, McGraw Hill Education.
2. Welding Principals and Practices, by- Edwars R. Bohnart, McGraw Hill Education.
3. Welding Engineering and Technology, by- R. S. Parmar, Khanna Publishsers.
4. Welding Handbooks (Vol. I & II).

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: PLANT LAYOUT AND MATERIAL HANDELING

UNIT -I

Introduction Criteria, Strategies/Tactics, Sustainability and Eco-Efficiency in Facility Design, Basic Planning,Alternative Machine Arrangements, Flow Lines, Location Models, Act/Building Details, Aisles and Security, Storage, Shipping and Receiving, Offices, Specialized Areas.

UNIT -II

Workstations, Unit Loads & Containers, Conveyors, Vehicles, Lifting Devices, WorkstationMaterial Handling, Ethics in Facility Design
Facilities design procedure and planning strategies, Production, activity and materials flowanalysis, Space requirements and personnel services design considerations.

UNIT -III

Layout construction techniques: systematic layout planning; activity relationship analysis, pairwise exchange, graph-based construction algorithmic.
Material Handling: Material handling principles; material handling equipment and materialhandling systems.

UNIT -IV

Computerized Layout and Analytical Methods: ALDEP, CORELAP, CRAFT, BLOCPLAN,etc. **Warehouse operations**: function, storage operations.
Manufacturing operation: JIT, TQM, AM, CIM, SCM, Facility systems,
Quantitative models: Layout model, waiting line, AS/RS, simulation model, etc.

UNIT -V

Assessment and evaluation of layout alternatives Projects, Use Spiral software to practice plant layout design, Apply mathematical and engineering techniques such as systematic layout planning approach, quantitative model, cost estimate to solve practical facility layout problem.

Books and References:

1. Plant Layout and Material Handling, by- James M. Apple, John Wiley & Sons.
2. Plant Layout and Material Handling, by- Fred E. Meyers, Prentice Hall.
3. Facility Layout and Location: An Analytical Approach, by Richard L, Francis, Pearson India.
4. Plant Layout and Material Handling, by- B. K. Aggarwal, Jain Brothers.
5. Plant Layout and Material Handling, by- S. C. Sharma, Jain Brothers.
6. Materials Handling Handbook, by- Raymond A. Kulwiec, John Wiley & Sons.
7. Plant Design and Economics, by- Peters, McGraw Hill Education.
8. Purchasing and Material Management, by- Gopalakrishnan, McGraw Hill Education.

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OPEN ELECTIVES- II

NON-CONVENTIONAL ENERGY RESOURCES

UNIT-I: Introduction :Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits.

Solar Cells: Theory of solar cells. solar cell materials, solar cell array, solar cell power plant,limitations.

UNIT-II :Solar Thermal Energy: Solar radiation, flat plate collectors and their materials,applications and performance, focussing of collectors and their materials, applications andperformance; solar thermal power plants, thermal energy storage for solar heating and cooling,limitations.

UNIT-III :Geothermal Energy: Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations. Magneto-hydrodynamics (MHD): Principle of working of MHD Power plant, performance and limitations. Fuel Cells: Principle of working of various types of fuel cells and their working, performance and limitations.

UNIT-IV :Thermo-electrical and thermionic Conversions:Principle of working, performance and limitations.Wind Energy: Wind power and its sources, site selection, criterion, momentum theory,classification of rotors, concentrations and augments, wind characteristics. performance and limitations of energy conversion systems.

UNIT-V :Bio-mass:Availability of bio-mass and its conversion theory.Ocean Thermal Energy Conversion (OTEC): Availability, theory and working principle,performance and limitations.Wave and Tidal Wave: Principle of working, performance and limitations. Waste Recycling Plants.

Text/References Books:

1. Raja etal, “Introduction to Non-Conventional Energy Resources” Scitech Publications.
2. John Twideu and Tony Weir, “Renewal Energy Resources” BSP Publications, 2006.
3. M.V.R. Koteswara Rao, “ Energy Resources: Conventional & Non-Conventional “ BSP Publications,2006.
4. D.S. Chauhan,”Non-conventional Energy Resources” New Age International.
5. C.S. Solanki, “Renewal Energy Technologies: A Practical Guide for Beginners” PHI Learning.
6. Peter Auer, "Advances in Energy System and Technology". Vol. 1 & II Edited by Academic Press.
7. Godfrey Boyle,“ Renewable Energy Power For A Sustainable Future”, Oxford University Press.

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: **QUALITY CONTROL**

UNIT-I

Introduction : Concept and evaluation of quality control. Measurement & Metrology, precisionvs accuracy. Process capability, standrdisation & Interchangeability.

Inspection and Gauges : Inspection methods. Types of Gauges. Limits Fits and Tolerances.Non-Destructive Testings & Evaluation.

UNIT-II

Control Charts for SQC : Statistical Quality Control (SQC). Control charts for variables suchas X, R charts and control charts for attributes such as p-chart, c-chart. Construction & use of the control charts. Process capability.

UNIT-III

Acceptance Sampling for SQC : Principle of acceptance sampling. Producer's and consumer'srisk. Sampling plans –single, double & sequential. Sampling by attributes and variables.

UNIT-IV

Reliability : Introduction to reliability, bath-tub curve. Life expectancy. Reliability based design.Series & Parallel System.

Defect Diagnosis and prevention : Basic causes of failure, curve/control of failure.
MTBF. Maintainability, Condition monitoring and dignostic techniques.

Value Engineering : Elements of value analysis, Techniques.

Unit-V :

TQM : Basic Concept, Quality control , Quality Assurance and Quality Management and Total Quality Management. Implementation of TQM . ISO 9000 and its series, Zero defect. . Taguchi method, Six Sigma concepts.
Other Factors in Quality : Human Factors such as attitude and errors. Material-Quality, Qualitycircles, Quality in sales & service.

Books and Reference:

1. Statistical Quality Control by Grant and Leavarworth, McGraw Hill
2. Maintenance for Reliability by Rao.