

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



Program: B.TECH
Course :(Mechanical Engineering)

Session: 2019-20

Program: B.TECH
Program: B.TECH
Program (Specific):B.TECH(M.E)
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 2019-20			
Semester	Course Code	Course	Course Outcome
SEMESTER III	BT-311	Thermodynamics	<p>CO 1-After completing this course, the students will be able to apply energy balance to systems and control volumes, in situations involving heat and work interactions.</p> <p>CO2-Students can evaluate changes in thermodynamic properties of substances.</p> <p>CO3-The students will be able to evaluate the performance of energy conversion devices.</p> <p>CO4-The students will be able to differentiate between high grade and low-grade energies.</p>
	BT-313	Materials Engineering	<p>CO1-students will be able to identify crystal structure and defects in crystal structure</p> <p>CO2-Understand how to tailor material properties of ferrous and non-ferrous alloys.</p> <p>CO3-How to quantify mechanical integrity and failure in materials.</p>
	BT-312	Fluid Mechanics	<p>CO1-Upon completion of this course, students will be able to mathematically analyze simple flow</p>

			<p>situations.</p> <p>CO2-They will be able to evaluate the performance of pumps and turbines.</p>
	BT-322	Engineering Science	<p>CO1- Upon completion of this course, students will get basic knowledge of different types of energy i.e. solar energy,nuclear energy,biomass,tidal,geothermal energy.</p> <p>CO2- They will get basic knowledge of nuclear fuel cycle</p> <p>CO3- The concept of green building and green architecture will be cleared</p>
	BT-304	Technical Communication	<p>CO1- Acquisition of technical communication's generic aspects like Reading Technical Material, Technical Writing, Listening, Thinking and using technical phrases in spoken, Knowing the parts of a technical documents like screenshots, graphs, tabular data, data analysis, pictorial depiction.</p> <p>CO2- Getting adapted with the technical generic formats/templates of technical writing of memos, technical report writing, technical presentations, technical proposal writing, minutes of meeting and the notes taking techniques</p> <p>CO3-Learning the skill of proofreading and copy editing, paraphrasing and spinning using technical tools and manually using the knowledge of advance technical grammar.</p>

	BT-364	Machine Drawing Lab	CO1- Upon completion of this course, the students can use computer and CAD software formodelling mechanical components.
	BT-362	Fluid Mechanics Lab	CO1- The students who have undergone the course will be able to measure various properties of fluids and characterize the performance of fluid/thermal machinery.
	BT-363	Material Science Lab	CO1- Students will study the crystal structure of the materials CO2-Understand the different types of defects
	BT-309	Compter System Security	CO1-Analyze and resolve security issues in networks and computer systems to secure an IT infrastructure.Design, develop, test and evaluate secure software. CO2-Develop policies and procedures to manage enterprise security risks.
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.

			<p>CO5-Apply the concept of radiation for black and non black bodies.</p> <p>CO6-Conduct thermal analysis of heat exchangers.</p>
	BT-569	Heat and Mass Transfer Lab	<p>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</p> <p>CO2 Determine thermal properties and performance of heat exchanger, vapour compression refrigerator and air conditioner</p>
	BT-520	Internal Combustion Engine	<p>CO1-Explain the working principle, performance parameters and testing of IC Engine.</p> <p>CO2-Understand the combustion phenomena in SI and CI engines and factors influencing combustion chamber design.</p> <p>CO3-Understand the essential systems of IC engine and latest trends and developments in IC Engines.</p> <p>CO4-Understand the effect of engine emissions on environment and human health and methods of reducing it.</p> <p>CO5-Apply the concepts of thermodynamics to air standard cycle in IC Engines</p> <p>CO6-Analyze the effect of various operating parameters on IC engine performance.</p>

	BT-515	CYBER SECURITY	<p>CO1-Analyze and resolve security issues in networks and computer systems to secure an IT infrastructure.Design, develop, test and evaluate secure software.</p> <p>CO2-Develop policies and procedures to manage enterprise security risks.</p> <p>CO3-Evaluate and communicate the human role in security systems with an emphasis on ethics, social engineering vulnerabilities and training.</p> <p>CO4-Interpret and forensically investigate security incidents.</p>
	BT-518	MANUFACTURING SCIENCE II	<p>CO1-Student will be able to choose machining processing to manufacture any component</p> <p>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.</p> <p>CO5-Student will be able to explain principle and applications of advanced machining processes</p>

	BT-517	MACHINE DESIGN I	<p>CO1- Recall the basic concepts of Solid Mechanics to understand the subject.</p> <p>CO2- Classify various machine elements based on their functions and applications</p> <p>CO3- Apply the principles of solid mechanics to machine elements subjected to static and fluctuating loads.</p> <p>CO4- Design the machine elements to meet the required specification.</p>
	BT-501	MANAGERIAL ECONOMICS	<p>CO1-Apply the knowledge of the mechanics of supply and demand to explain working of markets</p> <p>CO2-Describe how changes in demand and supply affect markets Understand the choices made by a rational consumer</p> <p>CO3-Explain relationships between production and costs CO4-Define key characteristics and consequences of different forms of markets</p>
	BT-567	DESIGN AND SIMULATION LAB	<p>CO1-Creation of part drawings and 3D models using CAD techniques.</p> <p>CO2-Ability to utilize experimental, statistical and computational methods and tools necessary for engineering practice.</p>
	BT-568	Manufacturing Technology II LAB	<p>CO1- Understand the casting process</p> <p>CO2- Perform different types of welding processes-gas welding,arc welding ,spot welding</p>

VII SEMESTER	BT-722	OPERATION RESEARCH	<p>CO1-Formulate and solve problems as networks and graphs.</p> <p>CO2-Develop linear programming (LP) models for shortest path, maximum flow, minimal spanning tree, critical path, minimum cost flow, and transshipment problems.</p> <p>CO3-Solve the problems using special solution algorithms.</p>
	BT-701	HUMAN VALUE	<p>CO1-The students become sensitive towards human values.</p> <p>CO2-They understand commitment and responsibility.</p> <p>CO3-They gain the ability to bring harmony to the society they live.</p>
	BT-721	POWER PLANT ENGINEERING	<p>CO1- Explain the economics involved in Power Plant and identify the factors related to selection of plant.</p> <p>CO2- Discuss various components of steam power plant and the factors influencing the site selection for the plant.</p> <p>CO3- Describe the working of various components of diesel power plant and compare it with steam power plant.</p> <p>CO4-Illustrate the working of gas turbine power plant and its components.</p> <p>CO5-Explain the components, principles and working of nuclear & non-conventional power plant.</p> <p>CO6- Describe the electrical, instrumentation & pollution control systems used in power plants.</p>

	BT-723	COMPUTER AIDED DESIGN/MANUFACTURING	CO1-Creation of part drawings and 3D models using CAD techniques. CO2- Generation of part programs for industrial components using CAM techniques. CO3-Skills to program and operate CNC machines. CO4- Ability to develop a product from conceptualization to reality.
	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 Automobile
	BT-772	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	<p>CO1-To study design of machine components</p> <p>CO2- Understanding and use of 3-D Modelling Software</p> <p>CO3- To study the characteristic features of CNC machine.</p>
	BT-775	INDUSTRIAL TRAINING	<p>CO1-Student is able to understand management of manufacturing</p> <p>CO2-Student is able to apply work improvement techniques in an organization where he undergoes for in-plant training.</p> <p>CO3-Student is able to find out and reduce work content of the job.</p>
	BT-774	PROJECT	<p>CO1-Identify, visualize, formulate and solve engineering problems in the field of mechanical Engineering.</p> <p>CO2-Use the techniques, skills, and modern engineering tools necessary for engineering practice with appropriate considerations for societal, and environmental constraints.</p> <p>CO3-Apply their fundamental field skills towards the understanding of the impact of engineering solutions on the society in a global and social context.</p>

<p>IV SEMESTER</p>	<p>BT-418</p>	<p>ENGINEERING MECHANICS</p>	<p>CO1-Determine the equilibrium of a particle in space using principle of laws of mechanics. CO2-Compute the equilibrium of rigid bodies in two dimensions and in three dimensions. CO3- Calculate the principal moment of inertia of plane areas. CO4 Solve the problems using equation of motions and analyze impact of elastic bodies on collision. CO5- Solve the problems of simple system with sliding friction and calculate linear and angular acceleration of moving body in general plane motion.</p>
	<p>BT-413</p>	<p>APPLIED THERMODYNAMICS</p>	<p>CO1-After completing this course, the students will get a good understanding of various practical power 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.</p>

	BT-412	MANUFACTURING PROCESS	CO1-Upon completion of This course, students will be able to understand the different conventionaland unconventional manufacturing methods employed for making different products
	BT-462	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-414	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-410	PYTHON PROGRAMMING LAB	CO1- Interpret the mathematical results in physical and other forms. CO2-Identify, formulate and solve the Linear Differential Equations. CO3-Classify and solve the contour integration of complex functions.
	BT-464	MACHINE DRAWING LAB	CO1-Upon completion of this course, the students can use computer and CAD software formodellingmechanical components

VI SEMESTER	BT-617(N)	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
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			systems.
	BT-619(N)	Machine Design	<p>CO1-Classify various machine elements based on their functions and applications.</p> <p>CO2-Apply the principles of solid mechanics to machine elements subjected to static and fluctuating loads.</p> <p>CO3-Analyze forces, bending moments, twisting moments and failure causes in various machine elements to be designed.</p> <p>CO4-Design the machine elements to meet the required specification.</p>
	BT-618(N)	Theory Of Machine	<p>CO1-Determine the kinematic chain and mobility, and perform the kinematic analysis of a given mechanism,</p> <p>CO2-Apply the fundamental principles of statics and dynamics to machinery,</p> <p>CO3- Understand and avoid/suppress certain common dynamical problems a machine may undergo,</p> <p>CO4- Understand the fundamentals of machine design for</p>

			desired kinematic or dynamic performance. CO5-Understand the fundamentals of mechanical vibrations.
	BT-601(N)	INDUSTRIAL MANAGEMENT	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-606(N)	SOCIOLOGY	<p>CO1: Describing Nature, Scope and Origin of Sociology</p> <p>CO2: Understanding the methods in Sociology</p> <p>CO3: Elaborating on basic concepts in Sociology, social structure, social system</p> <p>CO4: Elucidating various types of groups, culture and various concepts in connection with</p>
	BT-616(N)	FLUID MACHINERY	<p>CO1-Student will be able to understand the working of different types of turbine</p> <p>CO2- Student will be able to understand the working of different types of pump</p>
	BT-618(N)	THEORY OF MACHINE LAB	<p>CO1- Perform the experiments to Understand the fundamentals of machine design for desired kinematic or dynamic performance.</p> <p>CO5-Understand the fundamentals of mechanical vibrations.</p>

	BT-666(N)	FLUID MACHINERY LAB	CO1-Student will perform experiments to understand the working of different types of turbine CO2- Student will perform experiments to understand the working of different types of turbine
VIII SEMESTER	BT-821	TOTAL QUALITY MANAGEMENT	CO1-To realize the importance of significance of quality CO2- Manage quality improvement teams CO3- Identify requirements of quality improvement programs
	BT-806	RENEWABLE 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-822	ADVANCE WELDING	<p>CO1-Understand the physics of arc welding process and various operating characteristics of welding power source.</p> <p>CO2-Analyse various welding processes and their applications. Apply the knowledge of welding for repair & maintenance, along with the weldability of different materials.</p> <p>CO3-Apply the concept of quality control and testing of weldments in industrial environment.</p> <p>CO4-Evaluate heat flow in welding and physical metallurgy of weldments.</p>
	BT-871	SEMINAR	<p>CO1-Students will be able to show competence in identifying relevant information, defining and explaining topics under discussion.</p> <p>CO2-They will</p>

			<p>demonstrate depth of understanding, use primary and secondary sources; they will demonstrate complexity, insight, cogency, independent thought, relevance, and persuasiveness.</p> <p>CO3-They will be able to evaluate information and use and apply relevant theories.</p> <p>CO4-Students will be able to show competence in working with a methodology, structuring their oral work, and synthesizing information.</p>
	BT-872	PROJECT	<p>CO1-Identify, visualize, formulate and solve engineering problems in the field of mechanical Engineering.</p> <p>CO2-Use the techniques, skills, and modern engineering tools necessary for engineering practice with appropriate considerations for societal, and environmental constraints.</p> <p>CO3-Apply their fundamental field skills towards the</p>

			understanding of the impact of engineering solutions on the society in a global and social context
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TEACHING SCHEME AND EXAMINATIONS MARKS FOR : 3rd SEMESTER**YEAR -: 2019-20****Branch: - Mechanical Engineering**

S. No.	Subject Name	Subject Code	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1.	Thermodynamics	BT – 311	3	1	0	30	20	50	-	100	-	150	4
2.	Fluid Mechanics & Fluid Machines	BT – 312	3	1	0	30	20	50	-	100	-	150	4
3.	Materials Engineering	BT – 313	3	0	0	30	20	50	-	100	-	150	3
4.	Computer System Security/ Python Programming	BT – 309 / BT - 310	2	0	0	15	10	25	-	50	-	-	0
5.	Engineering Science Course/ Mathematics – IV	BT - / BT – 305	3	1	0	30	20	50	-	100	-	150	4
6.	Universal Human Values / Technical Communication	BT – 314 /	3	0	0	30	20	50	-	100	-	150	3
		BT – 304	2	1	0								
7.	Fluid Mechanics Lab	BT – 362	0	0	2	-	-	-	25	-	25	50	1
8.	Material Testing Lab	BT – 363	0	0	2	-	-	-	25	-	25	50	1
9.	Computer Aided Machine Drawing-I Lab	BT – 364	0	0	2	-	-	-	25	-	25	50	1
10.	Mini Project or Internship Assessment*	BT – 365	0	0	2	-	-	50	-	-	-	50	1
11.	MOOCs (Essential for Hons. Degree												
	Total											950	22

* The Mini Project or internship (3-4 weeks) conducted during summer break after II Semester and will be assessed during III Semester.

***Engineering Science Course:-**

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|-----------------------------|------------|---|------------|
| 1. Engineering Mechanics - | BT – 319 | 2. Basics Data Structure & Algorithms - | BT – 320 |
| 3. Material Science | - BT – 321 | 4. Energy Science & Engineering | - BT – 322 |
| 5. Sensor & Instrumentation | - BT – 323 | 6. Introduction to Soft Computing | - BT – 324 |
| 7. Analog Electronics | - BT – 325 | 8. Electronics Engineering | - BT – 326 |

Examination Controller

TEACHING SCHEME AND EXAMINATIONS MARKS FOR : 4th SEMESTER**YEAR -: 2019-20****Branch: - Mechanical Engineering**

S. No.	Subject Name	Subject Code	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1.	Engineering Mechanics	BT – 418	3	1	0	30	20	50	-	100	-	150	4
2.	Manufacturing Processes	BT – 412	3	1	0	30	20	50	-	100	-	150	4
3.	Applied Thermodynamics	BT – 413	3	0	0	30	20	50	-	100	-	150	3
4.	Computer System Security/ Python Programming	BT – 409 / BT - 410	2	0	0	15	10	25	-	50	-	-	0
5.	Engineering Science Course/ Mathematics – IV	BT - / BT – 405	3	1	0	30	20	50	-	100	-	150	4
6.	Universal Human Values / Technical Communication	BT – 414 /	3	0	0	30	20	50	-	100	-	150	3
		BT – 404	2	1	0								
7.	Manufacturing Processes Lab	BT – 462	0	0	2	-	-	-	25	-	25	50	1
8.	Applied Thermodynamics Lab	BT – 463	0	0	2	-	-	-	25	-	25	50	1
9.	Computer Aided Machine Drawing-II Lab	BT – 464	0	0	2	-	-	-	25	-	25	50	1
10.	MOOCs (Essential for Hons. Degree)												
	Total											900	21

***Engineering Science Course:-**

1. Engineering Mechanics - BT – 419

4. Material Science - BT – 421

5. Sensor & Instrumentation - BT – 423

8. Analog Electronics - BT – 425

2. Basics Data Structure & Algorithms - BT – 420

4. Energy Science & Engineering - BT – 422

6. Introduction to Soft Computing - BT – 424

8. Electronics Engineering - BT – 426

Examination Controller

TEACHING SCHEME AND EXAMINATIONS MARKS FOR : Vth SEMESTER**YEAR -: 2019-20****Branch: - Mechanical Engineering**

S. No.	Subject Name	Subject Code No.	L – T - P	Theory/ Lab Marks	Sessional	Total	Credit	
				ESE	CT	TA		
1.	Managerial Economics	BT – 501	3--0--0	70	20	10	100	3
2.	Machine Design – I	BT – 517	3--0--0	70	20	10	100	4
3.	Manufacturing Science & Technology – II	BT – 518	3--0--0	70	20	10	100	3
4.	Heat & Mass Transfer	BT – 519	3--1--0	70	20	10	100	4
5.	I. C. Engines & Compressors	BT – 520	3--1--0	70	20	10	100	4
6.	Sociology/ Cyber Security	BT – 506/ BT – 515	3--0--0	70	20	10	100	3
7.	Design and Simulation Lab I	BT – 567	0--0--2	50	-	50	100	1
8.	Manufacturing Technology - II Lab	BT – 568	0--0--2	50	-	50	100	1
9.	Heat & Mass Transfer Lab	BT – 569	0--0--2	50	-	50	100	1
10.	Seminar – I	BT – 570	0--0--2	50	-	50	100	1
				620	120	260	1000	24

Grand Total of Theory & Practical = 1000

Examination Controller

TEACHING SCHEME AND EXAMINATIONS MARKS FOR : 6th SEMESTER**YEAR -: 2019-20****Branch: - Mechanical Engineering**

S. No.	Subject Name	Subject Code	L – T - P	ESE Marks	Sessional		Total	Credit
					CT	TA		
1.	Industrial Management	BT – 601(N)	3-0-0	70	20	10	100	3
2.	Fluid Machinery	BT – 616(N)	3-0-0	70	20	10	100	3
3.	Departmental Elective – II Refrigeration & Air-conditioning	BT – 617(N)	3-1-0	70	20	10	100	4
4.	Theory of Machines	BT – 618(N)	3-1-0	70	20	10	100	4
5.	Machine Design – II	BT – 619(N)	3-0-0	70	20	10	100	3
6.	Sociology / Cyber Security	BT – 606(N) / BT – 615 (N)	3-0-0	70	20	10	100	3
7.	Fluid Machinery Lab	BT – 666(N)	0-0-2	50	-	50	100	1
8.	Theory of Machines Lab	BT – 668(N)	0-0-2	50	-	50	100	1
9.	Design and Simulation Lab II	BT – 669(N)	0-0-2	50	-	50	100	1
10.	Refrigeration & Air-conditioning Lab	BT – 667(N)	0-0-2	50	-	50	100	1
	Total						1000	24

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TEACHING SCHEME AND EXAMINATIONS MARKS FOR : VIIth SEMESTER**YEAR -: 2019-20****Branch: - Mechanical Engineering**

S. No.	Subject Name	Subject Code No.	L – T - P	Theory/ Lab Marks	Sessional		Total	Credit
				ESE	CT	TA		
1.	Understanding the human being Comprehensively Human Aspiration audits fulfilment	BT – 701	3--0--0	70	20	10	100	3
2.	Power Plant Engineering	BT – 721	3--0--0	70	20	10	100	3
3.	Operation Research	BT – 722	3--1--0	70	20	10	100	4
4.	CAD/CAM	BT – 723	3--1--0	70	20	10	100	4
5.	Automobile Engineering	BT – 724	3--0--0	70	20	10	100	3
6.	CAD/CAM Lab	BT – 773	0--0--2	50	-	50	100	1
7.	IC Engine & Automobile Lab	BT – 772	0--0--2	50	-	50	100	1
8.	Industrial Training	BT – 775	0--0--3	-	-	100	100	2
9.	Project – I	BT – 774	0--0--6	-	-	200	200	3
				450	100	450	1000	24

Grand Total of Theory & Practical = 1000

TEACHING SCHEME AND EXAMINATIONS MARKS FOR : 8th SEMESTER**YEAR -: 2019-20****Branch: - Mechanical Engineering**

S. No.	Subject Name	Subject Code	L – T - P	ESE Marks	Sessional		Total	Credit
					CT	TA		
1.	Renewable Energy Resources	BT - 806	3-0-0	70	20	10	100	3
2.	Total Quality Management	BT - 821	3-0-0	70	20	10	100	3
3.	Advance Welding	BT - 822	3-1-0	70	20	10	100	4
4.	Seminar	BT - 871	0-0-3	-	-	100	100	2
5.	Project	BT - 872	0-0-12	350	-	250	100	12
	Total			560	60	380	1000	24

SEMESTER-III

Session: 2019-20

THERMODYNAMICS

Objectives:

- To learn about work and heat interactions, and balance of energy between system and its surroundings.
- To learn about application of I law to various energy conversion devices.
- To evaluate the changes in properties of substances in various processes.
- To understand the difference between high grade and low-grade energies and II law limitations on energy conversion.

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, Property of mixture of gases, electrical, magnetic, gravitational, spring and shaft work.

Zeroth law of thermodynamics: Concept of Temperature and its measurement, Temperature scales.

First law of thermodynamics:

First Law for Flow Processes - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteady I law applications for system and control volume. 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.

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, Carnot theorem and its 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 & Moller chart, Dryness factor and its measurement, processes involving steam in closed and open systems. Simple Rankine cycle.

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

FLUID MECHANICS AND FLUID MACHINES**Objectives:**

- To learn about the application of mass and momentum conservation laws for fluid flows.
- To understand the importance of dimensional analysis.
- To obtain the velocity and pressure variations in various types of simple flows.
- To analyze the flow in water pumps and turbines.

UNIT-I

Definition of fluid, Newton's law of viscosity, Units and dimensions-Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension, Incompressible flow, Bernoulli's equation and its applications - Pitot tube, orifice meter, venturi meter and bend meter, notches and weirs, momentum equation and its application to pipe bends.

UNIT-II

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. Buckingham's Pi theorem, important dimensionless numbers and their significance.

UNIT-III

Equation of motion for laminar flow through pipes, turbulent flow, isotropic, homogeneous turbulence, scale and intensity of turbulence, measurement of turbulence, eddy viscosity, resistance to flow, minor losses, pipe in series and parallel, power transmission through a pipe, siphon, water hammer, three reservoir problems and pipe networks. Boundary layer thickness, boundary layer over a flat plate, laminar boundary layer, application of momentum equation, turbulent boundary layer, laminar sublayer, separation and its control, Drag and lift, drag on a sphere, a two-dimensional cylinder, and an aerofoil, Magnus effect.

UNIT-IV

Introduction to hydrodynamic thrust of jet on a fixed and moving surface, Classification of turbines, Impulse turbines, Constructional details, Velocity triangles, Power and efficiency calculations, Governing of Pelton wheel.

Francis and Kaplan turbines, Constructional details, Velocity triangles, Power and efficiency Principles of similarity, Unit and specific speed, Performance characteristics, Selection of water turbines.

UNIT-V

Classifications of centrifugal pumps, Vector diagram, Work done by impellor, Efficiencies of centrifugal pumps, Specific speed, Cavitation & separation, Performance characteristics. Reciprocating pump theory, Slip, Indicator diagram, Effect of acceleration, air vessels, Comparison of centrifugal and reciprocating pumps, Performance characteristics.

Books and References:

1. Introduction to fluid mechanics and Fluid machines by S.K Som, Gautam Biswas, S Chakraborty.
2. Fluid mechanics and machines by R.K Bansal.
3. F. M. White, Fluid Mechanics, 6th Ed., Tata McGraw-Hill, 2008.
4. Fluid Mechanics and Its Applications by V.K.Gupta et.al.
5. Fluid Mechanics by Yunus Cengel.
6. Batchelor, G. K. (1999). Introduction to fluid dynamics. New Delhi, India: Cambridge University Press.
7. Acheson, D. J. (1990). Elementary fluid dynamics. New York, USA: Oxford University Press.
8. R.W. Fox, A.T. McDonald and P.J. Pritchard, Introduction to Fluid Mechanics, 6th Ed., John Wiley, 2004.

SEMESTER-III

Session: 2019-20

MATERIALS ENGINEERING

Course Outcomes:

Student will be able to identify crystal structures for various materials and understand the defects in such structures. Understand how to tailor material properties of ferrous and non-ferrous alloys. How to quantify mechanical integrity and failure in materials.

Objectives:

Understanding of the correlation between the internal structure of materials, their mechanical properties and various methods to quantify their mechanical integrity and failure criteria. To provide a detailed interpretation of equilibrium phase diagrams. Learning about different phases and heat treatment methods to tailor the properties of Fe- C alloys.

UNIT-I

Crystal Structure: Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress.

Mechanical Property measurement: Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength.

UNIT-II

Static failure theories: Ductile and brittle failure mechanisms, Tresca, Von-mises, Maximum normal stress, Mohr-Coulomb and Modified Mohr-Coulomb; Fracture mechanics: Introduction to Stress-intensity factor approach and Griffith criterion. Fatigue failure: High cycle fatigue, Stress-life approach, SN curve, endurance and fatigue limits, effects of mean stress using the Modified Goodman diagram; Fracture with fatigue, Introduction to non-destructive testing (NDT).

UNIT-III

Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron-iron-carbide phase diagram and microstructural aspects of ledeburite, austenite, ferrite and cementite, cast iron.

UNIT-IV

Heat treatment of Steel: Annealing, tempering, normalising and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening.

UNIT-V

Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupro-nickel; Aluminium and Al-Cu - Mg alloys- Nickel based superalloys and Titanium alloys.

Books and References:

1. W. D. Callister, 2006, "Materials Science and Engineering-An Introduction", 6th Edition, Wiley India.
2. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
3. V. Raghavan, "Material Science and Engineering", Prentice Hall of India Private Limited, 1999.
4. Mechanics of materials by James M.Gere.
5. Introduction to engineering materials by B.K. Agarwal.
6. Physical metallurgy and advanced materials by R.E. Smallman.
7. Engineering mechanics of composite materials by Isaac M. Daniel.
8. U. C. Jindal, "Engineering Materials and Metallurgy", Pearson, 2011

FLUID MECHANICS LAB**Course Outcomes:**

The students who have undergone the course will be able to measure various properties of fluids and characterize the performance of fluid/thermal machinery.

Objectives:

To understand the principles and performance characteristics of flow and thermal devices.

To know about the measurement of the fluid properties.

List of Experiments :(At least 8 of the following)

1. To determine the coefficient of impact for vanes.
2. To determine coefficient of discharge of an orifice meter.
3. To determine the coefficient of discharge of Notch (V and Rectangular types).
4. To determine the friction factor for the pipes.
5. To determine the coefficient of discharge of venturi meter.
6. To determine the coefficient of discharge, contraction & velocity of an orifice.
7. To verify the Bernoulli's Theorem.
8. To find critical Reynolds number for a pipe flow.
9. To determine the meta-centric height of a floating body.
10. To determine the minor losses due to sudden enlargement, sudden contraction and bends.
11. To show the velocity and pressure variation with radius in a forced vortex flow

MATERIAL TESTING LAB**Objectives:**

To understand the principles and performance characteristics different materials.

To know about material properties.

List of Experiments: (At least 8 of the following)

1. Strength test of a given mild steel specimen on UTM with full details and stress versus 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 testing machines.
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 deflection with 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.

COMPUTER AIDED MACHINE DRAWING-I LAB**Course Outcomes:**

Upon completion of this course, the students can use computer and CAD software for modelling mechanical components.

Objectives:

To provide an overview of how computers can be utilized in mechanical component design.

UNIT-I**Introduction** (1 drawing sheets)

Introduction, classification of machine drawings, principles of drawing, conventional representation of machine components and materials, lines, types of lines, dimensioning types, 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, principle of visualization of objects, sectional views, full and half sectional views, auxiliary views.

UNIT-II**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.

UNIT-III**Riveted joints** (1 drawing sheet)

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

Free hand sketching (1 drawing sheet)

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

UNIT-IV

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.

UNIT-V

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. Siddeshwar, 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

Technical Communication

Course Outcomes

1. Students will be enabled to understand the nature and objective of Technical Communication relevant for the work place as Engineers.
2. Students will utilize the technical writing for the purposes of Technical Communication and its exposure in various dimensions.
3. Students would imbibe inputs by presentation skills to enhance confidence in face of diverse audience.
4. Technical communication skills will create a vast know-how of the application of the learning to promote their technical competence.
5. It would enable them to evaluate their efficacy as fluent & efficient communicators by learning the voice-dynamics.

Unit -1 Fundamentals of Technical Communication: Technical Communication: Features; Distinction between General and Technical Communication; Language as a tool of Communication; Dimensions of Communication: Reading & comprehension; Technical writing: sentences; Paragraph; Technical style: Definition, types & Methods; The flow of Communication: Downward; upward, Lateral or Horizontal; Barriers to Communication.

Unit - II Forms of Technical Communication: Technical Report: Definition & importance; Thesis/Project writing: structure & importance; synopsis writing: Methods; Technical research Paper writing: Methods & style; Seminar &

Conference paper writing; Expert Technical Lecture: Theme clarity; Analysis & Findings; 7 Cs of effective business writing: concreteness, completeness, clarity, conciseness, courtesy, correctness, consideration, C.V./Resume writing; Technical Proposal: Types, Structure & Draft.

Unit - III Technical Presentation: Strategies & Techniques Presentation: Forms; interpersonal Communication; Class room presentation; style; method; Individual conferencing: essentials: Public Speaking: method; Techniques: Clarity of substance; emotion; Humour; Modes of Presentation; Overcoming Stage Fear; Audience Analysis & retention of audience interest; Methods of Presentation: Interpersonal; Impersonal; Audience Participation: Quizzes & Interjections.

Unit - IV Technical Communication Skills: Interview skills; Group Discussion: Objective & Method; Seminar/Conferences Presentation skills: Focus; Content; Style; Argumentation skills: Devices: Analysis; Cohesion & Emphasis; Critical thinking; Nuances: Exposition narration & Description; effective business communication

competence: Grammatical; Discourse competence: combination of expression & conclusion; Socio-linguistic competence: Strategic competence: Solution of communication problems with verbal and non verbal means.

Unit - V Dimensions of Oral Communication & Voice Dynamics: Code and Content; Stimulus & Response; Encoding process; Decoding process; Pronunciation Etiquette; Syllables; Vowel sounds; Consonant sounds; Tone: Rising tone; Falling Tone; Flow in Speaking; Speaking with a purpose; Speech & personality; Professional Personality Attributes: Empathy; Considerateness; Leadership; Competence.

Reference Books

1. Technical Communication – Principles and Practices by Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2007, New Delhi.
2. Personality Development and Soft Skills by Barun K. Mitra, OUP, 2012, New Delhi.
3. Spoken English- A Manual of Speech and Phonetics by R.K.Bansal & J.B.Harrison, Orient Blackswan, 2013, New Delhi.
4. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
5. Practical Communication: Process and Practice by L.U.B. Pandey; A.I.T.B.S. Publications India Ltd.; Krishan Nagar, 2014, Delhi.
6. Modern Technical Writing by Sherman, Theodore A (et.al); Apprentice Hall; New Jersey; U.S.
7. A Text Book of Scientific and Technical Writing by S.D. Sharma; Vikas Publication, Delhi.
8. Skills for Effective Business Communication by Michael Murphy, Harward University, U.S.
9. Business Communication for Managers by Payal Mehra, Pearson Publication, Delhi.

SEMESTER-III

Session: 2019-20

DETAILED SYLLABUS

COMPUTER SYSTEM SECURITY		
	Course Outcome (CO)	Bloom's Knowledge Level (KL)
At the end of course , the student will be able to understand		
CO 1	To discover software bugs that pose cyber security threats and to explain how to fix the bugs to mitigate such threats	K₁, K₂
CO 2	To discover cyber attack scenarios to web browsers and web servers and to explain how to mitigate such threats	K₂
CO 3	To discover and explain mobile software bugs posing cyber security threats, explain and recreate exploits, and to explain mitigation techniques.	K₃
CO 4	To articulate the urgent need for cyber security in critical computer systems, networks, and world wide web, and to explain various threat scenarios	K₄
CO 5	To articulate the well known cyber attack incidents, explain the attack scenarios, and explain mitigation techniques.	K₅, K₆
DETAILED SYLLABUS		3-1-0
Unit	Topic	Proposed Lecture
I	Computer System Security Introduction: Introduction, What is computer security and what to I earn? , Sample Attacks, The Marketplace for vulnerabilities, Error 404 Hacking digital India part 1 chase. Hijacking & Defense: Control Hijacking ,More Control Hijacking attacks integer overflow ,More Control Hijacking attacks format string vulnerabilities, Defense against Control Hijacking - Platform Defenses, Defense against Control Hijacking - Run-time Defenses, Advanced Control Hijacking attacks.	08
II	Confidentiality Policies: Confinement Principle ,Detour Unix user IDs process IDs and privileges , More on confinement techniques ,System call interposition ,Error 404 digital Hacking in India part 2 chase , VM based isolation ,Confinement principle ,Software fault isolation , Rootkits ,Intrusion Detection Systems	08
	Secure architecture principles isolation and leas: Access Control Concepts , Unix and windows	

III	access control summary ,Other issues in access control ,Introduction to browser isolation . Web security landscape : Web security definitions goals and threat models , HTTP content rendering .Browser isolation .Security interface , Cookies frames and frame busting, Major web server threats ,Cross site request forgery ,Cross site scripting ,Defenses and protections against XSS , Finding vulnerabilities ,Secure development.	08
IV	Basic cryptography: Public key cryptography ,RSA public key crypto ,Digital signature Hash functions ,Public key distribution ,Real world protocols ,Basic terminologies ,Email security certificates ,Transport Layer security TLS ,IP security , DNS security.	08
V	Internet Infrastructure: Basic security problems , Routing security ,DNS revisited ,Summary of weaknesses of internet security ,.Link layer connectivity and TCP IP connectivity , Packet filtering firewall ,Intrusion detection.	08

Text books:

1. William Stallings, Network Security Essentials: Applications and Standards, Prentice Hall, 4th edition, 2010.
2. Michael T. Goodrich and Roberto Tamassia, Introduction to Computer Security, Addison Wesley, 2011.
3. William Stallings, Network Security Essentials: Applications and Standards, Prentice Hall, 4th edition, 2010.
4. Alfred J. Menezes, Paul C. van Oorschot and Scott A. Vanstone, Handbook of Applied Cryptography, CRC Press,2001.

Mapped With : <https://ict.iitk.ac.in/product/computer-system-security/>

Energy Science and Engineering

Unit-I Energy and its Usage: Units and scales of energy use, Mechanical energy and transport, Heat energy: Conversion between heat and mechanical energy, Electromagnetic energy: Storage, conversion, transmission and radiation, Introduction to the quantum, energy quantization, Energy in chemical systems and processes, flow of CO₂, Entropy and temperature, carnot and Stirling heat engines, Phase change energy conversion, refrigeration and heat pumps, Internal combustion engines, Steam and gas power cycles, the physics of power plants. Solid-state phenomena including photo, thermal and electrical aspects

Unit-II Nuclear Energy: Fundamental forces in the universe, Quantum mechanics relevant for nuclear physics, Nuclear forces, energy scales and structure, Nuclear binding energy systematics, reactions and decays, Nuclear fusion, Nuclear fission and fission reactor physics, Nuclear fission reactor design, safety, operation and fuel cycles

Unit-III Conventional & non-conventional energy sources: Biological energy sources and fossil fuels, Fluid dynamics and power in the wind, available resources, carriers, fluids, viscosity, types of fluid flow, lift, Wind turbine dynamics and design, wind farms, Geothermal power and ocean thermal energy conversion, Tidal/wave/hydro power

Unit-IV Conventional & non-conventional energy sources: Biological energy sources and fossil fuels, Fluid dynamics and power in the wind, available resources, carriers, fluids, viscosity, types of fluid flow, lift, Wind turbine dynamics and design, wind farms, Geothermal power and ocean thermal energy conversion, Tidal/wave/hydro power

Unit-V Conventional & non-conventional energy sources: Biological energy sources and fossil fuels, Fluid dynamics and power in the wind, available resources, carriers, fluids, viscosity, types of fluid flow, lift, Wind turbine dynamics and design, wind farms, Geothermal power and ocean thermal energy conversion, Tidal/wave/hydro power

Unit-V Systems and Synthesis: Overview of World Energy Scenario, Nuclear radiation, fuel cycles, waste and proliferation, Climate change, Energy storage, Energy conservation. Engineering for Energy conservation: Concept of Green Building and Green Architecture; Green building concepts, LEED ratings; Identification of energy related enterprises that represent the breath of the industry and prioritizing these as candidates; Embodied energy analysis and use as a tool for measuring sustainability. Energy Audit of Facilities and optimization of energy consumption

PYTHON PROGRAMMING

PYTHON PROGRAMMING		
Course Outcome (CO)		Bloom's Knowledge Level (KL)
At the end of course , the student will be able to understand		
CO 1	To read and write simple Python programs.	K ₁ , K ₂
CO 2	To develop Python programs with conditionals and loops.	K ₂ , K ₄
CO 3	To define Python functions and to use Python data structures -- lists, tuples, dictionaries	K ₃
CO 4	To do input/output with files in Python	K ₂
CO 5	To do searching ,sorting and merging in Python	K ₂ , K ₄
DETAILED SYLLABUS		3-1-0
Unit	Topic	Proposed Lecture
I	Introduction: The Programming Cycle for Python , Python IDE, Interacting with Python Programs , Elements of Python, Type Conversion. Basics: Expressions, Assignment Statement, Arithmetic Operators, Operator Precedence, Boolean Expression.	08
II	Conditionals: Conditional statement in Python (if-else statement, its working and execution), Nested-if statement and Elif statement in Python, Expression Evaluation & Float Representation. Loops: Purpose and working of loops , While loop including its working, For Loop , Nested Loops , Break and Continue.	08
III	Function: Parts of A Function , Execution of A Function , Keyword and Default Arguments ,Scope Rules. Strings : Length of the string and perform Concatenation and Repeat operations in it. Indexing and Slicing of Strings. Python Data Structure : Tuples , Unpacking Sequences , Lists , Mutable Sequences , List Comprehension , Sets , Dictionaries Higher Order Functions: Treat functions as first class Objects , Lambda Expressions	08

IV	<p>Sieve of Eratosthenes: generate prime numbers with the help of an algorithm given by the Greek Mathematician named Eratosthenes, whose algorithm is known as Sieve of Eratosthenes.</p> <p>File I/O : File input and output operations in Python Programming Exceptions and Assertions</p> <p>Modules : Introduction , Importing Modules , Abstract Data Types : Abstract data types and ADT interface in Python Programming. Classes : Class definition and other operations in the classes , Special Methods (such as <code>_init str_</code>, comparison methods and Arithmetic methods etc.) , Class Example , Inheritance , Inheritance and OOP.</p>	08
V	<p>Integrators & Recursion: Recursive Fibonacci , Tower Of Hanoi</p> <p>Search : Simple Search and Estimating Search Time , Binary Search and Estimating Binary Search Time</p> <p>Sorting & Merging: Selection Sort , Merge List , Merge Sort , Higher Order Sort</p>	08
<p>Text books:</p> <ol style="list-style-type: none"> 1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist``, 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/thinkpython/) 2. Guido van Rossum and Fred L. Drake Jr, —An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011. 3. John V Guttag, —Introduction to Computation and Programming Using Python``, Revised and expanded Edition, MIT Press , 2013 4. Robert Sedgewick, Kevin Wayne, Robert Dondero, —Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016. 5. Timothy A. Budd, —Exploring Python, Mc-Graw Hill Education (India) Private Ltd., 2015. 6. Kenneth A. Lambert, —Fundamentals of Python: First Programs, CENGAGE Learning, 2012. 7. Charles Dierbach, —Introduction to Computer Science using Python: A Computational ProblemSolving Focus, Wiley India Edition, 2013. 8. Paul Gries, Jennifer Campbell and Jason Montojo, —Practical Programming: An Introduction to Computer Science using Python 3, Second edition, Pragmatic Programmers, LLC, 2013. 		
<p>Mapped With : https://ict.iitk.ac.in/product/python-programming-a-practical-approach/</p>		

APPLIED THERMODYNAMICS**Objectives:**

- To learn about of I law for reacting systems and heating value of fuels.
- To learn about gas and vapor cycles and their first law and second law efficiencies.
- To understand about the properties of dry and wet air and the principles of psychrometry.
- To learn about gas dynamics of air flow and steam through nozzles.
- To learn the about reciprocating compressors with and without intercooling.
- To analyze the performance of steam turbines.

UNIT I

Introduction to solid, liquid and gaseous fuels– Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flame temperature- Chemical equilibrium and equilibrium composition calculations using free energy. Introduction and Otto, Diesel and Dual cycles.

UNIT II**Vapour Power cycles:**

Vapor power cycles Rankine cycle with superheat, reheat and regeneration, exergy analysis. Rankine cycle, effect of pressure and temperature on Rankine cycle, Reheat cycle, Regenerative cycle, Feed water heaters, Binary vapour cycle, Combined cycles, Cogeneration.

Fuels and Combustion: Combustion analysis, heating values, air requirement, Air/Fuel ratio, standard heat of reaction and effect of temperature on standard heat of reaction, heat of formation, Adiabatic flame temperature.

UNIT III

Boilers: Classifications and working of boilers, boiler mountings and accessories, Draught and its calculations, air pre-heater, feed water heater, super heater. Boiler efficiency, Equivalent evaporation. Boiler trial and heat balance.

Condenser: Classification of condenser, air leakage, condenser performance parameters.

UNIT IV

Steam and Gas Nozzles: Flow through Convergent and convergent-divergent nozzles, variation of velocity, area and specific volume, choked flow, throat area, Nozzle efficiency, Off design operation of nozzle, Shock waves stationary normal shock waves, Effect of friction on nozzle, Super saturated flow.

Steam Turbines: Classification of steam turbine, Impulse and Reaction turbines, Staging, Stage and Overall efficiency, reheat factor, Bleeding, Velocity diagram of simple and compound multistage impulse and reaction turbines and related calculations, work done, efficiencies of reaction, Impulse reaction turbines, state point locus, Losses in steam turbines, Governing of turbines, Comparison with steam engine.

UNIT V

Gas Turbine: Gas turbine classification, Brayton cycle, Principles of gas turbine, Gas turbine cycles with intercooling, reheat and regeneration and their combinations, Stage efficiency, Polytropic efficiency. Deviation of actual cycles from ideal cycles.

Jet Propulsion: Introduction to the principles of jet propulsion, Turbojet and turboprop engines and their processes, Principle of rocket propulsion, Introduction to Rocket Engine. Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors.

Books and References:

1. Basic and Applied Thermodynamics by P.K. Nag, mcgraw hill india.
2. Applied thermodynamics by Onkar Singh, New Age International.
3. Applied Thermodynamics for Engineering Technologists by Eastop, Pearson Education.
4. Applied Thermodynamics by Venkanna And Swati, PHI. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India
5. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.
6. Theory of Stream Turbine by WJ Kearton.

SEMESTER-IV

Session: 2019-20

ENGINEERING MECHANICS

Course Outcomes:

After completing this course, the students should be able to understand the various effect of force and motion on the engineering design structures.

Objectives:

To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering.

UNIT-I:

Two-dimensional force systems: Basic concepts, Laws of motion, Principle of transmissibility of forces, transfer of a force to parallel position, resultant of a force system, simplest resultant of two dimensional concurrent and non-concurrent force systems, distribution of force systems, free body diagrams, equilibrium and equations of equilibrium. Friction: Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – wedge friction.

UNIT-II:

Beam: Introduction, shear force and bending moment, different equations of equilibrium, shear force and bending moment diagram for statically determined beams. Trusses: Introduction, simple truss and solution of simple truss, methods of F-joint and methods of sections.

UNIT-III:

Centroid and moment of inertia: Centroid of plane, curve, area, volume and composite bodies, moment of inertia of plane area, parallel axis theorem, perpendicular axis theorem, principle moment of inertia, mass moment of inertia of circular ring, disc, cylinder, sphere, and cone about their axis of symmetry.

UNIT-IV:

Kinematics of rigid body: Introduction, plane motion of rigid body, velocity and acceleration under translational and rotational motion, relative velocity. Kinetics of rigid body: Introduction, force, mass and acceleration, work and energy, impulse and momentum, D'Alembert's principle and dynamic equilibrium.

UNIT-V:

Simple stress and strain: Introduction, normal and shear stresses, stress-strain diagrams for ductile and brittle material, elastic constants, one-dimensional loading of members of varying cross sections, strain energy.

Pure bending of beams: Introduction, simple bending theory, stress in beams of different cross sections.

Torsion: Introduction, torsion of shafts of circular cross sections, torque and twist, shear stress due to torque.

Books and References:

1. Beer, F.P and Johnston Jr. E.R., “Vector Mechanics for Engineers (In SI Units): Statics and Dynamics”, 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).
2. Vela Murali, “Engineering Mechanics”, Oxford University Press (2010).
3. A Textbook of Engineering Mechanics, R.K. Bansal, Laxmi Publications.
4. Engineering Mechanics, R.S. Khurmi, S.Chand Publishing.
5. Meriam J.L. and Kraige L.G., “Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2”, Third Edition, John Wiley & Sons (1993).
6. Rajasekaran S and Sankarasubramanian G., “Engineering Mechanics Statics and Dynamics”, 3 rd Edition, Vikas Publishing House Pvt. Ltd., (2005).
7. Bhavikatti, S.S and Rajashekarappa, K.G., “Engineering Mechanics”, New Age International (P) Limited Publishers, (1998).
8. Engineering mechanics by Irving H. Shames, Prentice-Hall.

MANUFACTURING PROCESSES**Course Outcomes:**

Upon completion of this course, students will be able to understand the different conventional and unconventional manufacturing methods employed for making different products.

Objectives:

To motivate and challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods.

UNIT-I

Conventional Manufacturing processes: Casting and moulding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses. Introduction to bulk and sheet metal forming, plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming (forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending) principles of powder metallurgy.

UNIT-II

Metal cutting: Single and multi-point cutting; Orthogonal cutting, various force components: Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, cutting tool materials, cutting fluids, Coating; Turning, Drilling, Milling and finishing processes, Introduction to CNC machining. Additive manufacturing: Rapid prototyping and rapid tooling. Joining/fastening processes: Physics of welding, brazing and soldering; design considerations in welding, Solid and liquid state joining processes; Adhesive bonding.

UNIT-III

Grinding & Super finishing: Grinding: Grinding wheels, abrasive & bonds, cutting action. Grinding wheel specification. Grinding wheel wear - attrition wear, fracture wear. Dressing and Truing. Max chip thickness and Guest criteria. Surface and cylindrical grinding. Centreless grinding. Super finishing: Honing, lapping and polishing.

UNIT-IV

Metal Joining (Welding): Survey of welding and allied processes. Gas welding and cutting, process and equipment. Arc welding: Power sources and consumables. TIG & MIG processes and their parameters. Resistance welding - spot, seam projection etc. Other welding processes such as atomic hydrogen, submerged arc, electroslag, friction welding. Soldering & Brazing. Adhesive bonding. Weld decay in HAZ.

UNIT-V

Unconventional Machining Processes: Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, principles and process parameters. Electrical Discharge Machining, principle and processes parameters, MRR, surface finish, tool wear, dielectric, power and control circuits, wire EDM; Electrochemical machining (ECM), etchant & maskant, process parameters, MRR and surface finish. Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining.

Books and References:

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)- Pearson India, 2014.
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems.
3. Manufacturing Technology by P.N. Rao., MCGRAW HILL INDIA.
4. Materials and Manufacturing by Paul Degarmo.
5. Manufacturing Processes by Kaushish, PHI.
6. Principles of Foundry Technology, Jain, MCGRAW HILL INDIA
7. Production Technology by RK Jain.
8. Degarmo, Black & Kohser, Materials and Processes in Manufacturing.

APPLIED THERMODYNAMICS LAB

Objectives:

To understand the principles and performance of various boilers and engines.

List of Experiments: (At least 8 of the 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.

SEMESTER-IV

Session: 2019-20

COMPUTER AIDED MACHINE DRAWING-II LAB

Objectives:

To provide an overview of how computers can be utilized in mechanical component design.

Note: All drawing conforms to BIS Codes.

Introduction: Conventional representation of machine components and materials, Conventional representation of surface finish, Roughness number symbol, Symbols of Machine elements and welded joints. Classification of Drawings: Machine drawings, Production drawing, part drawing and assembly drawing. Introduction to detail drawing and bill of materials (BOM).

Limits, Fits and Tolerances: General aspects, Nominal size and basic dimensions, Definitions, Basis of fit or limit system, Systems of specifying tolerances, Designation of holes, Shafts and fits, Commonly used holes and shafts. List of Standard Abbreviation used.

Part Modelling: Introduction to part modelling of simple machine components using any 3D software (like CATIA, PRO E, UGNX, Autodesk Inventor or SOLIDWORKS) covering all commands/ features to develop a part model (Minimum 24 machine components need to be developed).

Part Modelling& Assemblies of: Plummer Block Bearing, Machine Vice, Screw Jack, Engine Stuffing box, Lathe Tailstock, Feed Check Valve and Rams Bottom Safety Valve.

Books and References:

1. Textbook of Machine Drawing, K C John, PHI.
2. Machine Drawing by K.R. Gopalakrishna, Subhas Stores.
3. A Textbook of Machine Drawing by PS Gill from S.K. Kataria& Sons.
4. Machine Drawing-KL Narayana, P Kannaiah, KV Reddy, New Age publications.
5. Engineering Graphics with AutoCAD, Bethune, PHI.
6. Machine Drawing, N. Siddeshwar, P Kannaiah, VVS Shastry, Tata McGraw Hill.
7. Fundamentals of Machine Drawing, Dr Sadhu Singh & P L Shah, Prantice Hall India.

SEMESTER-IV

Session: 2019-20

MANUFACTURING PROCESS LAB

Course Outcomes:

Upon completion of this course, students will be able to understand the different conventional and Unconventional manufacturing methods employed for making different products.

Objectives:

To motivate and challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods.

List of Experiments: (At least 8 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.
15. Study and understanding of limits, fits & tolerances.
16. Study of temperature measuring equipment's.
17. Measurement using Strain gauge.
18. Experiment on dynamometers.
19. To study the displacement using LVDT.

SEMESTER-IV

Session: 2019-20

Universal Human Values and Professional Ethics L

Course Outcome:

On completion of this course, the students will be able to

1. Understand the significance of value inputs in a classroom, distinguish between values and skills, understand the need, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society
2. Distinguish between the Self and the Body, understand the meaning of Harmony in the Self the Co-existence of Self and Body.
3. Understand the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human-human relationships and explore their role in ensuring a harmonious society
4. Understand the harmony in nature and existence, and work out their mutually fulfilling participation in the nature.
5. Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.

Objectives:

1. To help students distinguish between values and skills, and understand the need, basic guidelines, content and process of value education.
2. To help students initiate a process of dialog within themselves to know what they 'really want to be' in their life and profession
3. To help students understand the meaning of happiness and prosperity for a human being.
4. To facilitate the students to understand harmony at all the levels of human living, and live accordingly.
5. To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life

Catalogue Description

Every human being has two sets of questions to answer for his life: a) what to do? and, b) how to do?. The first set pertains to the value domain, and the other to the skill domain. Both are complimentary, but value domain has a higher priority. Today, education has become more and more skill biased, and hence, the basic aspiration of a human being, that is to live with happiness and prosperity, gets defeated, in spite of abundant technological progress.

This course is aimed at giving inputs that will help to ensure the right understanding and right feelings in the students in their life and profession, enabling them to lead an ethical life. In this course, the students learn the process of self exploration, the difference between the Self and the Body, the naturally acceptable feelings in relationships in a family, the comprehensive human goal in the society, the mutual fulfillment in the nature and the coexistence in existence. As a natural outcome of such inputs, they are able to evaluate an ethical life and profession ahead.

UNIT-1 Course Introduction - Need, Basic Guidelines, Content and Process for Value Education Understanding the need, basic guidelines, content and process for Value Education, Self-Exploration—what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self exploration, Continuous

Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

UNIT-2 Understanding Harmony in the Human Being - Harmony in Myself Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya.

UNIT-3 Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship Understanding harmony in the Family- the basic unit of human interaction, Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship, Understanding the meaning of Vishwas; Difference between intention and competence, Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals, Visualizing a universal harmonious order in society Undivided Society (AkhandSamaj), Universal Order (SarvabhaumVyawastha)- from family to world family!.

UNIT-4 Understanding Harmony in the Nature and Existence – Whole existence as Co-existence Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature, Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.

UNIT-5 Implications of the above Holistic Understanding of Harmony on Professional Ethics Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, technologies and management models, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers, b) At the level of society: as mutually enriching institutions and organizations.

Text Books:

1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics.

References:

1. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA

2. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.

3. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991

4. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome’s report, Universe Books.
5. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.
6. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
7. A N Tripathy, 2003, Human Values, New Age International Publishers.
8. SubhasPalekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) KrishiTantraShodh, Amravati.
9. E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press
10. M Govindrajan, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
11. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
12. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

Mode of Evaluation: Assignment/ Seminar/Continuous Assessment Test/Semester End Exam

MACHINE DESIGN-I

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 and flexible 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 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 Education.
4. Design of Machine Elements, Sharma and Purohit, PHI.
5. Design of Machine Elements-M.F. Spott, Pearson Education
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, Juvinall & Marshek, John Wiley & Sons.

HEAT & MASS TRANSFER**UNIT-1**

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

Conduction :General differential heat conduction equation in the rectangular, cylindrical and spherical coordinate systems. 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 overall heat transfer coefficient; Critical radius of insulation.

UNIT-2

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

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

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.

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.

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.

UNIT-5

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

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

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

Books:

1. Fundamentals of Heat and Mass Transfer, by Incropera & 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

SEMESTER-V

Session: 2019-20

MANUFACTURING SCIENCE& TECHNOLOGY-II

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.

Unit-II

Machine Tools

Lathe: Principle, construction, types, operations, Turret/capstan, semi/Automatic, Tool layout Shaper, slotter, planer: Construction, operations & drives.

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

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

Unit-III

Grinding & Super finishing

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

Super finishing: Honing, lapping and polishing.

Limits, Fits & Tolerance and Surface roughness:

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

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, friction welding. Soldering & Brazing. Adhesive bonding. Thermodynamic and Metallurgical aspects in welding and weld, Weldability, Shrinkage/residual stress in welds. Distortions & Defects in welds and remedies. 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. Introduction to Manufacturing Processes – John A. Schey, McGraw-Hill
4. Production Engineering Science - P.C. Pandey, Standard Publishers Distributors,
5. Modern Machining Processes - P.C. Pandey & H.S. Shan, McGraw-Hill
6. Degarmo's Materials and Processes in Manufacturing - Ernest P. De Garmo, J. T. Black, Ronald A. Kohser, Wiley
7. Fundamentals of Metal Cutting & Machine Tools – B.L. Juneja & G.S. Shekhon Wiley
8. Process & Materials of Manufacturing – R.A. Lindburg, Pearson Education
9. Advanced Machining Process - VK Jain, Allied Publishers
10. Manufacturing Engineering & Technology, -Kalpakjian, Pearson
11. Manufacturing Technology Part I and Part II, -Rao, PN, McGraw-Hill

SEMESTER-V

Session: 2019-20

Departmental Elective Course-1 I C ENGINES & COMPRESSOR

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.

Unit-II

SI Engines: Combustion in SI engine, Flame speed, Ignition delay, Abnormal combustion and its control, 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

Unit-III

CI Engine: Combustion in CI engines, Ignition delay, Knock and its control, Combustion chamber design 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 its control

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

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.

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, Dhanpat Rai & 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 Education

Design and Simulation - Lab I

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 wherever necessary 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

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

MANUFACTURING TECHNOLOGY-II – LAB

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

Managerial Economics

Unit	Topic	Proposed Lecture
I	Introduction of Engineering Economics and Demand Analysis: Meaning and nature of Economics, Relation between science, engineering, technology and economics; Meaning of Demand, Determinants of Demand, Shifts in demand, Law of Demand, Price Elasticity of Demand &Types, Income Elasticity, Cross price Elasticity, Determinants of Elasticity, uses and importance of elasticity.	06
II	Concept of Supply: Law of Supply, Factors affecting Supply, Elasticity of supply. Demand Forecasting: Introduction, Meaning and Forecasting, Methods or Techniques of Demand Forecasting, Criteria for Good Demand Forecasting, Demand Forecasting for a New Product;	06
III	Cost Analysis- Introduction, Types of Costs, Cost-Output Relationship: Cost Function, Cost-Output Relationships in the Short Run, and Cost-Output Relationships in the Long Run; Short run and long run, Break- Even Analysis; Production functions: laws of variable proportions, law of returns; Economies of scale: Internal and external.	06
IV	Market Structure: Market Structure Perfect Competition, Imperfect competition – Monopolistic, Oligopoly, duopoly sorbent features of price determination and various market conditions.	06

V	Nature and characteristics of Indian economy, concepts of LPG, elementary concepts of National Income, Inflation and Business Cycles ,Concept of N.I. and Measurement., Meaning of Inflation, Types and causes , Phases of business cycle .Investment decisions for boosting economy(National income and per capital income)	06
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References:

1. Premvir Kapoor, Sociology and Economics for Engineers, Khanna Publishing House (Edition 2018)
2. Salvatore D, "Principles of Microeconomics", Oxford University Press.
3. Koutsoyiannis A, "Modern Microeconomic", Macmillan Education Ltd.
4. Dwivedi DN, "Principles of Microeconomics", Pearson Education.
5. Cowell, FA, "Microeconomic Principles and Analysis", Oxford University Press.

SEMESTER-V**Session: 2019-20****CYBER SECURITY**

Unit	Topic	Proposed Lecture
I	Introduction- Introduction to Information Systems, Types of Information Systems, Development of Information Systems, Introduction to Information Security, Need for Information Security, Threats to Information Systems, Information Assurance, Cyber Security, and Security Risk Analysis.	08
II	Application Security- (Database, E-mail and Internet), Data Security Considerations- Backups, Archival Storage and Disposal of Data, Security Technology-Firewall and VPNs, Intrusion Detection, Access Control. Security Threats -Viruses, Worms, Trojan Horse, Bombs, Trapdoors, Spoofs, E-mail Viruses, Macro Viruses, Malicious Software, Network and Denial of Services Attack, Security Threats to E-Commerce- Electronic Payment System, e- Cash, Credit/Debit Cards. Digital Signature, Public Key Cryptography	08
III	Developing Secure Information Systems- Application Development Security, Information Security Governance & Risk Management, Security Architecture & Design Security Issues in Hardware, Data Storage & Downloadable Devices, Physical Security of IT Assets, Access Control, CCTV and Intrusion Detection Systems, Backup Security Measures.	08
IV	Security Policies- Development of Policies, WWW Policies, Email Security Policies, Policy Review Process-Corporate Policies-Sample Security Policies, Publishing and Notification Requirement of the Policies. Evolving Technology Security – Mobile, Cloud, Outsourcing, SCM.	08

V	<p>Information Security Standards-ISO, IT Act, Copyright Act, Patent Law, IPR. Cyber Laws in India; IT Act 2000 Provisions, Intellectual Property Law: Copy Right Law, Software License, Semiconductor Law and Patent Law.</p> <p>Case Study – Corporate Security</p>	08
<p>References:</p> <ol style="list-style-type: none"> 1. Charles P. Pfleeger, Shari Lawerance Pfleeger, “Analysing Computer Security”, Pearson Education India. 2. V.K.Pachghare, “Cryptography and information Security”, PHI Learning Private Limited, DelhiIndia. 3. Sarika Gupta & Gaurav Gupta, Information Security and Cyber Laws, Khanna Publishing House 4. Anshul Kaushik, Cyber Security, Khanna Publishing House 5. Dr.Surya Prakash Tripathi, Ritendra Goyal, Praveen Kumar Shukla ,”Introduction to InformationSecurity and Cyber Law” Willey Dreamtech Press. 6. Michael E.Whitman and Herbert J Mattord "Principle of Information Security" Cengage 7. Mike Chapple and David Seidl "Cyberwarfare: Information operations in a connected world"Jones & Bartlett Learning 8. Schou, Shoemaker, “Information Assurance for the Enterprise”, Tata McGraw Hill. 9. CHANDER, HARISH,” Cyber Laws And It Protection ” , PHI Learning Private Limited ,Delhi 10. V.K. Jain, Cryptography and Network Security, Khanna Publishing House, Delhi 		

SEMESTER-VI

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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, Velocity triangles, Power and efficiency calculations, Governing of Pelton wheel

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.

UNIT-III

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

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 Open FOAM', 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 Sukumar Pati, Tata McGraw Hill

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 faced followers 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 plane balancing, graphical and analytical methods, balancing of reciprocating masses,

Governors: Introduction, types of governors, characteristics of centrifugal governors, gravity controlled and 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: Amitabha Ghosh and Ashok Kumar Mallik, Third Edition Affiliated East-West Press.
3. Theory of Machines and Mechanisms: Joseph Edward Shigley and John Joseph Uicker, Jr. Oxford University Press
4. Kinematics and dynamics of machinery: R L Norton, McGraw Hill
5. Theory of Machines: S.S. Rattan, McGraw Hill
6. Theory of Machines: Thomas Bevan, CBS Publishers.

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MACHINE DESIGN-II

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.

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 strength of bevel gears, Effective load of gear tooth, Design of a bevel gear system.

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

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,

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

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 of crankshaft

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 Education.
4. Design of Machine Elements, Sharma and Purohit, PHI.
5. Design of Machine Elements-M.F. Spott, Pearson Education.
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, Juvinall & Marshek, John Wiley & Sons.

Departmental Elective Course-II**REFRIGERATION & AIR CONDITIONING**

- 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.

Unit-1**Refrigeration:**

Introduction to refrigeration system, Methods of refrigeration, Carnot refrigeration cycle, Unit of refrigeration, 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).

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.

Unit-3

Vapour Absorption system; Working Principle 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.

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

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.

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.

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. byKuhlen, Ramsey &Thelked.

FLUID MACHINERY Lab

- CO1-Student will perform experiments to understand the working of different types of turbine
- CO2- Student will perform experiments to understand the working of different types of turbine

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 types of pumps and turbines.
12. Experiment on Compressor
13. Experiment for measurement of drag and lift on aerofoil in wind tunnel

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

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

A. 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*)

B. Mini Project: Each student will be given a real life problem for the complete design of a subsystem/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.

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.

SOCIOLOGY

Unit	Topic	Proposed Lecture
I	Industrial Sociology: Nature, Scope and Importance of Industrial Sociology. Social Relations in Industry, Social Organisation in Industry- Bureaucracy, Scientific Management and Human Relations.	06
II	Rise and Development of Industry: Early Industrialism – Types of Productive Systems – The Manorial or Feudal system. The Guild system, The domestic or putting-out system, and the Factory system. Characteristics of the factory system. Causes and Consequences of industrialization. Obstacles to and Limitations of Industrialization.	06
III	Industrialization in India. Industrial Policy Resolutions – 1956. Science, Technology and Innovation Policy of India 2013.	06
IV	Contemporary Issues: Grievances and Grievance handling Procedure. Industrial Disputes: causes, Strikes and Lockouts. Preventive Machinery of Industrial Disputes: Schemes of Workers Participation in Management- Works Committee, Collective Bargaining, Bi-partite & Tri-partite Agreement, Code of Discipline, Standing Orders. Labour courts & Industrial Tribunals.	06
V	Visualizing the future: Models of industrialization- Collectivist, anarchist, free market, environmentalist, etc. Cultural issues, consumer society and sociological concerns.	06

References:

1. PREMVIR KAPOOR, Sociology & Economics for Engineers, Khanna Publishing House (Edition 2018).
2. GISBERT PASCAL, Fundamentals of Industrial sociology, Tata McGraw Hill, New Delhi, 1972.
3. SCHNEIDER ENGNO V., Industrial Sociology 2nd Ed., McGraw Hill Publishing Co., New Delhi, 1979.
4. MAMORIA C.B. And MAMORIA S., Dynamics of Industrial Relations in India.
5. SINHA G.P. and P.R.N. SINHA, Industrial Relations and Labour Legislations, New Delhi, Oxford and IBH Publishing Co., 1977.
6. S.C. SHARMA, Industrial Safety and Health Management, Khanna Book Publishing Co. (P) Ltd., Delhi (ISBN: 978-93-86173-188)
7. NADKARNI, LAKSHMI, Sociology of Industrial Worker, Rawat, Jaipur, 1998.
8. BHOWMICK SHARIT, Industry, Labour and Society, Orient, 2012.
9. RICHARD BROWN, JOHN CHILD, AND S R PARKER, The Sociology of Industry 1st Edition, Routledge, 2015.

INDUSTRIAL MANAGEMENT

Unit	Topic	Proposed Lecture
I	Introduction: Concept and scope of Industrial Management. Productivity: Definition, measurement, productivity index, types of production system, Industrial Ownership.	06
II	Functions of Management, Taylor's Scientific Management Theory, Fayol's Principles of Management, Social responsibilities of Management, Introduction to Human resources management: Nature of HRM, functions and importance of HRM.	06
III	Work Study: Introduction, definition, objectives, steps in work study, Method study: definition, objectives, steps of method study, Work Measurement: purpose, types of study — stop watch methods — steps — allowances — standard time calculations — work sampling, Production Planning and Control Inventory Control: Inventory, Cost, Models of inventory control: EOQ, ABC, VED	06
IV	Quality Control: statistical quality control, Control charts for variables and attributes, Acceptance Sampling- Single sampling- Double sampling plans, Introduction to TQM.	06
V	Project Management: Project network analysis, CPM, PERT and Project crashing and resource Leveling	06

References:

1. Engineering Management (Industrial Engineering & Management)/ S.C. Sharma & T.R. Banga, KhannaBook Publishing Co. (P) Ltd., Delhi (ISBN: 978-93-86173-072)
2. Industrial Engineering and Management/ P. Khanna, Dhanpatrai publications Ltd.
3. Production & Operation Management /PaneerSelvam /PHI.
4. Industrial Engineering Management/NVS Raju/Cengage Learning.
5. Industrial Engineering Management I RaviShankar/ Galgotia.

SEMESTER-VII

CAD/CAM

UNIT-I:

Principles of Computer Graphics:

Point plotting, drawing of lines, Bresenham's circle algorithm.

Transformation in Graphics:

Co-ordinate system used in Graphics and windowing, view port, views. 2D transformations – rotation, scaling, translation, mirror, reflection, shear - homogeneous transformations – concatenation.

3D Transformation – Perspective Projection – Technique (Description of techniques only).

Geometric Modelling: Classification of Geometric Modelling – Wire frame, Surface and Solid Modelling, applications – representation of curves and surfaces – Parametric form.

Design of curved shapes- Cubic spline – Bezier curve – B-spline – Design of Surfaces - features of Surface Modelling Package – Solid Primitives, CSG.

B-rep and description of other modelling techniques like Pure primitive instancing, cell decomposition, spatial occupancy enumeration, Boolean Operations (join, cut, intersection), Creating 3D objects from 2D profiles (extrusion, revolving etc).

UNIT-II:

Graphics standard & Data storage:

Standards for computer graphics GKS, PHIGS. Data exchange standards – IGES, STEP - Manipulation of the model - Model storage.

Finite Element Modelling:

Introduction, Mesh Generation – mesh requirements.

Semi-Automatic Methods- Node-based approach, Region based approach, Solid-modelling-based methods.

Fully Automatic Methods- Element-based approach, Application, Mesh Refinements using Isoperimetric Finite Elements, Meshing in high gradient areas, Transition Regions. Sub modelling Concept.

An overview of modelling software's like PRO-E, CATIA, IDEAS, SOLID EDGE etc.

UNIT-III:

CAM:

Scope and applications – NC in CAM – Principal types of CNC machine tools and their construction features – tooling for CNC – ISO designation for tooling – CNC operating system – FANUC, SINUMERIK – LINUMERIK.

Programming for CNC machining – coordinate systems – manual part programming – computer assisted part programming – CNC part programming with CAD system.

Material handling in CAM environment:

Types – AGVS – AS/RS – Swarf handling and disposal of wastes – single and mixed mode assembly lines – quantitative analysis of assembly systems.

UNIT-IV:

Robotics: Classification and specification – drive and controls – sensors - end effectors - grippers- tool handling and work handling – machine vision – robot programming concepts – case studies in assembly.

Quality Function Deployment: Process Planning – CAPP – Variant and Generative systems- Concurrent Engineering and Design for Manufacturing.

Advanced manufacturing Planning Computer Aided Production Planning and Control – Aggregate production planning and master production schedule – MRP – MRP II – ERP - Capacity planning.

UNIT-V:

Rapid prototyping:

Need for rapid prototyping, Basic principles and advantages of RP, General features and classifications of different RP techniques with examples.

Introduction to three representative RP techniques: Fusion Deposition Modelling, Laminated Object Manufacturing and Stereo-lithography.

Flexible manufacturing cells:

Systems – characteristics – economics and technological justification – planning, installation, operation and evaluation issues – role of group technology and JIT in FMS – typical case studies future prospects.

Books and References:

1. Chris McMahon and - CAD/CAM – Principle Practice and Manufacturing Management, Jimmie Browne Addison Wesley England, Second Edition, 2000.
2. Dr. Sadhu Singh - Computer Aided Design and Manufacturing, Khanna Publishers, New Delhi, Second Edition, 2000.
3. P. Radhakrishnan, - CAD/CAM/CIM, New Age International (P) Ltd., New Delhi. S. Subramanian and V. Raju.
4. Groover M.P. and - CAD/CAM; Computer Aided Design and Manufacturing, Prentice Hall Zimmers EW. International, New Delhi, 1992.
5. Ibrahim Zeid - CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd., Company Ltd., New Delhi, 1992.
6. Mikell P. Groover - Automation , Production Systems and Computer Integrated Manufacturing, Second edition, Prentice Hall of India, 2002.
7. S. Kant Vajpayee - Principles of Computer Integrated Manufacturing, Prentice Hall of India, 1999.
8. David Bed worth - Computer Integrated Design and Manufacturing, TMH, 1998.

SEMESTER-VII

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AUTOMOBILE ENGINEERING

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.

UNIT-II:

Transmission System:

Requirements. Clutches. Torque 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. Hotchkiss drive and Torque tube drive.

UNIT-III:

Braking System:

General requirements, Road, tyre adhesion, weight transfer, Braking ratio. Mechanical brakes, Hydraulic brakes. Vacuum and air brakes. Thermal aspects. Antilock braking system (ABS), electronic brake force distribution (EBD) and traction control.

Chassis 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.

UNIT-IV:

Electrical System:

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

Fuel Supply System:

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

UNIT-V:

Emission standards and pollution control:

Indian standards for automotive vehicles-Bharat I and II, Euro-I and Euro-II norms, fuel qualitystandards, environmental management systems for automotive vehicles, engine emissioncontrol by 3-way catalytic converter system, fueladditives and modern trends in automotive engine efficiencyand emission control.

Alternative Energy Sources:

Alternative energy sources, natural gas, LPG, biodiesel, bio-ethanol, gasohol and hydrogenfuels in automobiles, modifications needed, performance, combustion & emissioncharacteristics of alternative fuels in SI and CI engines, Electric and Hybrid vehicles,application of Fuel Cells. Prevention maintenance and overhauling

Books and References:

1. Automotive Engineering- Hietner.
2. Automobile Engineering - Narang.
3. Automobile Engineering –TTTTI, Pearson India.
4. Automotive Mechanics- Crouse.
5. Automobile Engineering - Newton and Steeds.
6. Automobile Engineering –Ramakrishna, PHI, India.
7. Automobile Engineering - Kripal Singh.
8. Kirpal Singh, Automobile Engineering, 7th ed., Standard Publishers, New Delhi, 1997.

CAD/CAM LAB

List of Experiments: (Total EIGHT Experiments are to be carried out. FOUR Experiments each from CAD and CAM.)

A. CAD Experiments:

1. Line Drawing or Circle Drawing experiment: Writing and validation of computer program.
2. Geometric Transformation algorithm experiment for translation/rotation/scaling: Writing and validation of computer program.
3. Design of machine component or other system experiment: Writing and validation of computer program.
4. Understanding and use of any 3-D Modelling Software commands.
5. Pro/E/Idea etc. Experiment: Solid modelling of a machine component.
6. Writing a small program for FEM for 2 spring system and validation of program or using a 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 of computer program.

B. CAM Experiments:

1. To study the characteristic features of CNC machine.
2. Part Programming (in word address format) experiment for turning operation (including operations 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 feedback devices.
9. Experiment on Mechatronics and controls.

I.C. ENGINES & AUTOMOBILE LAB

Experiments: Say at least 8 experiments out of following in depth and details.

1. Performance Analysis of Four stroke S.I. Engine- Determination of indicated and brake thermalefficiency, 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 brake thermalefficiency, 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- Carburettor, Fuel Injection Pump andMPFI.
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 Maruti Swift, Hyundaii20, Chevrolet Aveo, Tata Indica, Ford Fusion etc.
15. Comparative study & technical features of common scooters & motorcycles available in India.
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.

POWER PLANT ENGINEERING**UNIT-I:****Introduction:**

Power and energy, sources of energy, review of thermodynamic cycles related to power plants, fuels and combustion calculations. Load estimation, load curves, various terms and factors involved in power plant calculations. Effect of variable load on power plant operation, Selection of power plant units. Power plant economics and selection. Effect of plant type on costs, rates, fixed elements, energy elements, customer elements and investor's profit; depreciation and replacement, theory of rates. Economics of plant selection, other considerations in plant selection.

UNIT-II:**Steam power plant:**

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

UNIT-III:**Diesel power plant:**

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

Gas turbine power plant:

Layout of gas turbine power plant, Elements of gas turbine power plants, Gas turbine fuels, cogeneration, auxiliary systems such as fuel, controls and lubrication, operation and maintenance, Combined cycle power plants, Site selection of gas turbine power plant, Integrated Gasifier based Combined Cycle (IGCC) systems.

UNIT-IV:

Nuclear power plant:

Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants.

Hydroelectric and Non-Conventional Power Plant:

Hydroelectric power plants, classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems.

UNIT-V:

Electrical system: Generators and generator cooling, transformers and their cooling, bus bar, etc.

Energy Saving and Control:

Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

Books and References:

1. Power Plant Engineering, by F.T. Morse, Affiliated East-West Press Pvt. Ltd.
2. Power Plant Engineering by Hedge, Pearson India.
3. Power Plant Technology, by Wakil, McGraw Hill.
4. Power Plant Engineering by P.K. Nag, Tata McGraw Hill.
5. Steam & Gas Turbines & Power Plant Engineering by R. Yadav, Central Pub. House.
6. Power Plant Engineering by Gupta, PHI India.
7. El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.
8. Power Plant Engineering. Mahesh Verma, Metropolitan Book Company Pvt. Ltd.

OPERATIONS RESEARCH

UNIT-I:

Introduction:

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

Linear Programming:

Introduction & Scope, Problem formulation, Graphical Method, Simplex methods, primal and dual problem sensitivity analysis.

UNIT-II:

Transportation Problem:

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

Assignment Problem:

Methods of obtaining optimum solution, Maximization problem, travelling salesman problem.

UNIT-III:

Game Theory:

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

Sequencing:

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

UNIT-IV:

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

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

UNIT-V:

Queuing models: Characteristics of Queuing Model, M/M/1 and M/M/S system, cost consideration. **Project management:** Basic Concept of network Scheduling, Rules for drawing network diagram, Applications of CPM and PERT techniques in Project planning and control; crashing of operations; resource allocation.

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.

SEMESTER-VII

Session: 2019-20

Subject Name: Understanding the Human Being Comprehensively – Human Aspirations and its Fulfillment

ROE074

Course Objectives:

1. To help the students having the clarity about human aspirations, goal, activities and purpose of life.
2. To facilitate the competence to understand the harmony in nature/existence and participation of human being in the nature/existence.

3. To help the students to develop the understanding of human tradition and its various components.

Course Methodology:

1. The methodology of this course is explorational and universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence.
2. It is free from any dogma or set of do's and don'ts related to values.
3. It is a process of self-investigation and self-exploration, and not of giving sermons. Whatever is found as truth or reality is stated as a proposal and the students are facilitated and encouraged to verify it in their own right, based on their Natural Acceptance and subsequent Experiential Validation.

5. This self-exploration also enables them to critically evaluate their pre-conditionings and present beliefs.

Module 1: Introduction

The basic human aspirations and their fulfillment through Right understanding and Resolution; All-encompassing Resolution for a Human Being, its details and solution of problems in the light of Resolution

Module 2: Understanding Human being and its expansion.

The domain of right understanding starts from understanding the human being (the knower, the experiencer and the doer); and extends up to understanding nature/existence – its interconnectedness and co-existence; and finally understanding the role of human being in existence (human conduct).

Module 3: Activities of the Self.

Understanding the human being comprehensively is the first step and the core theme of this course; human being as co-existence of the self and the body; the activities and potentialities of the self; Reasons for harmony/contradiction in the self

Module 4: Understanding Co-existence with other orders.

The need and the process of inner evolution (through self-exploration, self-awareness and self-evaluation)- particularly awakening to activities of the Self: Realization, Understanding and Contemplation in the Self (Realization of Co-Existence, Understanding of Harmony in Nature and Contemplation of Participation of Human in this harmony/ order leading to comprehensive knowledge about the existence).

Module 5: Expansion of harmony from self to entire existence.

Understanding different aspects of All-encompassing Resolution (understanding, wisdom, science etc.), Holistic way of living for Human Being with All-encompassing Resolution covering all four dimensions of human endeavour viz., realization, thought, behavior and work (participation in the larger order) leading to harmony at all levels from self to Nature and entire Existence

Reference Books:

1. A Foundation Course in Human Values and Profession Ethics (Text Book and Teachers' Manual), R. R. Gaur, R. Sangal, G. P. Bagaria (2010), Excel Books, New Delhi [ISBN 978-8-174-46781-2]
2. Avartansheel Arthshastra, A. Nagraj, Divya Path Sansthan, Amarkantak, India
3. Economy of Permanence – (a quest for social order based on non-violence), J. C. Kumarappa (2010), Sarva-Seva-Sangh-Prakashan, Varansi, India
4. Energy and Equity, Ivan Illich (1974), The Trinity Press, Worcester & Harper Collins, USA
5. IshandiNauUpnishad, Shankaracharya, Geeta press, Gorakhpur,
6. Manav Vyavahar Darshan, A. Nagraj, Divya Path Sansthan, Amarkantak, India
7. Manaviya Sanvidhan, A. Nagraj, Divya Path Sansthan, Amarkantak, India
8. MahasatipatthanSutta , S N Goenka, Vipassana Research Institute, First

Edition, 1996

9. Small Is Beautiful: A Study of Economics as if People Mattered, E. F.

Schumacher, 1973, Blond & Briggs, UK

10. Slow is Beautiful, Cecile Andrews <http://www.newsociety.com/Books/S/Slow->

[is-Beautiful](http://www.newsociety.com/Books/S/Slow-is-Beautiful))

11. Science & Humanism – towards a unified worldview, P. L. Dhar & R. R. Gaur

(1990), Commonwealth Publishers, New Delhi

12. Sanchian Sri Guru Granth Sahib Ji ,Shiromani GurdwaraParbhandhak

Committee, 2001

13. SamanSuttam, JinendraVarni ,1974.

14. Vyavaharvadi Samajshastra, A. Nagraj, Divya Path Sansthan, Amarkantak,

India

15. Vyavahatmak Janvad, A. Nagraj, Divya Path Sansthan, Amarkantak, India.

SEMESTER-VIII

SEMESTER-VIII

Session: 2019-20

ADVANCED WELDING

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

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

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.

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

UNIT-II:

Welding Processes:

Manual Metal Arc Welding (MMAW), TIG, MIG, Plasma Arc, Submerged Arc Welding, Electro gas and Electro slag, 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.

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.

UNIT-IV:

Repair & Maintenance Welding:

Hard facing, Cladding, Surfacing, Metalizing processes and Reclamation welding.

Weld ability: Effects of alloying elements on weld ability, welding of plain carbon steel, Cast Iron and aluminum. 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.

Books and References:

1. Welding and Welding Technology, by- Richard L. Little, McGraw Hill Education.
2. Welding Principles and Practices, by- Edwards R. Bohnart, McGraw Hill Education.
3. Welding Engineering and Technology, by- R. S. Parmar, Khanna Publishers.
4. Welding Technology Fundamentals by William. A. Bowditch.
5. Welding Technology by N K Srinivasan.
6. Welding Engineering and Technology by R S Parmar.
7. Modern Welding Technology by Howard B Cary and Scott Helzer.
8. Welding Handbooks (Vol. I & II).

SEMESTER-VIII

Session: 2019-20

TOTAL QUALITY MANAGEMENT (TQM)

UNIT -I:

Quality Concept Evolution of Quality control, concept change, TQM Modern concept, Quality concept in design.

Control on Purchased Product:

Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure.

Manufacturing Quality:

Methods and Techniques for manufacture, Inspection and control of product, Quality in sales and services, Guarantee, analysis of claims.

UNIT -II:

Quality Management:

Organization structure and design, Quality function, decentralization, Designing and fitting organization for different types products and company, Economics of quality value and contribution, Quality cost, optimizing quality cost, seduction programme.

TQM Principles:

Leadership, strategic quality planning; Quality councils- employee involvement, motivation; Empowerment; Team and Teamwork; Quality circles, recognition and reward, performance appraisal; Continuous process improvement; PDCE cycle, 5S, Kaizen; Supplier partnership, Partnering, Supplier rating & selection.

UNIT -III:

Tools and Techniques:

Seven QC tools (Histogram, Check sheet, Ishikawa diagram, Pareto, Scatter diagram, Control chart, flowchart).

Control Charts: Theory of control charts, measurement range, construction and analysis of R charts, process capability study, use of control charts, P-charts and C-charts.

UNIT -IV:

Defects Diagnosis and Prevention:

Defect study, identification and analysis of defects, corrective measure, factors affecting reliability, MTTF, calculation of reliability, Building reliability in the product, evaluation of reliability, interpretation of test results, reliability control, maintainability, zero defects, quality circle.

UNIT -V:

ISO and its concept of Quality Management:

Quality systems, need for ISO 9000, ISO 9001-9008; Quality system- elements, documentation, Quality auditing, QS 9000, ISO 14000- concepts, requirements and benefits; TQM implementation in manufacturing and service sectors, Auditing, Taguchi method, JIT in some details.

Books and References:

1. Total Quality Management, by Dale H. Besterfield, Pearson India.
2. Beyond Total Quality Management, Greg Bounds, McGraw Hill.
3. Besterfield D.H. et al., Total quality Management, 3rd ed., Pearson Education Asia, 2006.
4. Evans J.R. and Lindsay W.M., The management and Control of Quality, 8th ed., first Indian edition, Cengage Learning, 2012.
5. Janakiraman B. and Gopal R.K., Total Quality Management, Prentice Hall India, 2006.
6. Suganthi L. and Samuel A., Total Quality Management, Prentice Hall India, 2006.
7. Total Quality Management by Mukherjee, P.N.
8. TQM in New Product manufacturing, H. G. Menon, McGraw Hill

SEMESTER-VIII

Session: 2019-20

ROE086: RENEWABLE ENERGY RESOURCES

L T P 3 0 0

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 and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.

UNIT-III **Geothermal Energy:** Resources of geothermal energy, thermodynamics of geothermal 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 thermionic Conversions: Principle of working, performance and limitations. **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 books:

1. Raja etal, "Introduction to Non-Conventional Energy Resources" Scitech Publications.

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