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

Program: B.TECH
Course :(Mechanical Engineering)

Session: 2021-22

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 2021-22		
Semester	Course Code	Course	Course Outcome
SEMESTER III	BT-311	Thermodynamics	CO 1-After completing this course, the students will be able to apply

			energy balance to systems andcontrol volumes, in situations involving heat and work interactions. CO2-Students can evaluate changes in thermodynamic properties of substances. CO3-The students will be able to evaluate the performance of energy conversion devices. CO4-The students will be able to differentiate between high grade and low-grade energies.
		Materials Engineering	CO1- Students will be able to identify crystal structure and defects in crystal structure CO2-Understand how to tailor material properties of ferrous and non-ferrous alloys. CO3-How to quantify mechanical integrity and failure in materials.
	BT-312	Fluid Mechanics	CO1-Upon completion of this course, students will be able to mathematically analyze simple flowsituations. CO2-They will be able to

			evaluate the performance of pumps and turbines.
	BT-322	Engineering Science	CO1- Upon completion of this course, students will get basic knowledge of different types of energy i.e. solar energy,nuclear energy,biomass,tidal,geot hermal energy. CO2- They will get basic knowledge of nuclear fuel cycle CO3- The concept of green building and green architecture will be cleared
	BT-304	Technical Communication	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. 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

			CO3-Learning the skill of proofreading and copy editing, paraphrasing and spinning using technical tools and manually using the knowledge of advance technical grammar.
	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 andcharacterize the performance of fluid/thermal machinery.
	BT-309	Cyber Security System	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.
			CO3-Evaluate and communicate the human role in security systems with an emphasis on ethics, social engineering vulnerabilities and training.
			CO4-Interpret and forensically investigate security incidents.
SEMESTER V	BT-519(N)	Heat and Mass Transfer	CO1-Understand the fundamentals of heat and mass transfer. CO2-Apply the concept of steady and transient heat conduction. CO3-Apply the concept of thermal behavior of fins. CO4-Apply the concept of forced and free convection. CO5-Apply the concept of radiation for black and non black bodies. CO6-Conduct thermal analysis of heat exchangers.
	BT-569(N)	Heat and Mass Transfer Lab	CO1 Conduct experiments on conduction, convection and radiation of heat; collect data, perform analysis and interpret results to draw valid conclusions through standard test procedures CO2 Determine thermal properties and performance of heat exchanger, vapour compression refrigerator and air

			conditioner
	BT-521(N)	Internal Combustion Engine	CO1-Explain the working principle, performance parameters and testing of IC Engine. CO2-Understand the combustion phenomena in SI and CI engines and factors influencing combustion chamber design. CO3-Understand the essential systems of IC engine and latest trends and developments in IC Engines. CO4-Understand the effect of engine emissions on environment and human health and methods of reducing it. CO5-Apply the concepts of thermodynamics to air standard cycle in IC Engines CO6-Analyze the effect of various operating parameters on IC engine performance.

	BT-520(N)	Strength of Material	CO1-Understand the concept of stress and strain under different conditions of loading CO2-Determine the principal stresses and strains in structural members CO3-Determine the stresses and strains in the members subjected to axial, bending and torsional loads CO4-Apply the concepts of stresses and strain in solving problems related to springs, column and pressure vessels Calculate the slope, deflection and buckling of loaded members
	BT-522(N)	ADVANCE WELDING	CO1-Understand the physics of arc welding process and various operating characteristics of welding power source. CO2-Analyse various welding processes and their applications. Apply the knowledge of welding for repair & maintenance, along with the weldability of different materials. CO3-Apply the concept of quality control and testing of weldments in industrial environment. CO4-Evaluate heat flow in welding and physical metallurgy of weldments.

	BT-559(N)	INTERNET OF THINGS	CO1-The students will be thorough about the technology behind the IoT and associated technologies. CO2-The students will be able to use the IoT technologies in practical domains of society. CO3-The students will be able to gain knowledge about the state of the art methodologies in IoT application domains
	BT-572(N)	INTERNET OF THINGS LAB	CO1-The students will get practical knowledge of the technology behind the IoT and associated technologies. CO2-The students will be able to use the IoT technologies in practical domains of .
	BT-571(N)	PYTHON PROGRAMMING LAB	1. Interpret the mathematical results in physical and other forms. 2. Identify, formulate and solve the Linear Differential Equations. 3. Classify and solve the contour integration of complex functions.
	BT-510(N)	CONSTITUTION OF INDIA	CO1- Understand the emergence and evolution of Indian constitution CO2- Understand the structure and composition of Indian Constitution

	BT-518(N)	INDUSTRIAL ENGINEERING	CO1-Understand the concept of production system, productivity, facility and process planning in various industries CO2-Apply the various forecasting and project management techniques CO3-Apply the concept of break even analysis, inventory control and resource utilization using queuing theory CO4-Apply principles of work study and ergonomics for design of work systems Formulate mathematical models for optimal solution of industrial problems using linear programming approach
VII SEMESTER	BT-722(N)	POWER PLANT ENGINEERING	CO1- Explain the economics involved in Power Plant and identify the factors related to selection of plant. CO2- Discuss various components of steam power plant and the factors influencing the site selection for the plant. CO3- Describe the working of various components of diesel power plant and compare it with steam power plant. CO4-Illustrate the working of gas turbine power plant and its components. CO5-Explain the components, principles and working of nuclear & non-conventional

			power plant. CO6- Describe the electrical, instrumentation & pollution control systems used in power plants.
	BT-702(N)	Renewable Energy Resources	CO1-Understand the need of energy conversion and the various methods of energy storage CO2- Explain the field applications of solar ener CO3- Identify Winds energy as alternate form of energy and to know how it can be tapped CO4- Explain bio gas generation and its impact on environment
	BT-721(N)	ADDITIVE MANUFACTURING	CO1-To introduce students the basics of additive manufacturing/rapid prototyping and its applications in various fields, reverse engineering techniques. CO2-To familiarize students with different processes in rapid prototyping systems. CO3-To teach students about mechanical properties and geometric issues relating to specific rapid prototyping applications.
	BT-701(N)	Project Management & Entrepreneurship	CO1- Students will pick up about Foundation of Entrepreneurship Development and its theories. CO2- Students will identify the type of entrepreneur and the steps involved in an entrepreneurial venture.

			CO3- Students will understand various steps involved in starting a venture and to explore marketing methods & new trends in entrepreneurship.
	BT-775	INDUSTRIAL TRAINING	CO1-Student is able to understand management of manufacturing CO2-Student is able to apply work improvement techniques in an organization where he undergoes for in-plant training. CO3-Student is able to find out and reduce work content of the job.
	BT-774	PROJECT	CO1-Identify, visualize, formulate and solve engineering problems in the field of mechanical Engineering. CO2-Use the techniques, skills, and modern engineering tools necessary for engineering practice with appropriate considerations for societal, and environmental constraints. CO3-Apply their fundamental field skills towards the understanding of the impact of engineering solutions on the society in a global and social context.

IV SEMESTER	BT-418	ENGINEERING MECHANICS	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.
	BT-413	APPLIED THERMODYNAMICS	C01-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.
	BT-412	MANUFACTURING PROCESS	Upon completion of This course, students will be able to understand the different conventionaland unconventional manufacturing methods employed for making different products
	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 DESIGN LAB	CO1-Upon completion of this course, the students can use computer and CAD software for modelling Mechanical components

VI SEMESTER	BT-620(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 systems.
	BT-621(N)	Machine Design	CO1-Classify various machine elements based on their functions and applications. CO2-Apply the principles of solid mechanics to machine elements subjected to staticand fluctuating loads. CO3-Analyze forces, bending moments, twisting moments and failure causes in various machine elements to be designed. CO4-Design the machine elements to meet the required specification.
	BT-622(N)	Theory Of Machine	CO1-Determine the kinematic chain and mobility, and perform the kinematic analysis of a given mechanism, CO2-Apply the fundamental principles of statics and dynamics to machinery, CO3- Understand and avoid/suppress certain common dynamical problems a machine may undergo, CO4- Understand the fundamentals of machine design for

			desired kinematic or dynamic performance. CO5-Understand the fundamentals of mechanical vibrations.
	BT-624(N)	Understand the human being comprehensively-Human aspirations and their fullfillment	CO1- Understanding the human being- I and body 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-623(N)	Non Destructive Testing	CO1-The student shall be able to select an appropriate NDT technique as per requirement. CO2-The student shall be able to set various process parameters and control the NDT process for the desired output parameters. CO3-The student shall be able to find the internal flaws in the material by NDT and take measures to eliminate them. CO4-The student shall be able to solve various problems encountered like leakage, cracks, blowholes etc with the manufacturing process by analyzing the data
	BT-610(N)	CONSTITUTION OF INDIA	CO1- Understand the emergence and evolution of Indian constitution CO2- Understand the structure and composition of Indian Constitution

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	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 TECHNIQUE	CO1-Understand the physics of arc welding process and various operating characteristics of welding power source. CO2-Analyse various welding processes and their applications.

			Apply the knowledge of welding for repair & maintenance, along with the weldability of different materials. CO3-Apply the concept of quality control and testing of weldments in industrial environment. CO4-Evaluate heat flow in welding and physical metallurgy of weldments.
	BT-871	SEMINAR	CO1-Students will be able to show competence in identifying relevant information, defining and explaining topics under discussion. CO2-They will demonstrate depth of understanding, use primary and secondary sources; they will demonstrate complexity, insight, cogency, independent thought, relevance, and persuasiveness. CO3-They will be able to evaluate information and use and apply relevant theories. CO4-Students will be able to show competence in working with a methodology, structuring their oral

			work, and synthesizing information.
	BT-872	PROJECT	CO1-Identify, visualize, formulate and solve engineering problems in the field of mechanical Engineering. CO2-Use the techniques, skills, and modern engineering tools necessary for engineering practice with appropriate considerations for societal, and environmental constraints. CO3-Apply their fundamental field skills towards the understanding of the impact of engineering solutions on the society in a global and social context

TEACHING SCHEME AND EXAMINATIONS MARKS FOR : 3rd SEMESTER   YEAR -: 2019-20

Branch: - Mechanical Engineering

S. No.	Subject Name	Subject Code	L	T	P	CT	TA	Total	PS	TE	PE	Total	Credit
			Periods			**Evaluation Scheme**				**End Semester**		**Total**	**Credit**
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 / BT – 304	3 / 2	0 / 1	0 / 0	30	20	50	-	100	-	150	3
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:-

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 Co-ordinator

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 / BT – 404	3 / 2	0 / 1	0 / 0	30	20	50	-	100	-	150	3
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   2. Basics Data Structure & Algorithms -   BT – 420

4. Material Science	-	BT – 421	4. Energy Science & Engineering	-	BT – 422
5. Sensor & Instrumentation	-	BT – 423	6. Introduction to Soft Computing	-	BT – 424
8. Analog Electronics	-	BT – 425	8. Electronics Engineering	-	BT – 426

Examination Co-ordinator

TEACHING SCHEME AND EXAMINATIONS MARKS FOR : Vth SEMESTER   YEAR -: 2021-22

Branch: - Mechanical Engineering

S. No.	Subject Name	Subject Code No.	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1.	Industrial Engineering	BT – 518 (N)	3	1	0	30	20	50		100		150	4
2.	Heat and Mass Transfer	BT – 519 (N)	3	1	0	30	20	50		100		150	4
3.	Strength of Material	BT – 520 (N)	3	1	0	30	20	50		100		150	4
4.	**Department Elective – I** I. C. Engines & Compressors	BT – 521 (N)	3	0	0	30	20	50		100		150	3
5.	**Department Elective – II** Advance welding	BT – 522 (N)	3	0	0	30	20	50		100		150	3
6.	Indian Tradition, Culture and Society/ Constitution of India, Law and Engineering	BT – 509 (N) / BT - 510 (N)	2	0	0	15	10	25		50		50	NC
7.	Heat Transfer Lab	BT – 569 (N)	0	0	2				25		25	50	1
8.	Python Lab	BT – 571 (N)	0	0	2				25		25	50	1
9.	Internet of Things Lab	BT – 572 (N)	0	0	2				25		25	50	1
10.	Mini Project/Internship **	BT – 570 (N)	0	0	2				50				1

11.	MOOCs (Essential for Hons. Degree)													
	Total		**17**	**3**	**8**								**950**	**22**

** The Mini Project or Internship (4weeks) conducted during summer break after IVth Semester and will be assessed during Vth Semester.

Grand Total of Theory & Practical = 950

Examination Co-ordinator

TEACHING SCHEME AND EXAMINATIONS MARKS FOR : VIth SEMESTER   YEAR -: 2021-22

Branch: - Mechanical Engineering

S. No.	Subject Name	Subject Code No.	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1.	Refrigeration and Air Conditioning	BT – 620 (N)	3	1	0	30	20	50		100		150	4
2.	Machine Design	BT – 621 (N)	3	1	0	30	20	50		100		150	4
3.	Theory of Machine	BT – 622 (N)	3	1	0	30	20	50		100		150	4
4.	**Open Elective – I** Understanding the Human Being Comprehensively human Aspirations and its Fulfillment	BT – 624 (N)	3	0	0	30	20	50		100		150	3
5.	**Department Elective – III** Non-Destructive Testing	BT – 623 (N)	3	0	0	30	20	50		100		150	3
6.	Indian Tradition, Culture and Society/ Constitution of India	BT – 609 (N) / BT - 610 (N)	2	0	0	15	10	25		50		50	NC
7.	Refrigeration and Air Conditioning Lab	BT – 670 (N)	0	0	2				25		25	50	1
8.	Machine Design Lab	BT – 671 (N)	0	0	2				25		25	50	1
9.	Theory of Machine Lab	BT – 672 (N)	0	0	2				25		25	50	1
10.	MOOCs (Essential for Hons. Degree)												

	Total		17	3	6							900	21

Grand Total of Theory & Practical = 900

Examination Co-ordinator

Branch: - Mechanical Engineering

S. No.	Subject Name	Subject Code No.	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1.	Project Management & Entrepreneurship	BT – 701 (N)	3	0	0	30	20	50		100		150	3
2.	Renewable Energy Resources	BT – 702 (N)	3	0	0	30	20	50		100		150	3
3.	**Department Elective – IV** Additive Manufacturing	BT – 721 (N)	3	0	0	30	20	50		100		150	3
4.	**Department Elective – V** Power Plant Engineering	BT – 722 (N)	3	0	0	30	20	50		100		150	3
5.	Measurement & Metrology Lab	BT – 773 (N)	0	0	2				25		25	50	1
6.	Mini Project or Internship Assessment**	BT – 774 (N)	0	0	2				50			50	1
7.	Project I	BT – 775 (N)	0	0	8				150			150	4
	MOOCs (Essential for Hons. Degree)												
	Total											850	18

Grand Total of Theory & Practical = 850

Examination Co-ordinator

Branch: - Mechanical Engineering

S. No.	Subject Name	Subject Code No.	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1.	Automation & Robotics							50		100		150	3
2.	Enterneroship Development							50		100		150	3
3.	Rural Development							50		100		150	3
4.	Project							100		300		400	3
5.	MOOCs (Essential for Hons. Degree)												
	Total											**850**	**18**

Grand Total of Theory & Practical = 850

THERMODYNAMICS

Objectives:

- To learn about work and heat interactions, and balance of energy between system anditssurroundings.
- 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 lawlimitationson energy conversion.

UNIT I

Review of Fundamental Concepts and Definitions:

Introduction- Basic Concepts: System, ControlVolume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopicviewpoints, 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 statesteady flow processes including throttling; Examples of steady flow devices;Unsteady processes;examples of steady and unsteady I law applications for system andcontrol 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 it's corollaries, Thermodynamic Temperature Scale, PMM-II.
Entropy: Clausius inequality, Concept of Entropy, Entropy change of pure substance in different thermodynamic processes, Tds equation, Principle of entropy increase, T-S diagram, Statement of the third law of thermodynamics.

UNIT III

Availability and Irreversibility:

Available and unavailable energy, Availability and Irreversibility, Second law efficiency, Helmholtz &Gibb's function.

Thermodynamic relations:

Conditions for exact differentials. Maxwell relations, Clapeyron equation, Joule-Thompson coefficientand 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 it's measurement,processes involving steam in closed and open systems. Simple Rankine cycle.

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

UNIT V

Refrigeration Cycles:

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

Books and References:

1. Basic and Applied Thermodynamics by PK Nag, MCGRAW HILL INDIA.
2. Thermodynamics for Engineers by Kroos& Potter, Cengage Learning.
3. Thermodynamics by Shavit and Gutfinger, CRC Press.
4. Thermodynamics- An Engineering Approach by Cengel, MCGRAW HILL 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, JohnWiley.
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 surfacetension, 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, homogenous 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 byV.K.Gupta et.al.
5. Fluid Mechanics byYunusCengel.
6. Batchelor, G. K. (1999). Introduction to fluid dynamics. New Delhi, India: Cambridge UniversityPress.
7. Acheson, D. J. (1990). Elementary fluid dynamics. New York, USA: Oxford UniversityPress.
8. R.W. Fox, A.T. McDonald and P.J. Pritchard, Introduction to Fluid Mechanics, 6th Ed., John Wiley,2004.

MATERIALS ENGINEERING

Objectives:

- Understanding of the correlation between the internal structure of materials, their mechanicalproperties 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-Calloys.

UNIT-I

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

Mechanical Property measurement: Tensile, compression and torsion tests; Young'smodulus, relations between true and engineering stress-strain curves, generalized Hooke'slaw, 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, Maximumnormal stress, Mohr-Coulomb and Modified Mohr-Coulomb; Fracture mechanics:Introduction to Stress- intensity factor approach and Griffith criterion. Fatigue failure: Highcycle fatigue, Stress-life approach,SN curve, endurance and fatigue limits, effects of meanstress 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 binaryphase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron Iron-carbide phase diagram and microstructural aspects ofledeburite, austenite, ferrite and cementite, cast iron.

UNIT-IV

Heat treatment of Steel: Annealing, tempering, normalising and spheroidising, isothermaltransformation diagrams for Fe-C alloys and microstructure development. Continuouscooling curves and interpretation of final microstructures and properties- austempering,martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame andinduction 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 andcupro-nickel; Aluminium and Al-Cu – Mg alloys- Nickel based superalloys and Titaniumalloys.

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 ofIndia 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 offluids andcharacterize 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 vertex 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 onthe 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 gaugeto 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 flawdetector, eddy current testing machine, dye penetrant tests.

COMPUTER AIDED MACHINE DRAWING-I LAB

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 ofdimensioning.

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 orflexible 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.

Course Outcomes:

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

Books and References:

Fundamentals of Machine Drawing by Sadhu Singh & Shah, PHI.

Engineering Drawing by Bhat, & Panchal, Charotar Publishing House.

Machine Drawing with AutoCAD by Pohit and Ghosh, Pearson.

Machine Drawing-KL Narayana, P Kannaiah, KV Reddy, New Age.

Machine Drawing, N. Siddeshswar, P Kannaiah, VVS Shastry, Tata McGraw Hill.

Engineering Drawing, Pathak, Wiley.

Textbook of Machine Drawing, K C John, PHI.

AutoCAD 2014 for Engineers & Designers, Bhatt, WILEY

Energy Science and Engineering

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-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 CO_2, 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-III Solar   Introduction

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: 2021-22

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	K_1, K_2
CO 2	To discover cyber attack scenarios to web browsers and web servers and to explain how to mitigate such threats	K_2
CO 3	To discover and explain mobile software bugs posing cyber security threats, explain and recreate exploits, and to explain mitigation techniques.	K_3
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	K_4
CO 5	To articulate the well known cyber attack incidents, explain the attack scenarios, and explain mitigation techniques.	K_5, K_6
DETAILED SYLLABUS		**3-1-0**
Unit	**Topic**	**Proposed Lecture**
I	**Computer System Security Introduction**: Introduction, What is computer security and what to l 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
III	**Secure architecture principles isolation and leas:** Access Control Concepts , Unix and windows 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/

SEMESTER-IV   Session: 2021-22

Universal Human Values and Professional Ethics

BT – 414

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

- 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
- Distinguish between the Self and the Body, understand the meaning of Harmony in the Self the Co-existence of Self and Body.
- 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
- Understand the harmony in nature and existence, and work out their mutually fulfilling participation in the nature.
- Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work. 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 andprogram 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 HumanValues and Professional Ethics.

References:

1. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs,Britain.
2. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
3. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.
4. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak
5. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
6. A N Tripathy, 2003, Human Values, New Age International Publishers.
7. SubhasPalekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) KrishiTantraShodh, Amravati.
8. E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers , Oxford University Press
9. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
10. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
11. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.
12. Mode of Evaluation: Assignment/ Seminar/Continuous Assessment Test/Semester End Exam

SEMESTER-IV   Session: 2021-22

APPLIED THERMODYNAMICS

BT – 413

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 lawanalysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flametemperatureChemical equilibrium and equilibrium composition calculations using freeenergy. 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 andtheir processes, Principle of rocket propulsion, Introduction to Rocket Engine. Reciprocating compressors, staging of reciprocating compressors, optimal stage pressureratio, 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.

5. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons.

6. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India

7. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons. 8. Theory of Stream Turbine by WJ Kearton.

SEMESTER-IV   Session: 2021-22

ENGINEERING MECHANICS   BT- 418

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.

SEMESTER-IV   Session: 2021-22

MANUFACTURING PROCESSES   BT – 412

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, Mach inability, 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 - attritions wear, fractures 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.

MANUFACTURING PROCESS LAB

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.

COMPUTER AIDED MACHINE DRAWING-II LAB

Course Outcomes:

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

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. Siddeshswar, P Kannaiah, VVS Shastry, Tata McGraw Hill.

7. Fundamentals of Machine Drawing, Dr Sadhu Singh & P L Shah, Prantice Hall India.

8. Autodesk Inventor by Examples, Sam Tikoo, Wile

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	**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. **File I/O :** File input and output operations in Python Programming **Exceptions and Assertions** **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 _init_, _str_, comparison methods and Arithmetic methods etc.) , Class Example , Inheritance , Inheritance and OOP.	**08**
V	**Iterators & Recursion:** Recursive Fibonacci , Tower Of Hanoi **Search :** Simple Search and Estimating Search Time , Binary Search and Estimating Binary Search Time **Sorting & Merging:** Selection Sort , Merge List , Merge Sort , Higher Order Sort	**08**

Text books:

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.

Mapped With : https://ict.iitk.ac.in/product/python-programming-a-practical-approach/

Mathematics-IV

	Course Outcome (CO)	Bloom's Knowledge Level (KL)
	At the end of this course, the students will be able to:	
CO 1	Remember the concept of partial differential equation and to solve partial differential equations	K_1 & K_3
CO 2	Analyze the concept of partial differential equations to evaluate the problems concerned with partial differential equations	K_4 & K_5
CO 3	Understand the concept of correlation, moments, skewness and kurtosis and curve fitting	K_2
CO 4	Remember the concept of probability to evaluate probability distributions	K_1 & K_5
CO 5	Apply the concept of hypothesis testing and statistical quality control to create control charts	K_3 & K_6

K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5 – Evaluate, K_6 – Create

Subject Code	KAS302/KAS402					
Category	Basic Science Course					
Subject Name	MATHEMATICS-IV					
Scheme and Credits	**L-T-P**	**Theory Marks**	**Sessional**		**Total**	**Credit**
			Test	**Assig/Att.**		
	3—1—0	100	30	20	150	4
Pre- requisites (if any)	Knowledge of Mathematics I and II of B. Tech or equivalent					

The students will learn:

- The idea of partial differentiation and types of partial differential equations
- The idea of classification of second partial differential equations, wave , heatequation and transmission lines
- The basic ideas of statistics including measures of central tendency,correlation, regression and their properties.
- The idea s of probability and random variables and various discreteand continuous robability distributions and their properties.
- The statistical methods of studying data samples, hypothesis testing and statisticalquality control, control charts and their properties.

Module I: Partial Differential Equations

Origin of Partial Differential Equations, Linear and Non Linear Partial Equations of first order, Lagrange's Equations, Charpit's method, Cauchy's method of Characteristics, Solution of Linear Partial Differential Equation of Higher order with constant coefficients, Equations reducible to linear partial differential equations with constant coefficients.

Module II: Applications of Partial Differential Equations:

Classification of linear partial differential equation of second order, Method of separation of variables, Solution of wave and heat conduction equation up to two dimension, Laplace equationin two dimensions, Equations of Transmission lines.

Module III: Statistical Techniques I:

Introduction: Measures of central tendency, Moments, Moment generating function (MGF) , Skewness, Kurtosis, Curve Fitting , Method of least squares, Fitting of straight lines, Fitting of second degree parabola, Exponential curves ,Correlation and Rank correlation, Regression Analysis: Regression lines of y on x and x on y, regression coefficients, properties of regressions coefficients and non linear regression.

Module IV: Statistical Techniques II:

Probability and Distribution: Introduction, Addition and multiplication law of probability, Conditional probability, Baye's theorem, Random variables (Discrete and Continuous Random variable) Probability mass function and Probability density function, Expectation and variance, Discrete and Continuous Probability distribution: Binomial, Poission and Normal distributions.

Module V: **Statistical Techniques III:**

Sampling, Testing of Hypothesis and Statistical Quality Control: Introduction , SamplingTheory (Small and Large) , Hypothesis, Null hypothesis, Alternative hypothesis, Testing aHypothesis, Level of significance, Confidence limits, Test of significance of difference of means,T-test, F-test and Chi-square test, One way Analysis of Variance (ANOVA).Statistical Quality Control (SQC) , Control Charts , Control Charts for variables (X and R Charts), Control Chartsfor Variables (p, np and C charts).

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Text Books

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9thEdition, John Wiley &Sons, 2006. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory,Universal Book Stall, 2003(Reprint).
2. S. Ross: A First Course in Probability, 6th Ed., Pearson Education India, 2002.
3. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rdEd., Wiley, 1968.

Reference Books

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.2.T.Veerarajan : Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi.

3. R.K. Jain and S.R.K. Iyenger: Advance Engineering Mathematics; Narosa PublishingHouse, New Delhi.

4. J.N. Kapur: Mathematical Statistics; S. Chand & Sons Company Limited, New Delhi.

5. D.N.Elhance,V. Elhance & B.M. Aggarwal: Fundamentals of Statistics; Kitab MahalDistributers, New Delhi.

COURSE OUTCOMES

Evaluation methodology to be followed:

The evaluation and assessment plan consists of the following components:

a. Class attendance and participation in class discussions etc.
b. Quiz.
c. Tutorials and assignments.
d. Sessional examination.
e. Final examination.

Award of Internal/External Marks:

Assessment procedure will be as follows:

1. These will be comprehensive examinations held on-campus (Sessionals).
2. Quiz.
   a. Quiz will be of type multiple choice, fill-in-the-blanks or match the columns.
   b. Quiz will be held periodically.
3. Tutorials and assignments
   a. The assignments/home-work may be of multiple choice type or comprehensive type atleast one assignment from each Module/Unit.
   b. The grades and detailed solutions of assignments (of both types) will be accessible onlineafter the submission deadline.
4. Final examinations. These will be comprehensive external examinations held on-campus or off campus (External examination) on dates fixed by the Dr. APJ Abdul Kalam Technical University, Lucknow.

Subject Code: KME 501	Heat and Mass Transfer	L T P : 3 1 0	Credits: 4

The students will be able to		Blooms Taxonomy
CO 1	Understand the fundamentals of heat and mass transfer.	K2
CO 2	Apply the concept of steady and transient heat conduction.	K3
CO 3	Apply the concept of thermal behavior of fins.	K3
CO 4	Apply the concept of forced and free convection.	K3
CO 5	Apply the concept of radiation for black and non black bodies.	K3
CO 6	Conduct thermal analysis of heat exchangers.	K4

- **UNIT 1**
Introduction to Heat Transfer

Introduction of thermodynamics and Heat Transfer, Modes of Heat Transfer: Conduction, convection and radiation, Effect of temperature on thermal conductivity of different types of materials, Introductionto combined heat transfer mechanism, General differential heat conduction equation in the rectangular,cylindrical and spherical coordinate systems, Initial and system boundary conditions.

Steady State one dimensional Heat conduction
Simple and Composite Systems in rectangular, cylindrical and spherical coordinates with and withoutenergy generation, Concept of thermal resistance, Analogy between heat and electricity flow, Thermalcontact resistance and over all heat transfer coefficient, Critical radius of insulation for cylindrical, andspherical bodies.

UNIT 2

Fins

Heat transfer through extended surfaces and its classification, Fins of uniform cross sectional area, Error in measurement of temperature of thermometer wells.

Transient Conduction

Transient heat conduction, Lumped capacitance method, Time constant, Unsteady state heat conduction in one dimension only, Heisler charts and their applications.

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, cylinders and sphere, combined free and forced convection, Effect of turbulence.

UNIT 4

Thermal Radiation

Basic concepts of radiation, Radiation properties of surfaces, Black body radiation Planck's law, Wein's displacement law, Stefan Boltzmann law, Kirchhoff'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; Greenhouse effect, Radiation network analysis.

UNIT 5

Heat Exchanger

Different types of heat exchangers, Fouling factors, Overall heat transfer coefficient, Logarithmic mean temperature difference (LMTD) method, Effectiveness number of transfer unit (NTU) method and Compact Heat Exchangers.

Condensation and Boiling

Introduction of 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, Drop wise condensation, Heat pipes, Boiling modes, pool boiling, Hysteresis in boiling curve, Forced convection boiling.

Introduction to Mass Transfer

Introduction of Fick's law of diffusion, Steady state equimolar counter diffusion, Steady state diffusion through a stagnant gas film, Heat and Mass Transfer Analogy Convective Mass Transfer Correlations

Reference Books:

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

Subject Code: KME 502	Strength of Material	L T P : 3 1 0	Credits: 4

Unit I   **8 Hours**

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

Unit II   **8 Hours**

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

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

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

Unit III   **8 Hours**

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

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

Unit IV   **8 Hours**

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

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

Unit V   **8 Hours**

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

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

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Text Books:

1.   Strength of materials by Sadhu Singh, Khanna Book Publishing Co. (P) Ltd.
2.   Strength of Material by Rattan, MC GRAW HILL INDIA
3.   Mechanics of Materials by B.C. Punmia, Laxmi Publications (P) Ltd.

Reference Books:

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

Subject Code: KME 503	Industrial Engineering	L T P : 3 1 0	Credits: 4

Unit I:

Overview of Industrial Engineering: Types of production systems, concept of productivity, productivity measurement in manufacturing and service organizations, operations strategies, liability and process design.

Facility location and layout: Factors affecting facility location; principle of plant layout design, types of plant layout; computer aided layout design techniques; assembly line balancing; materials handling principles, types of material handling systems, methods of process planning, steps in process selection, production equipment and tooling selection, group technology, and flexible manufacturing.

Unit II:

Production Planning and control: Forecasting techniques – causal and time series models, moving average, exponential smoothing, trend and seasonality; aggregate production planning; master production scheduling; materials requirement planning (MRP) and MRP II; routing, scheduling and priority dispatching, concept of JIT manufacturing system

Project Management: Project network analysis, CPM, PERT and Project crashing.

Unit III:

Engineering economy and Inventory control: Methods of depreciation; break even analysis, techniques for evaluation of capital investments, financial statements, time cost trade off, resource levelling; Inventory functions, costs, classifications, deterministic inventory models, perpetual and periodic inventory control systems, ABC analysis, and VED analysis.

Queuing Theory: Basis of Queuing theory, elements of queuing theory, Operating characteristics of a queuing system, Classification of Queuing models.

Unit IV

Work System Design: Taylor's scientific management, Gilbreths's contributions; work study: method study, micro motion study, principles of motion economy; work measurement -time study, work
sampling, standard data, Predetermined motion time system (PMTS); ergonomics; job evaluation, meritrating, incentive schemes, and wage administration.

Product Design and Development: Principles of product design, tolerance design; quality and cost considerations; product life cycle; standardization, simplification, diversification, value engineering and analysis, and concurrent engineering.

Unit V:

Operational Analysis: Formulation of LPP, Graphical solution of LPP, Simplex Method, Sensitivity Analysis, degeneracy and unbound solutions.transportation and assignment models; Optimality test: thestepping stone method and MODI method, simulation.

Books and References:

1.   Industrial Engineering and Production Management by Martand T Telsang S. Chand Publishing
2.   Industrial Engineering and Production Management by M. MahajanDhanpatRai& Co. (P) Limited
3.   Industrial Engineering and Management by Ravi Shankar, Galgotia Publications Pvt Ltd
4.   Production and Operations Management by Adam, B.E. & Ebert, R.J., PHI
5.   Product Design and Manufacturing by Chitale A.V. and Gupta R.C., PHI
6.   Operations Research Theory & Applications by J K Sharma, Macmillan India Ltd,
7.   Production Systems Analysis and Control by J.L.Riggs, John Wiley & Sons
8.   Automation, Production Systems & Computer Integrated Manufacturing by Groover, M.P. PHI
9.   Operations Research, by A.M. Natarajan, P. Balasubramani, A. Tamilarasi, Pearson Education
10.   Operations Research by P. K. Gupta and D. S. Hira, S. Chand & Co.

Subject Code: KME 054	I C Engine, Fuel and Lubrication	L T P : 3 0 0	Credits: 3

Unit I

Introduction to I.C Engines: Engine classification and basic terminology, Two and four stroke engines, SIand CI engines, Valve timing diagram, Valve mechanism Push rod type, Overhead type (SOHC,DOHC).

Thermodynamic analysis of Air standard cycles: Otto cycle, Diesel cycle, Dual cycle, Comparison of Otto,Diesel and Dual cycles Fuel air cycle, factors affecting the fuel air cycle, Actual cycle.

Testing and Performance: Performance parameters, Basic measurements, Blow by measurement,Testing of SI and CI engines.

Unit-II

Combustion: Stages of Combustion in SI & CI engine, Factors affecting combustion, Flame speed, IgnitionDelay, Abnormal combustion and its control.

Combustion chamber: Squish, Swirl & tumble, Combustion chamber design for SI & CI engine & factorsaffecting it.

Unit-III

Carburetion, Mixture requirements, Carburetors and fuel injection system in SI Engine, MPFI, Scavengingin 2 Stroke engines.

Fuel injection in CI engines, Requirements, Types of injection systems, Fuel pumps, Fuel injectors,Injection timings.

Turbocharging & its types Variable Geometry Turbocharger, Waste Gate Turbocharger, Effect ofturbocharging on power & emission.

Unit IV

Engine Emission and Control: Pollutant Sources and types – Effect on environment and human health formation of OxHydrocarbon Emission MechanismCarbon Monoxide Formation Particulateemissions

Methods of controlling Emissions Catalytic converters and Particulate Traps SelectiveCatalytic Reduction(SCR) Diesel Oxidation Catalyst (DOC).

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.

UNIT V

Engine Cooling and Lubrication: Different cooling systems, Radiators and cooling fans, Engine friction, Lubrication principle, Type of lubrication, Lubrication oils, Crankcase ventilation.

Ignition System in SI Engine: Ignition system requirements, Magneto and battery ignition systems,ignition timing and spark plug, Electronic ignition.

Recent trends in IC engine: Lean burn engine, Stratified charge spark ignition engine, Homogeneous charge spark ignition engine, GDI.

Text Books

1. A Course in International Combustion Engines, by Mathur& Sharma, DhanpatRai& Sons.
2. I.C Engine, by Ganeshan, Tata McGraw Hill Publishers.

Reference Books

1. I.C Engine Analysis & Practice by E.F Obert.
2. Internal Combustion Engine Fundamentals, by John B. Heywood, Tata Mcgraw Hill Publishers.
3. Engine Emission, by B. B. Pundir, Narosa Publication.
4. Engineering Fundamentals of Internal Combustion Engines by W.W. Pulkrabek, Pearson Education.
5. Fundamentals of Internal Combustion Engine by Gill, Smith, Ziurs, Oxford & IBH Publishing CO.
6. Fundamentals of Internal Combustion Engines by H.N. Gupta, Prentice Hall of India.

Subject Code: KME 055	Advance welding	L T P : 3 0 0	Credits: 3

- **UNIT I:**

Introduction: Introduction to welding, application, classification and process selection criterion. Health& safety in welding.

Welding Arc: Physics of welding arc, arc initiation, voltage distribution, arc characteristics, arc efficiency, arc temperatures and arc blow.Mechanism and types of metal transfer.

Welding Power Sources: Types of welding power sources, operation characteristics and specifications.

- **UNIT II:**

Welding Processes: Shielded Metal Arc Welding (SMAW), Gas Metal Arc Welding (GMAW) Gas Tungsten Arc Welding (GTAW) Plasma Arc, Submerged Arc Welding, Electro gas and Electroslag, Resistance welding, Friction welding, Brazing, Soldering & Braze welding. Laser beam welding, Electron beam welding, Ultrasonic welding, Explosive welding, Friction Stir Welding, Underwater welding.

Advances in Welding Processes: Narrow Gap, Tandem (Twin / Multi Wire) Welding, A TIG, Hybrid Welding processes**,** Magnetically impelled arc butt (MIAB) welding**,** welding automation and robotic applications.

- **UNIT III:**

Heat Flow Welding: Weld thermal cycle, Temperature distribution, Peak temperature; Heat Affected Zone (HAZ), heating, cooling and solidification rates.

Welding Metallurgy: Fundamentals of physical metallurgy, Principle of solidification of weld metal, Reactions in weld pool Gas metal reaction, Slag metal reaction, factors affecting changes in microstructure and mechanical properties of HAZ, Micro and macro structures in weld metal and HAZ

- **UNIT IV:**

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

Weldability: Effects of alloying elements on weldability, carbon equivalent, welding of plain carbonsteel, Stainless steel, Cast Iron and Aluminium alloys, Welding of Dissimilar Materials

UNIT V:

Weld Design: Types of welds & joints, Welding Symbols, Weld defects and Remedies, Residual Stresses & Distortion, Inspection and testing of welds: Introduction to Non Destructive Techniques; Destructive Techniques Bulk and Microhardness test, Wear test and types, corrosion test, tensile test, bend test, SEM, EDS and XRD.

Welding Codes, WPS & PQR: Introduction to welding codes, ISO, ASME and BIS specifications, Welding Procedure Specification (WPS) & Procedure Qualification Record (PQR), Welding of pipe lines and pressure vessels.

Books and References:

1. Welding and Welding Technology, by Richard L. Little, McGraw Hill Education.
2. Welding Principals and Practices, by Edwars R. Bohnart, McGraw Hill Education.
3. Welding Engineering and Technology, by R. S. Parmar, KhannaPublishsers.
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)
9. Advanced Welding Processes, Woodhead publishing, J. Norrish
10. ASME Sec. IX, Boiler and Pressure Vessel Code

Internet of Things Lab

List of Experiments:

S.No	Name of Experiment	Outcome
1.	Familiarization with concept of IoT, Arduino/Raspberry Pi and perform necessary software installation.	Will be able to understand IoT, Arduino/Raspberry Pi, and also able to install software setup of Arduino/ Respberry Pi
2.	To interface motor using relay with Arduino/Raspberry Pi and write a program to turn ON/OFF motor	Able to use relay to control motor and other mechanical devices
3.	To interface sensors* with Arduino/Raspberry Pi and write a program to displaysensors data on the computer screen.	Able to retrieve data from sensors and to display it on computer screen
4.	To interface OLED with Arduino/Raspberry Pi and write a program to display sensor data on it.	Able to retrieve data from sensors and to display it on OLED
5.	To interface sensor with Arduino/Raspberry Pi and write a program to turn ON/OFF Relay when sensor data is detected.	Able to control relay with help of microcontroller and sensors
6.	To interface sensor with Arduino/Raspberry Pi and write a program to turn ON/OFF Solenoid valve when sensor data is detected	Able to control Solenoid valve with help of microcontroller and sensors
7.	To interface sensor with Arduino/Raspberry Pi and write a program to turn ON/OFF Linear Actuator when sensor data is detected.	Able to control linear actuator with help of microcontroller and sensors
8.	To interface sensor with Arduino/Raspberry Pi and write a program to turn ON/OFF Starter Motor when sensor data is detected.	Able to control Starter Motor with help of microcontroller and sensors
9.	To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smart phone using Bluetooth.	Able to communicate sensor data from microcontroller to smart phone
10.	To interface Bluetooth with Arduino/Raspberry Pi	Able to control actuators using mobile phone through

	and write a program to turn Actuators* ON/OFF when message is received from smart phone using Bluetooth	Bluetoth
11.	Write a program on Arduino/Raspberry Pi to upload Sensor data to thingspeak cloud.	Able to upload status of devices and sensors on web cloud
12.	Write a program on Arduino/Raspberry Pi to retrieve sensors data from thingspeak cloud.	Able to retrieve status of devices and sensors from web cloud
13.	Able to retrieve status of devices and sensors from web cloud	Able to develop smart lock system of motor cycle/car
14.	Develop IoT based Smart water flow system	Able to develop smart water flow system
15.	Develop IoT based home security system	Able to develop smart home security system

Components required-

1. Arduino with cable

2. Raspberry Pi with cable and memory card

3. Node MCU

4. *Sensors-IR, LDR, DHT11 sensor, Push button, Pressure senser, Temperature sensor, Vibration,

Rotation, Location, Torque, Sound, Weight etc.

5. *Actuators-LED, Buzzer, Relay Switch, Motors, Motor Drivers, OLED, Display, Linear Actuator,

Solenoid Valve, Starter Motor etc.

6. Bluetooth Module, Wi-fi Module, Ethernet Module

7. Smart Phone

8. Computer

9. Power Supply-5V, 12V, 3.3V

10. Internet facility

Heat and Mass Transfer Lab

List of Experiments

Minimum eight experiment of the following

1. To determine thermal conductivity of conductive material(s).

2. To determine thermal conductivity of insulating material(s).

3. To determine heat conduction through lagged pipe.

4. To determine heat transfer through fin under natural convection.

5. To determine the heat transfer Rate and Temperature Distribution for a Pin Fin.

6. Determination of thermal conductivity of differenttypes of fluids.

7. Experiment on Stefan's Law - determination of emissivity, etc.

8. Experiment on convective heat transfer through flat plate solar collector.

9. To compare LMTD and Effectiveness of Parallel and Counter Flow Heat Exchangers.

10. To find the heat transfer coefficient for Forced Convection in a tube.

11. To find the heat transfer coefficient for Free Convection in a tube.

12. To conduct experiments on heat pipe.

13. To study the rates of heat transfer for different materials and geometries.

14. Visit to a Thermal Power Station for practical exposure.

INDIAN TRADITIONS, CULTURAL AND SOCIETY

COURSE OBJECTIVES:

• The course aims at imparting basic principles of thought process, reasoning and inference to identify the roots and details of some of the contemporary issues faced by our nation and try to locate possible solutions to these challenges by digging deep into our past.

• To enable the students to understand the importance of our surroundings and encourage the students to contribute towards sustainable development.

• To sensitize students towards issues related to 'Indian' culture, tradition and its composite character.

Non Credit Course 2021-22 AICTE Model Curriculum K series (V & VI Semester)

• To make students aware of holistic life styles of Yogic-science and wisdom capsules in Sanskrit literature that are important in modern society with rapid technological advancements and societal disruptions.

• To acquaint students with Indian Knowledge System, Indian perspective of modern scientific world-view and basic principles of Yoga and holistic health care system.

COURSE OUTCOMES: Ability to understand, connect up and explain basics of Indian Traditional knowledge modern scientific perspective. Suggested Pedagogy for Teachers

• Project based learning

• Case studies

• Group discussion

• Presentations

Module 1- Society State and Polity in India State in Ancient India: Evolutionary Theory, Force Theory, Mystical Theory Contract Theory, Stages of State Formation in Ancient India, Kingship , Council of Ministers Administration Political Ideals in Ancient India Conditions' of the Welfare of Societies, The Seven Limbs of the State, Society in Ancient India, Purusārtha, Varnāshrama System, Āshrama or the Stages of Life, Marriage, Understanding Gender as a social category, The representation of Women in Historical traditions, Challenges faced by Women. Four-class Classification, Slavery.

Module 2- Indian Literature, Culture, Tradition, and Practices Evolution of script and languages in India: Harappan Script and Brahmi Script. The Vedas, the Upanishads, the Ramayana and the Mahabharata, Puranas, Buddhist And Jain Literature in

ali,Prakrit And Sanskrit, Kautilya's Arthashastra, Famous Sanskrit Authors, Telugu Literature,Kannada Literature,Malayalam Literature ,Sangama Literature Northern Indian Languages & Literature, Persian And Urdu ,Hindi Literature

Module 3- Indian Religion, Philosophy, and Practices Pre-Vedic and Vedic Religion, Buddhism, Jainism, Six System Indian Philosophy, Shankaracharya, Various Philosophical Doctrines , Other Heterodox Sects, Bhakti Movement, Sufi movement, Socio religious reform movement of 19th century, Modern religious practices.

Module 4-Science, Management and Indian Knowledge System Astronomy in India, Chemistry in India, Mathematics in India, Physics in India, Agriculture in India, Medicine in India ,Metallurgy in India, Geography, Biology, Harappan Technologies,

Water Management in India, Textile Technology in India ,Writing Technology in India Pyrotechnics in India Trade in Ancient India/,India's Dominance up to Pre-colonial Times

Module 5- Cultural Heritage and Performing Arts Indian Architect, Engineering and Architecture in Ancient India, Sculptures, Seals, coins, Pottery, Puppetry, Dance, Music, Theatre, drama, Painting, Martial Arts Traditions, Fairs and Festivals, Current developments in Arts and Cultural, Indian's Cultural Contribution to the World. Indian Cinema

Suggested Text & Reference Books

1. V. Sivaramakrishna (Ed.), Cultural Heritage of India-Course Material, Bharatiya Vidya Bhavan, Mumbai, 5th Edition, 2014

2. S. Baliyan, Indian Art and Culture, Oxford University Press, India

3. Swami Jitatmanand, Modern Physics and Vedant, Bharatiya Vidya Bhavan

4. Romila Thapar, Readings In Early Indian History Oxford University Press , India

5. Fritz of Capra, Tao of Physics

6. Fritz of Capra, The wave of Life

7. V N Jha (English Translation), Tarkasangraha of Annam Bhatta, Inernational Chinmay Foundation,Velliarnad,Amaku,am

8. Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkatta

9. GN Jha (Eng. Trans.) Ed. R N Jha, Yoga-darshanam with Vyasa Bhashya, Vidyanidhi Prakasham, Delhi,2016

10. RN Jha, Science of Consciousness Psychotherapy and Yoga Practices, Vidyanidhi Prakasham, Delhi, 2016

11. P R Sharma (English translation), Shodashang Hridayam

12. Basham, A.L., The Wonder that was India (34th impression), New Delhi, Rupa & co

13. Sharma, R.S., Aspects of Political Ideas and Institutions in Ancient India(fourth edition), Delhi, Motilal Banarsid

Subject Code: KME 601	Refrigeration & Air Conditioning	L T P : 3 1 0	Credits: 4

Unit 1

Refrigeration:

Introduction to refrigeration system, Methods of refrigeration, Unit of refrigeration, Refrigeration effect,Carnot refrigeration cycle, Refrigerator and Heat Pump, C.O.P.

Air Refrigeration cycle:

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

Unit 2

Vapour Compression System:

Reversed vapour Carnot cycle, limitation of Reversed vapour Carnot cycle, Simple vapour compression cycle, 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 System:

Multistage vapour compression system requirement, Different configuration of multi pressure system, Removal of flash gas, Intercooling, Multi evaporator system, Cascade system.

Unit 3

Vapour Absorption system;

Working Principal of vapour absorption refrigeration system, Comparison between absorption & compression systems, Elementary idea of refrigerant absorbent mixtures, Temperature – concentrationdiagram & 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 Environment friendly refrigerants, Anti freeze solution, Phase changing materials, Ozone layer depletion and global warming considerations of refrigerants, Selection of refrigerants, Future Refrigerants like Hydrofluoro Olefines

Unit 4

Air Conditioning:

Introduction to air conditioning, Psychrometric properties and their definitions, Psychrometric chart, Different Psychrometric processes, Air Washers, Cooling towers & humidifying efficiency, 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).

Window air Conditioner, Simple air conditioning system, Air conditioning system with ventilation.

Unit 5
Refrigeration System Equipment:

Compressors, Condensers, Expansion Devices and Evaporators, Elementary knowledge of transmissionand distribution of air through ducts and fans,

Application:
Food preservation, Transport refrigeration, Cold storage, Refrigerates Freezers, Ice plant, Water coolers,Comfort and Industrial air conditioning Refrigeration.

Other systems:
Cryogenic liquefaction and refrigeration systems, Brief introduction of Thermo electric refrigerationsystem, Steam jet refrigeration system, Vortex tube refrigeration system, Magnetic refrigeration system.

Reference 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
6. Refrigeration and Air conditioning by Arora&Domkundwar. DhanpatRai
7. Thermal Environment Engineering. By Kuhen, Ramsey &Thelked

Subject Code: KME 602	Machine Design	L T P : 3 1 0	Credits: 4

Unit I
Introduction

Definition, Design requirements of machine elements, Design procedure, Standards in design, Standards designation of carbon & alloy steels, Selection of preferred sizes, Selection of materials for static and fatigue loads, Design against Static Load

Design against Fluctuating Loads

Cyclic stresses, Fatigue and endurance limit, Stress concentration factor, Stress concentration factor for various machine parts, Design for finite & infinite life, Soderberg, Goodman, Gerber criteria

Unit II
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

Welded Joints

Stress relieving of welded joints, Butt Joints, Fillet Joints, Strength of Butt Welds, Strength of parallel fillet welds, Strength of transverse fillet weldsShafts
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, Keys, Types of keys, Selection of square and flat keys, Strength of sunk key

Unit III
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, Failureof gear tooth, Design of spur gears, AGMA and Indian standards.

Helical Gears

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

Introduction, Classification and Applications of Bevel & Worm Gears

Unit IV

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.

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.

Unit V

IC Engine Parts

Selection of type of IC engine, General design considerations, Design of Cylinder and cylinder head; Design of piston, piston ring and gudgeon pin;

Friction Clutches

Clutches, Difference between coupling and clutch, Single plate friction clutch, Torque transmitting capacity, Multi Disk Clutches, Friction Material

Note: Design data book is allowed in the examination

Text Books:
1. Design of Machine Elements V.B. Bhandari, McGraw Hill Co.
2. Design of Machine Elements, Sharma and Purohit, PHI.

Reference Books:
1. Mechanical Engineering Design, 9e – Joseph E. Shigely, McGraw Hill Education.
2. Machine Design Maleev and Hartman, CBS Publishers.
3. Design of Machine Design M.F. Spott, Pearson Education.
4. Elements of Machine Component Design, Juvinal&Marshek, John Wiley & Sons.
5. Machine design, Robert L. Norton, Pearson Education

6. Theory & Problem of Machine Design (Schaum's Outline Series) Hall, Holowenko, Laughlin, Tata McGraw Hill Co.
7. Machine Design Sharma and Agrawal, S.K. Kataria& Sons.
8. Machine Design, U C Jindal, Pearson Education.

Subject Code: KME 603	Theory of Machines	L T P : 3 1 0	Credits: 4

Unit I

Introduction, mechanisms and machines, kinematics and kinetics, types of links, kinematic pairs andtheir 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, Coriolis 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 andplanet 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.

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Unit IV

Balancing: Introduction, static balance, dynamic balance, balancing of rotating masses, two plane balancing, graphical and analytical methods, balancing of reciprocating masses, balancing of singlecylinder engine.

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

Gyroscope: Space motion of rigid bodies, angular momentum, gyroscopic couples, gyroscopic stabilization, ship stabilization, stability of four wheel and two wheel vehicles moving on curved paths.

Text / Reference Books
1. Kinematics and dynamics of machinery: Wilson and Sadler, Third edition, Pearson.
2. Theory of Mechanisms and Machines: Amitabh Ghosh and Ashok Kumar Mallik, Third EditionAffiliated East West Press.
3. Theory of Machines and Mechanisms: Joseph Edward Shigley and John Joseph Uicker, Jr. OxfordUniversity 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.

Suggested Software
MechAnalyzer

	Nondestructive Testing	L T P : 3 0 0	Credits: 3

Unit I:

Introduction to NDT, DT, advantages & limitations of NDT, classification of NDT methods, Comparison with DT, Terminology, Flaws and Defects. Scope of NDT.Codes, Standards and Certifications in NDT.

Visual Inspection- Equipment used for visual inspection, Borescopes, Application of visual inspection tests in detecting surface defects and their interpretation, advantages & limitations of visual inspection, Visual Inspection in Welding.

Unit II:
Liquid Penetrant Testing – Principle, Scope, Testing equipment, Advantages, Limitations, types of penetrants and developers, standard testing procedure, Zyglo test, Illustrative examples and interpretation of defects.

Magnetic Particle Inspection – Principle, Scope, Testing equipment, Advantages, Limitations, Applicationof MPI & standard testing procedure, DC & AC magnetization, Skin Effect, different methods to generate magnetic fields, Illustrative examples and interpretation of defects.

Unit III:
Radiographic Testing – Introduction to electromagnetic waves and radioactivity, various decays, Attenuation of electromagnetic radiations, Photoelectric effect, coherent scattering and Incoherentscattering, Beam geometry.

X ray Radiography – Principle, equipment & methodology, applications, source, types of radiations and limitations; ray Radiography – Principle, equipment, ray source & technique; Radiography Image Quality Indicators, Film Processing, advantages of ray radiography over X ray radiography. Precautions against radiation hazards.

Unit IV:
Ultrasonic Testing – Introduction, Principle, Piezoelectricity and Piezoelectric Transducers, Wave propagation, Ultrasonic probes, selection of angle probes, Acoustic Impedance, Reflection and transmission coefficient, Snell's law, standard testing procedure & calibration, advantages & limitations. Data representation A scan, B scan, C scan. Applications in inspection of welded joints, castings, forgings and dimensional measurements. Introduction to TOFD & Phased Array Ultrasonic Testing.

Unit V:
Special NDT Techniques:

Eddy Current Inspection- Introduction, Principle, Methods, scope, Equipment, types of probes, Sensitivity, standard testing procedure, advanced ECT methods, advantages and limitations.

Acoustic Emission Technique- Introduction, Types of AE signal, Principle, Advantages & Limitations, Interpretation of Results, Applications.

Holography, Thermography- Introduction, Principle, advantages, limitations and applications.

Books and References:

1. Non Destructive Testing and Evaluation of Materials, by Prasad, McGraw Hill Education.
2. Practical Non destructive Testing, by Baldev Raj, T. Jayakumar, M. Thavasimuthu, WoodheadPublishing.
3. Non Destructive Testing Techniques, by Ravi Prakash, New Age International.
4. Non destructive Testing Handbook, by Robert C. McMaster, American Society for Nondestructive.
5. Introduction to Non destructive Testing: A Training Guide, by Paul E. Mix, wiley.
6. Electrical and Magnetic Methods of Non destructive Testing, by J. Blitz, springer.
7. Practical non destructive testing by Raj, Baldev.
8. Basics of Non Destructive Testing, by Lari & Kumar, KATSON Books.
9. ASME Sec. V, boiler and pressure vessel code

CONSTITUTION OF INDIA, LAW AND ENGINEERING

COURSE OBJECTIVE:

1. To acquaint the students with legacies of constitutional development in India and help thoseto understand the most diversified legal document of India and philosophy behind it.
2. To make students aware of the theoretical and functional aspects of the Indian ParliamentarySystem.
3. To channelize students' thinking towards basic understanding of the legal concepts and itsimplications for engineers.
4. To acquaint students with latest intellectual property rights and innovation environment withrelated regulatory framework.
5. To make students learn about role of engineering in business organizations and e-governance.

Module 1--Introduction and Basic Information about Indian Constitution:

Meaning of the constitution law and constitutionalism, Historical Background of the Constituent Assembly, Government of India Act of 1935 and Indian Independence Act of 1947,Enforcement of the Constitution, Indian Constitution and its Salient Features, The Preamble of the Constitution, Fundamental Rights, Fundamental Duties, Directive Principles of State Policy, Parliamentary System, Federal System, Centre-State Relations, Amendment of the ConstitutionalPowers and Procedure, The historical perspectives of the constitutional amendments in India, Emergency Provisions: National Emergency, President Rule, Financial Emergency, and Local Self Government – Constitutional Scheme in India.

Module 2-Union Executive and State Executive:

Powers of Indian Parliament Functions of Rajya Sabha, Functions of Lok Sabha, Powers and Functions of the President, Comparison of powers of Indian President with the United States, Powers and Functions of the Prime Minister, Judiciary – The Independence of the Supreme Court, Appointment of Judges, Judicial Review, Public Interest Litigation, Judicial Activism, LokPal, Lok Ayukta, The Lokpal and Lok ayuktas Act 2013, State Executives – Powers and Functions of the Governor, Powers and Functions of the Chief Minister, Functions of State Cabinet, Functions of State Legislature, Functions of High Court and Subordinate Courts.

Module 3- Introduction and Basic Information about Legal System:

The Legal System: Sources of Law and the Court Structure: Enacted law -Acts of Parliamentare of primary legislation, Common Law or Case law, Principles taken from decisions of judges constitute binding legal rules. The Court System in India and Foreign Courtiers (District Court, District Consumer Forum, Tribunals, High Courts, Supreme Court). Arbitration: As an alternative to resolving disputes in the normal courts, parties who are in dispute can agree that this will instead be referred to arbitration. Contract law, Tort, Law at workplace.

Module 4- Intellectual Property Laws and Regulation to Information:
Intellectual Property Laws: Introduction, Legal Aspects of Patents, Filing of Patent Applications, Rights from Patents, Infringement of Patents, Copyright and its Ownership, Infringement of Copyright, Civil Remedies for Infringement, Regulation to Information- Introduction, Right to Information Act, 2005, Information Technology Act, 2000, Electronic Governance, Secure Electronic Records and Digital Signatures, Digital Signature Certificates, Cyber Regulations Appellate Tribunal, Offences, Limitations of the Information Technology Act.

Module 5 -Business Organizations and E-Governance:

Sole Traders, Partnerships: Companies: The Company's Act: Introduction, Formation of a Company, Memorandum of Association, Articles of Association, Prospectus, Shares, Directors, General Meetings and Proceedings, Auditor, Winding up.

E-Governance and role of engineers in E-Governance, Need for reformed engineering serving at the Union and State level, Role of I.T. professionals in Judiciary, Problem of Alienation and Secessionism in few states creating hurdles in Industrial development.

Pedagogy: Lecture, Problem based learning, Group discussions, Visual media, Films,Documentaries, Debate forums.

Suggested Readings:

6. Brij Kishore Sharma: *Introduction to the Indian Constitution*, 8th Edition, PHI LearningPvt. Ltd.
7. Granville Austin: *The Indian Constitution: Cornerstone of a Nation (Classic Reissue)*,Oxford University Press.
8. S.G Subramanian: *Indian Constitution and Indian Polity*, 2nd Edition, Pearson Education2020.
9. Subhash C. Kashyap: *Our Constitution: An Introduction to India's Constitution andconstitutional Law*, NBT, 2018.
10. Madhav Khosla: *The Indian Constitution*, Oxford University Press.
11. PM Bakshi: *The Constitution of India*, Latest Edition, Universal Law Publishing.
12. V.K. Ahuja: *Law Relating to Intellectual Property Rights* (2007)
13. Suresh T. Viswanathan: *The Indian Cyber Laws, Bharat Law House*, New Delhi-88
14. P. Narayan: Intellectual Property Law, Eastern Law House, New Delhi
15. Prabudh Ganguli: *Gearing up for Patents: The Indian Scenario*, Orient Longman.
16. BL Wadehra: Patents, Trademarks, *Designs and Geological Indications Universal Law* Publishing - LexisNexis.
17. *Intellectual Property Rights: Law and Practice, Module III* by ICSI (only relevant sections)
18. Executive programme study material Company Law, Module II, by ICSI (The Institute ofCompanies Secretaries of India) (Only relevant sections i.e., Study 1, 4 and 36).https://www.icsi.edu/media/webmodules/publications/Company%20Law.pdf
19. Handbook on e-Governance Project Lifecycle, Department of Electronics & Information Technology, Government of India, https://www.meity.gov.in/writereaddata/files/e- Governance_Project_Lifecycle_Participant_Handbook-5Day_CourseV1_20412.pdf
20. Companies Act, 2013 Key highlights and analysis by PWC. https://www.pwc.in/assets/pdfs/publications/2013/companies-act-2013-key-highlights- and-analysis.pdf

Referred Case Studies:

21. Keshavanand Bharati V. State of Kerala, AIR 1973 SC 1461.
22. Maneka Gandhi V. Union of India AIR, 1978 SC 597.
23. S.R. Bammai V. Union of India, AIR 1994 SC 1918.
24. Kuldip Nayyar V. Union of India, AIR 2006 SC312.
25. A.D.M. Jabalpur V. ShivkantShakla, AIR 1976 SC1207.
26. Remshwar Prasad V. Union of India, AIR 2006 SC980.
27. Keshav Singh in re, AIR 1965 SC 745.
28. Union of India V. Talsiram, AIR 1985 SC 1416.
29. Atiabari Tea Estate Co.V. State of Assam, AIR 1961SC232.
30. SBP & Co. Vs. Patel Engg. Ltd. 2005 (8) SCC 618.
31. Krishna Bhagya Jala Nigam Ltd. Vs. G. Arischandra Reddy (2007) 2 SCC 720.
32. Oil & Natural Gas Corporation Vs. Saw Pipes Ltd. 2003 (4) SCALE 92 – 185.

** (Other relevant case studies can be consulted by the teacher as per the topic).Prescribed Legislations:

1. Information Technology Act, 2000 with latest amendments.
2. RTI Act 2005 with latest amendments.
3. Information Technology Rules, 2000
4. Cyber Regulation Appellate Tribunal Rules, 2000

Suggested aid for Students and Pedagogic purpose
33. RSTV debates on corporate law, IPR and patent issues
34. NPTEL lectures on IPR and patent rights

Episodes of 10 -part mini TV series "Samvidhan: The Making of Constitution of India" byRSTV.

Power Plant Engineering

Unit I

Introduction to Power Plants Introduction to the sources of energy: conventional and non-conventional; Principal types of power

plants; Present status and future trends; Carbon credits. Thermal Power Plant General layout of modern thermal power plant, Review of Rankine and modified Rankine cycles, Power plant boilers including critical and super critical boilers. Fluidized bed boilers, boilers mountings and

accessories. 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 II

Hydroelectric Power Plant Hydro-electric plant, General arrangement of hydroelectric power plant, Plant layout, Penstock and water hammer, Specific speed and capacity calculations, Classification of hydro-plant, Low-, mediumand high-head plants, Pumped storage plant, Run-off river power plant, Surge tanks.

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 Gas fire based Combined Cycle (IGCC) systems. Controlling of air fuel ratio (AFR) in power plant.

Unit III

Nuclear Power Plants Classification of nuclear reactors, Thermal fission reactors and power plant and their location, Pressurized water reactor, Boiling water reactor, CANDU heavy water reactor, Gas-cooled reactor, Fast breeder reactors, Organic substance cooled reactor, Reactor control, Radiation hazards, Radioactive waste disposal, Nuclear power generation in India. Solar Power PlantSolar energy collectors, Photovoltaic power system, Solar central receiver system, Solar thermal energy,types of solar thermal plant, typical layout and components, solar parabolic trough plants, solar towerpower plants, and solar dish power plants. Working principle of concentrating solar thermal power plant and their applications.

Unit IV

Non-Conventional Power Plants

Geothermal energy: Hydrothermal systems, Petro thermal systems, Hybrid geothermal fossil systems, Problems associated with geothermal conversion,

Wind energy: Components of a wind generator, Horizontal and vertical axis wind mills, Aerodynamic considerations of wind mill design, Coefficient of performance of wind mill rotor, Availability of wind energy in India, Wind power by country. Tidal energy: The simple single pool tidal system, The modulated single pool tidal system, The two-pool tidal system, Ocean thermal energy conversion, Principle of working, Ocean temperature differences,

The open or Claude cycle, The closed or Anderson OTEC cycle, Electricity generation from Fuel cells and city garbage.

Unit V

Electrical system: Introduction to generator and exciters, Earthing of power systems, Power and unit transformer, Circuit breakers, Protective equipment, Switch gear. Power Plant Economics: Types of loads, Effect of variable load on power plant design and operation, Methods to meet variable

load, Prediction of future loads, Terminology used in power supply, Cost of electrical energy, Depreciation, Energy rates (tariffs) for electrical energy, Factors affecting economics of generation and distribution of power Environmental Aspects of Power Station Environmental aspects, Different pollutants due to thermal power plant and their effect on human health, Thermal pollution of water and its control, Effluents from power plants and impact on

environment, Radiation from nuclear power plant effluents, Methods of pollution mitigation and control.

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.

PROJECT MANAGEMENT & ENTREPRENEURSHIP

Unit Topics Lectures

IEntrepreneurship: Entrepreneurship: need, scope , Entrepreneurial competencies & traits, Factors affecting entrepreneurial development, Entrepreneurial motivation

(Mc Clellend's Achievement motivation theory), conceptual model of entrepreneurship , entrepreneur vs. intrapreneur; Classification of entrepreneurs;

Entrepreneurial Development Programmes

Unit II Entrepreneurial Idea and Innovation: Introduction to Innovation, Entrepreneurial Idea Generation and Identifying Business Opportunities, Management skills for Entrepreneurs and managing for Value Creation, Creating and Sustaining Enterprising Model & Organizational Effectiveness

Unit-III Project Management: Project management: meaning, scope & importance, role of project manager; project life-cycle Project appraisal: Preparation of a real time project feasibility report containing Technical appraisal,; Environmental appraisal, Market appraisal (including market survey for forecasting future demand and sales) and Managerial appraisal.

Unit-IV Project Financing: Project cost estimation & working capital requirements, sources of funds, capital budgeting, Risk & uncertainty in project evaluation ,

preparation of projected financial statements viz. Projected balance sheet, projected income statement, projected funds & cash flow statements, Preparation of detailed

project report, Project finance.

Unit-V Social Entrepreneurship: Social Sector Perspectives and Social Entrepreneurship, Social Entrepreneurship Opportunities and Successful Models, Social Innovations

and Sustainability, Marketing Management for Social Ventures, Risk Management in Social Enterprises, Legal Framework for Social Ventures.

Text Book:

1. Innovation and Entrepreneurship by Drucker, P.F.; Harper and Row

2. Business, Entrepreneurship and Management: Rao, V.S.P. ;Vikas

3. Entrepreneurship: Roy Rajeev; OUP.

4. Text Book of Project Management: Gopalkrishnan, P. and Ramamoorthy, V.E.; McMillan

5. Project Management for Engineering, Business and Technology: Nicholas, J.M., and Steyn, H.;

PHI

6. Project Management: The Managerial Process: Gray, C.F., Larson, E.W. and Desai, G.V.;

MGH

Measurement & Metrology

List of Experiments

Minimum 08 experiments out of following (or such experiment) are to be performed:

1. Measurement of effective diameter of a screw thread using 3 wire method.

2. Measurement of angle using sine bar & slip gauges.

3. Study of limit gauges.

4. Study & angular measurement using Bevel protector.

5. Study of different types of Comparators.

6. Study of important parameters of surface finish.

7. Study of principle and operation of coordinate-measuring machine (CMM).

8. Use of dial indicator and V Block to check the circularity and plot the polar Graph.

9. Study and understanding of limits, fits & tolerances in assembly of machine components.

10. Study and understanding of different methods of measurement of pressure.

11. Study and understanding of different methods of measurement of temperature.

12. Study and understanding of measurement of strain using strain gauges.

13. Study and understanding of different methods of measurement of flow.

14. Study and understanding of different methods of measurement of vibration/power.

15. Study and understanding of measurement of displacement using LVDT.

OPEN ELECTIVES II LIST 2021-22

	RENEWABLE ENERGY RESOURCES	3L:0T:0P	3 Credits

Unit	Topics	Lectures
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.	8
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 energystorage for solar heating and cooling, limitations.	8
III	Geothermal Energy: Resources of geothermal energy, thermodynamics of geo- thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations. Magneto-hydrodynamics (MHD): Principle of working of MHD Power plant, performance and limitations. Cells: Principle of working of various types of fuel cells and their working, performance and limitations.	8
IV	Thermo-electrical and thermionic Conversions: Principle of working, performance and limitations. Wind Energy: Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments. wind characteristics. Performance and limitations of energy conversion systems.	8

2. John Twideu and Tony Weir, "Renewal Energy Resources" BSP Publications, 2006.
3. M.V.R. Koteswara Rao, "Energy Resources: Conventional & Non-Conventional" BSP Publications,2006.
4. D.S. Chauhan,"Non-conventional Energy Resources" New Age International.
5. C.S. Solanki, "Renewal Energy Technologies: A Practical Guide for Beginners" PHI Learning.

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.	8

Text Book:

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

SEMESTER-VIII   **Session: 2021-22**

AUTOMATION AND ROBOTICS   MM:100

Unit-I

Automation: Definition, Advantages, goals, types, need, laws and principles of Automation. Elements of Automation. Fluid power and its elements, application of fluid power, Pneumatics vs. Hydraulics, benefit and limitations of pneumatics and hydraulics systems, Role of Robotics in Industrial Automation.

II

Manufacturing Automation: Classification and type of automatic transfer machines; Automation in part handling and feeding, Analysis of automated flow lines, design of single model, multimode and mixed model production lines. Programmable Manufacturing Automation CNC machine tools, Machining centers, Programmable robots, Robot time estimation in manufacturing operations.

III

Robotics: Definition, Classification of Robots - Geometric classification and Control classification, Laws of Robotics, Robot Components, Coordinate Systems, Power Source. Robot anatomy, configuration of robots, joint notation schemes, work volume, manipulator kinematics, position representation, forward and reverse transformations, homogeneous transformations in robot kinematics, D-H notations, kinematics equations, introduction to robot arm dynamics.

IV

Robot Drives and Power Transmission Systems: Robot drive mechanisms: Hydraulic/Electric/Pneumatics, servo & stepper motor drives, Mechanical transmission method: Gear transmission, Belt drives, Rollers, chains, Links, Linear to Rotary motion conversion, Rotary-to-Linear motion conversion, Rack and Pinion drives, Lead screws, Ball Bearings. Robot end Effectors: Classification of End effectors – active and passive grippers, Tools as end effectors, Drive system for rippers. Mechanical, vacuum and magnetic grippers. Gripper force analysis and gripper design.

V

Robot Simulation: Methods of robot programming, Simulation concept, Off-line programming, advantages of offline programming. Robot Applications: Robot applications in manufacturing-Material transfer and machine loading/unloading, Processing operations like Welding & painting, Assembly operations, Inspection automation, Limitation of usage of robots in processing operation. Robot cell design and control, Robot cell layouts-Multiple robots & Machine interference.

Books:
 1 An Introduction to Robot Technology, by Coifet Chirroza, Kogan Page.
 2. Robotics for Engineers, by Y. Koren, McGraw Hill.
3. Robotic: Control, Sensing, Vision and Intelligence, by Fu, McGraw Hill.
 4. Introduction to Industrial Robotics, by Nagrajan, Pearson India.
5. Robotics, by J.J. Craig, Addison-Wesley.
6. Industrial Robots, by Groover, McGraw Hill.
7. Robotic Engineering - An Integrated Approach : Richard D. Klafter Thomas A.
8. Robots & Manufacturing Automation, by Asfahl, Wiley.

SEMESTER-VIII   Session: 2021-22

ENTREPRENEURSHIP DEVELOPMENT

Unit I Entrepreneurship- definition. growth of small scale industries in developing countries and their positions vis-a-vis large industries; role of small scale industries in the national economy; characteristics and types of small scale industries; demand based and resources based ancillaries and sub-control types. Government policy for small scale industry; stages in starting a small scale industry. 08

Unit II Project identification- assessment of viability, formulation, evaluation, financing, field-study and collection of information, preparation of project report, demand analysis, material balance and output methods, benefit cost analysis, discounted cash flow, internal rate of return and net present value methods. 08

Unit III Accountancy- Preparation of balance sheets and assessment of economic viability, decision making, expected costs, planning and production control, quality control, marketing, industrial relations, sales and purchases, advertisement, wages and incentive, inventory control, preparation of financial reports, accounts and stores studies. 08

Unit IV Project Planning and control: The financial functions, cost of capital approach in project planning and control. Economic evaluation, risk analysis, capital expenditures, policies and practices in public enterprises. profit planning and programming, planning cash flow, capital expenditure and operations. control of financial flows, control and communication. 08

Unit V Laws concerning entrepreneur viz, partnership laws, business ownership, sales and income taxes and workman compensation act. Role of various national and state agencies which render assistance to small scale industries. 08

 Text Books:
1. Forbat, John, "Entrepreneurship" New Age International.
2. Havinal, Veerbhadrappa, "Management and Entrepreneurship" New Age International
3. Joseph, L. Massod, "Essential of Management", Prentice Hall of India

SEMESTER-VIII   Session: 2021-22

RURAL DEVELOPMENT: ADMINISTRATION

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Unit-I Topics Lectures
 Rural Planning & Development: Concepts of Rural Development, Basic elements of rural Development, and Importance of Rural Development for creation of Sustainable Livelihoods, An overview of Policies and Programmes for Rural Development- Programmes in the agricultural sector, Programmes in the Social Security, Programmes in area of Social Sector.

Unit-II Rural Development Programmes: Sriniketan experiment, Gurgaon experiment,
marthandam experiment, Baroda experiment, Firkha development scheme, Etawa pilot project, Nilokheri experiment,approaches to rural community development: Tagore, Gandhi etc

Unit-III Panchayati Raj & Rural Administration: Administrative Structure:bureaucracy, structure of administration; Panchayati Raj Institutions Emergence and Growth of Panchayati Raj Institutions in India; People and Panchayati Raj; Financial Organizations in Panchayati Raj Institutions, Structure of rural finance, Government & Non-Government Organizations / Community Based Organizations, Concept of Self help group.

Unit- IV Human Resource Development in Rural Sector: Need for Human Resource Development, Elements of Human Resource Development in Rural Sector Dimensions of HRD for rural development-Health, Education, Energy, Skill Development, Training, Nutritional Status access to basic amenities - Population composition.

Unit-V Rural Industrialization and Entrepreneurship: Concept of Rural Industrialization, Gandhian approach to Rural Industrialization, Appropriate Technology for Rural Industries, Entrepreneurship and Rural IndustrializationProblems and diagnosis of Rural Entrepreneurship in India, with special reference to Women Entrepreneurship; Development of Small Entrepreneurs in India, need for and scope of entrepreneurship in Rural area.

Text Book:
1. Corporate Social Responsibility: An Ethical Approach - Mark S. Schwartz
2. Katar Singh: Rural Development in India – Theory History and Policy
3. TodaroM.P. Economic Development in III World war
4. Arora R.C – Integrated Rural Development in India
5. Dhandekar V.M and Rath N poverty in India
6. A.N.Agarwal and KundanaLal: Rural Economy of India
7. B.K.Prasad: Rural Development-Sarup& Son's Publications.