SANJIVANI RURAL EDUCATION SOCIETY'S

SANJIVANI COLLEGE OF ENGINEERING KOPARGAON

(An Autonomous Institute Affiliated to SPPU Pune)

DEPARTMENT OF MECHANICAL ENGINEERING

COURSE STRUCTURE – 2020 PATTERN for AY 2023-24

FINAL YEAR B. TECH.

LIST OF ABBREVIATIONS			
Abbreviation	**Full Form**	**Abbreviation**	**Full Form**
ES	Engineering Science	HSMC	Humanity Science
PCC	Professional Core	CIA	Continuous Internal Assessment
PE	Professional Elective	OR	End Semester Oral Examination
OE	Open Elective	PR	End Semester Practical Examination
ISE	In-Semester Evaluation	TW	Continuous Term Work Evaluation
ESE	End-Semester Evaluation	BSC	Basic Science Course
PRJ	Project	MLC	Mandatory Learning Course

Final B.Tech. SEM VII 2020

Cat	Code	Course Title	Hrs./Week			Credits	Marks						
							Theory			TW	OR	PR	Total
			L	T	P		ISE	ESE	CIA				
PCC	ME401	Finite Element Analysis	3	-	-	3	30	50	20	-	-	-	100
PCC	ME402	Heating Ventilation and Air Conditioning	3	-	-	3	30	50	20	-	-	-	100
PCC	ME403	Dynamics of Machines	3	-	-	3	30	50	20	-	-	-	100
PEC	ME404	Professional Elective-III	4	-	-	4	30	50	20	-	-	-	100
PEC	ME405	Professional Elective-IV	3	-	-	3	30	50	20	-	-	-	100
PCC	ME406	Lab- I Finite Element Analysis	-	-	2	1				-	-	50	50
PCC	ME407	Lab-II Heating Ventilation and Air Conditioning	-	-	2	1	-	-	-	-	-	50	50
PCC	ME408	Lab-III Dynamics of Machines	-	-	2	1	-	-	-	-	50	-	50
PRJ	ME409	Project Stage-I	-	-	6	3	-	-	-	100	50	-	150
MLC	MC410	Mandatory Learning Course-VII	1	-	-	Non Credit	-	-	-	-	-	-	Pass / Fail
		Total	**17**	**-**	**12**	**22**	**150**	**250**	**100**	**100**	**100**	**100**	**800**

Final B.Tech. SEM VIII 2020

Cat	Code	Course Title	Hrs./Week			Credits	Marks						
							Theory			TW	OR	PR	Total
			L	T	P		ISE	ESE	CIA				
OE	ME411	Open Elective-I	3	-	-	3	-	75	25	-	-	-	100
OE	ME412	Open Elective-II	3	-	-	3	-	75	25	-	-	-	100
OE	ME413	Open Elective -III	2	-	-	2	-	75	25	-	-	-	100
PCC	ME415	Professional Internship	-	-	8	6	-	-	-	100	50	-	150
PRJ	ME417	Project Stage-II	-	-	4	2	-	-	-	-	50	-	50
		Total	**9**	**-**	**12**	**16**	**-**	**225**	**75**	**100**	**100**	**-**	**500**

Professional Elective – III		**Professional Elective – IV**	
ME404A	Heat Transfer Equipment Design	ME405A	Energy Audit And Management
ME404B	Material Handling Equipment Design	ME405B	Pressure Vessel and Piping System Design
ME404C	Welding Application Technology	ME405C	Industrial Engineering and Operations Research
ME404D	Data Science	ME405D	Advanced Materials and Testing

ME410	Mandatory Learning Course-VII	Financially Smart

Open Electives-I		**Open Electives-II**		**Open Electives-III**	
ME411A	Fundamentals of Artificial Intelligence	ME412A	Introduction to Machine Learning	ME413A	Data Science for Engineers
ME411B	Functional and Conceptual Design	ME412B	Design of Mechatronic Systems	ME413B	Design Practice - II
ME411C	Fundamentals of Additive Manufacturing Technologies	ME412C	Automation in Manufacturing	ME413C	Design, Technology and Innovation
ME411D	Introduction to Internet of Things	ME412D	Introduction to Industry 4.0 and Industrial Internet of Things	ME413D	Innovation, Business Models and Entrepreneurship

FINITE ELEMENT ANALYSIS (ME401)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**CIA:**	20 Marks
Practical:	-	**In Sem Exam:**	30 Marks
		End Sem Exam:	50 Marks
Credits:	**3**	**Total:**	100 Marks

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Prerequisite Course: Numerical Methods, Solid Mechanics, Theory of Elasticity, Engineering Mathematics, Statistical Methods

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Course Objectives:

1. To understand the philosophy and general procedure of Finite Element Method as applied to solid mechanics and thermal analysis problems.
2. To familiarize students with the displacement-based finite element method for displacement and stress analysis and to introduce related analytical and computer tools.
3. It provides a bridge between hand calculations based on mechanics of materials and machine design and numerical solutions for more complex geometries and loading states.
4. To study approximate nature of the finite element method and convergence of results are examined.
5. It provides some experience with a commercial FEM code and some practical modeling exercises
6. It provides some experience of using commercial finite element analysis software to solve complex problems in solid mechanics

Course Outcomes (COs): At the end of the course, learner will be able to

COs	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Explain the fundamental concepts of FEA	2	Understand
CO2	Examine 1-D element stiffness matrices and load vectors to solve for displacements and stresses	3	Apply
CO3	Examine 2-D element stiffness matrices and load vectors to solve for displacements and stresses	3	Apply
CO4	Find and use Iso-parametric elements and numerical methods to solve for displacements and stresses.	2	Understand

CO5	Analyse simple mechanical structure by using 1-D thermal element of various 1-D structures and also able to Perform simple 1-D modal analysis	4	Analyse
CO6	Interpret the results of finite element analyses and make an assessment of the results in terms of modelling (physics assumptions) errors, discretization (mesh density and refinement toward convergence) errors, and numerical (round-off) errors.	5	Evaluate

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	3	2	1	2	2	2	-	2	3	3	-
CO2	3	1	2	1	3	2	1	2	2	2	-	2	3	3	-
CO3	3	1	2	1	3	2	1	2	2	2	-	2	3	3	-
CO4	3	1	2	1	3	2	1	2	2	2	-	2	3	3	-
CO5	3	1	2	1	3	2	1	2	2	2	-	2	3	3	-
CO6	3	1	2	1	3	2	1	2	2	2	-	2	3	3	-

Course Contents

Unit	Contents	No.of Hours	COs
1	**Fundamental Concepts of FEA**		
	Brief history of FEM, Finite Element terminology (nodes, elements, domain, continuum, degrees of freedom, loads & constraints), general steps involved in FEM, applications of FEM in various fields, advantages and disadvantages of FEM, consistent units system, essential and natural boundary conditions, symmetric boundary conditions. Types of Analysis (Introduction): Linear static analysis, Non-linear analysis, Dynamic analysis, Linear buckling analysis, Thermal analysis, Fatigue analysis, Crash analysis.	6 Hrs.	CO1
2	**1D Elements and their Analysis**		
	Types of 1D elements, displacement function, global and local coordinate systems, polynomial form of interpolation functions- linear, quadratic and cubic, properties of shape function, primary and secondary variables.	6 Hrs.	C02

	Formulation of elemental stiffness matrix and load vector for bar, truss and beam using FEA approach, Assembly of global stiffness matrix and load vector, properties of stiffness matrix, stress and reaction forces calculations		
3	**Introduction to 2D Elements**		
	Two-Dimensional Stress Analysis: Plane Stress/Strain problems in 2D elasticity, constitutive relations Constant Strain Triangle(CST), Linear Strain Rectangle (LSR), displacement function, Pascal's triangle, compatibility and completeness requirement, geometric isotropy, convergence requirements. Formulation of element stiffness matrix and load vector for Plane Stress/Strain problems Assembly of global stiffness matrix and load vector, Boundary conditions, solving for primary variables (displacement), stress calculations	6 Hrs.	C03
4	**Isoparametric Elements**		
	Concept of isoparametric elements, Terms isoparametric, super parametric and subparametric. *Coordinate mapping* : Natural coordinates, Area coordinates (for triangular elements), higher order triangular and quadrilateral elements (Lagrangean and serendipity elements), geometry associative mesh, quality checks, mesh refinement- p vs h refinements, Uniqueness of mapping - Jacobian matrix.	6 Hrs.	C04
5	**1D Steady State Heat Transfer and Dynamic Analysis**		
	Introduction, Governing differential equation, steady-state heat transfer formulation of 1D element for conduction and convection problem, boundary conditions and solving for temperature distribution. Types of dynamic analysis, General dynamic equation of motion, point and distributed mass, lumped and Consistent mass, Mass matrices formulation of bar element.	6 Hrs.	C05
6	**Introduction to 3-D analysis**		
	3 D problems in stress analysis, Mesh generation. Techniques such as semi-automatic and fully Automatic use of software such as ANSYS using Hexahedral and Tetrahedral Elements.	6 Hrs.	CO6

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1	A First Course in the Finite Element Method	Daryl L. Logan	Logan, 2007	
2	Finite Element Analysis	G Lakshmi Narasaiah	B S Publications	
3	Text book of Finite Element Analysis	P. Seshu	PHI Learning Private Ltd. , Delhi	

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Fundamental of Finite Element Analysis	David V. Hutton	Tata McGraw-Hill	
2.	Finite Element Procedures	Bathe K. J.,	PHI (P) Ltd., New Delhi	
3.	Concepts and Applications of Finite Element Analysis	R. D. Cook	Wiley, India	

HEATING VENTILATION AND AIR CONDITIONING (ME402)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**CIA** **Insem Exam:**	20 Marks 30 Marks
Practical	-	**End Sem Exam:**	50 Marks
Credits:	**3**	**Total:**	100 Marks

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Prerequisite Course: Basic Thermodynamics and Heat Transfer

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Course Objectives:

1. To understand and compare different refrigerants with respect to properties, applications and Environmental issues.
2. To Understand and apply the Psychrometry for air conditioning applications.
3. To Understand, conceptualize and determine cooling load of the building
4. To Explain working of types of desiccant, evaporative, thermal storage, and heat pump air-conditioning systems
5. To Design the Vapour Compression refrigeration system for various applications
6. To Design the duct for various air conditioning systems

Course Outcomes (COs): At the end of the course, learner will be able to

COs	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Determine COP of Vapour Compression Refrigeration System and Explain the properties, applications and environmental issues of different refrigerants	3	Apply
CO2	Understand Psychrometric processes and Calculate different psychrometric properties.	3	Apply
CO3	Estimate the heating load and cooling loads for buildings.	3	Apply
CO4	Explain the working of Desiccant-Based Air Conditioning Systems and heat pump systems.	2	Understand
CO5	Estimate the thermal performance of refrigeration system component.	3	Apply
CO6	Design of air distribution system and Calculate pressure drop and size of ducts.	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	1	2	2	3	3	-	1	-	-	3
CO2	3	2	2	-	-	-	-	-	3	3	-	1	-	-	3
CO3	3	2	2	-	-	-	-	-	3	3	-	1	-	-	3
CO4	3	1	-	-	-	-	-	-	3	3	-	1	-	-	3
CO5	3	2	2	-	-	-	-	-	3	3	-	1	-	-	3
CO6	3	2	2	1	1	1	-	-	3	3	-	1	-	-	3

Course Contents

Unit	Contents	No. of Hours	COs
1	**Refrigeration Systems and Refrigerants**		
	Introduction to refrigeration, applications of refrigeration, simple saturated Vapour compression refrigeration cycle, effect of change in evaporator and condenser pressure, effect of pressure drops, methods of improvement in the performance of the cycle like sub cooling, superheating, use of heat exchanger , actual Vapour compression refrigeration cycle, simple Vapour Absorption refrigeration System. **Refrigerants** Survey of Refrigerants, Designation of Refrigerants, Selection of a Refrigerant, Thermodynamic, Chemical, Physical, and safety Requirements, Secondary Refrigerants, Ozone depletion, Global warming, greenhouse effect, Environment friendly refrigerant R134a, R410a, R600a, R290, R32.	6 Hrs.	CO1
2	**Psychrometrics of Air – Conditioning Processes**		
	Psychrometric properties, Psychrometric chart, Psychrometric processes, BPF of coil, ADP, adiabatic mixing of two air streams, SHF, RSHF, GSHF, ESHF. Factors contributing to cooling load, Numerical based on psychrometric processes. **Thermal Comfort:** Basic parameters, Thermodynamics of human body, Human comfort, Factors affecting thermal comfort, comfort chart and limitations, effective temperature, factors governing effective temperature, design considerations.	6 Hrs.	CO2
3	**Heat Load Estimation in Building Structures:**		
	Cooling load calculations – Various heat sources contributing to heat load , solar load ,equipment load ,infiltration air load , duct heat gain , fan load , moisture gain through permeable walls and fresh air load, internal and external factor , sol-air temperature, Decrement factor & time lag method, Equivalent Temperature Differential	6 Hrs.	CO3

	(ETD), cooling load calculation using CLTD methods, cooling load calculations using software.		
4	**Advanced Air-conditioning Systems**		
	Advanced AC Systems: Working of summer, winter and year-round AC systems, all air system, all water system, air water system, variable refrigerant flow and variable air volume systems, unitary and central air conditioning. **Desiccant-Based Air Conditioning Systems** : Introduction, Sorbents & Desiccants, Dehumidification, Liquid Spray Tower, Rotary Desiccant Dehumidifiers, Evaporative-Cooling Air Conditioning Systems, Thermal Storage Air Conditioning Systems **Heating systems** – warm air systems, hot water systems, steam heating systems, panel and central heating systems, Heat pump circuit and Heat sources for heat pump.	6Hrs.	CO4
5	**Refrigeration System Components**		
	Types of Compressors, Thermodynamic Processes during Compression, Principal Dimensions of a Reciprocating Compressor, Performance Characteristics of a Reciprocating Compressor, Capacity Control of Reciprocating Compressors, Rotary Compressors, Screw Compressors, Centrifugal Compressors, Digital scroll compressors Construction, working and Types of condensers, evaporators and expansion devices, Capillary Tube and Its Sizing. Types & Application of Chillers	6 Hrs.	CO5
6	**Air Distribution Systems**		
	Ventilation and infiltration: Natural ventilation, Mechanical ventilation. **Ducts:** Types of Ducts, duct fittings, Dampers, Flexible ducts, classification of duct, Duct Gauge Selection, Comparison Between Different Shapes of Duct, Duct Materials , air flow through simple duct system, pressure losses in duct (friction losses, dynamic losses) equivalent diameter, Duct Designing Methods : Equal Friction Method, velocity reduction and static regain method **Air handling unit** Air handling unit, Fan Coil Units & Fresh air handling units, types of fans used air conditioning applications, fan laws, filters, supply and return grills, sensors (humidity, temperature, smoke). Types of Air Terminal Device, Selection And Sizing of Air Terminal Device	6 Hrs.	CO6

Books

S.N.	Title of Book	Authors	Publication House	Accession No
1.	Refrigeration and Air conditioning	Arora, C.P	Tata-McGraw Hill	
2.	Basic Refrigeration and Air Conditioning	P .N. Ananthanarayanan	McGraw Hill	
3.	Refrigeration and Air conditioning.	Manohar Prasad	New Age International	
4.	Elementary Refrigeration and Air-conditioning	Stoecker, W.F., and Jones, J.W.,	McGraw Hill , 2002	
5.	Principle of Refrigeration	Roy J.Dossat	Wiley Eastern limited, 1987 Third Edition	
6.	Refrigeration and Air conditioning	R.S. Khurmi J.K. Gupta	Eurasia Publishing House (P) Ltd.	
7.	ASHRAE Handbook – Refrigeration.	ASHRAE Technical Committees, Task Groups, and Technical Resource Groups	ASHRAE	
8.	Refrigeration and Air Conditioning.	Langley, Billy C.	Engie wood Cliffs (N.J) Prentice Hall 1986.	
9.	Air Conditioning Engineering.	W.P.Jones	English Language Book Society Edward Arold pub.	
10.	Refrigeration and Air Conditioning Technology	Whitman, Johnson, Jomcztk	Delmar Thomson learning	

DYNAMICS OF MACHINES (ME403)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**CIA**	20 Marks
Practical:	-	**In Sem Exam:**	30 Marks
Credits:	**3**	**End Sem Exam:**	50 Marks
		Total:	100 marks

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Prerequisite Course: (if Any) Machine Design-I,II, Strength of Materials, and Applied Mechanics, Kinematics

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Course Objectives:

1. To Provide fundamentals of vibration and noise so that the students can solve real engineering problems and design engineering systems.
2. To Make students able to prepare a mathematical model of the mechanical system in the form of spring, mass and damping elements.
3. To Provide knowledge of gyroscope, flywheel and governor
4. To Make aware about the instrumentation used for measurement of vibration and noise
5. To Provide fundamentals of balancing of rotating and reciprocating masses
6. To Provide knowledge of free and forced vibrations

Course Outcomes (COs): At the end of the course, learner will be able to

CO's	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Calculate the gyroscopic couple acting on applications like ships, aero planes, two and four wheeler	3	Apply
CO2	Determine the dimensions of flywheel based on the turning moment diagram and calculate the characteristics of governors.	3	Apply
CO3	Determine balancing force for rotating and reciprocating masses using static and dynamic balancing method	3	Apply
CO4	Calculate natural frequency for a single degree of freedom free vibratory systems	3	Apply
CO5	Determine response to forced vibration due to harmonic excitation, base excitation and excitation due to unbalance forces.	3	Apply
CO6	Determine vibration and noise measurement parameters for industrial / real life applications.	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	-	-	-	-	-	2	-	-	-	2	-	-
CO2	3	3	3	-	-	-	-	-	2	-	-	2	3	-	-
CO3	3	2	2	-	-	-	-	-	-	2	-	2	2	-	-
CO4	3	3	3	-	-	-	-	-	-	2	-	-	2	-	-
CO5	2	3	2	-	-	3	-	2	-	2	-	2	2	-	-
CO6	3	3	2	-	2	2	-	2	-	-	-	2	3	-	-

Course Contents

Unit	**Contents**	No. of Hours	COs
1	**Gyroscope**		
	Introduction- Gyroscopic couple and its effect on spinning bodies, Gyroscopic effect on naval ships during steering, pitching and rolling, Ship stabilization with gyroscopic effect. Two wheeler and four wheeler on curved path- effect of gyroscopic and centrifugal couples, maximum permissible speeds on curve paths, Gyroscopic effect due to lateral misalignment of rigid disc mounted on shaft, gyroscopic effects in airplanes, Introduction to MEMS based gyroscopes	6 Hrs.	CO1
2	**Flywheel and Governors**		
	Fundamental equation of motion, torque analysis, Significance of turning moment diagram for input and output shaft, Fluctuation of speed & energy, disk and rimmed flywheels, stresses in flywheel rim and arms, design of disc and rimmed flywheels for various applications, standard dimensions of flywheels, flywheels for punching press. Comparison between governors and flywheel, Types of centrifugal governors, inertia governors, Force analysis of gravity loaded governors– Watt, Porter, Proell, Force analysis of spring loaded governors Hartnell, Hartung, Wilson Hartnell, Force analysis of spring and gravity loaded governor, Performance characteristics of governor stability, Sensibility, Isochronisms, Hunting, Governor effort and governor power, Coefficient of insensitiveness,	8 Hrs.	C02
3	**Balancing of rotating and reciprocating masses**		
	Causes of unbalance, Balancing of rotating masses-static and dynamic balancing, two plane balancing. Balancing of several masses rotating in the same plane and balancing of several masses rotating in different planes. Balancing of reciprocating masses –identification of inertia, forces for reciprocating masses in engine mechanisms, partial primary balancing of	6 Hrs.	C03

	single cylinder engines and locomotives, balancing of multi cylinder engines, V-twin engines and radial engines-direct and reverse crank methods. Balancing machines.		
4	**Free Vibrations**		
	Single degree of freedom systems– free vibration, fundamentals of vibration, Types of vibration, equivalent stiffness and damping. Formulation of differential equation of motion using Newton law, D Alembert principle and energy method. Natural frequency for longitudinal, transverse and torsional vibratory systems. Damped free vibrations: Types of damping, free vibrations with viscous damping- over damped, critically damped and under damped systems, logarithmic decrement Natural frequency of free torsional vibrations, two rotor systems, torsionally equivalent shaft.	8 Hrs.	C04
5	**Forced Vibrations**		
	Single degree of freedom forced vibrations of longitudinal systems, frequency response to harmonic excitation, Excitation due to reciprocating and rotating unbalance, base excitation, and magnification factor, Concept of force and motion transmissibility. Critical speed of shaft having single rotor of undamped systems.	6 Hrs	CO5
6	**Vibration and Noise Measurement**		
	Vibration Testing and modal analysis, Instruments for measurement of displacement, velocity and acceleration and frequency of vibration. Accelerometers, Impact hammer, Vibration shaker-Construction, principles of operation and uses, FFT Vibration Analyzer, Vibration based condition monitoring, Analysis of Vibration Spectrum, Standards used for vibration measurement, Numerical on vibration measurement sensors. Fundamentals of noise Sound concepts, Decibel Level, sound pressure level, Logarithmic addition, subtraction and averaging, sound intensity, noise measurement. Numerical on noise level measurement.	6 Hrs.	CO6

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No.
1	Theory of Machines	S. S. Rattan	McGra-Hill	
2	Theory of Machines	T Beven	CBS Publishers	
3	Mechanical Vibrations	Grover G. K.	New Chand and Bros. , Roorke	620.3, GRO-TB, 58742
4	Mechanical Vibrations	S. S. Rao	Pearson Education Inc. New Delhi.	620.3, RAO-TB, 23294
5	Mechanical Vibrations	V. P. Singh	Dhanpat Rai and Co.	
6	Vibration and Noise for Engineers	Kewal Pujara	Dhanpat Rai and Co.	621.811, PUJ-TB, 70437

Reference Books

Sr. No.	Title of Book	Authors	Publication House
1	Theory of Machines and Mechanisms-	J.E.Shigley:	Tata McGraw Hill
2	Vibration of Mechanical System	Alok Sinha	Cambridge university Press , India
3	Vibration Problems in Engineering.	Weaver	Wiley India Pvt. Ltd, New Delhi.
4	Mechanical Vibration	William J Palm III,	Wiley India Pvt. Ltd, New Delhi
5	Engineering Vibration	Daniel J. Inman	Pearson Education Inc.
6	Mechanical Vibrations	S.Graham Kelly	Tata McGra-Hill

HEAT TRANSFER EQUIPMENT DESIGN (ME404A)

Teaching Scheme		Examination Scheme	
Lectures:	4 Hrs. / Week	**CIA** **Insem Exam**	20 marks 30 Marks
Practical:	-	**End Sem Exam:**	50 Marks
Credits:	**4**	**Total:**	100 Marks

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Prerequisite Course: Basic Thermodynamics and Heat Transfer

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Course Objectives:

1. To Understand the basic concept and design methodology of heat exchangers.
2. To Identify the design requirements for different types of heat exchangers
3. To Define the important heat-exchanger design parameters
4. To Perform sizing of a given type of heat exchanger for a specific application.
5. To Design and analyze various heat exchangers using heat exchanger design standards and codes
6. To Design and analyze air cooled heat exchanger using heat exchanger design standards and codes.

Course Outcomes (COs): At the end of the course, learner will be able to

COs	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	**Understand** and **explain** different types of heat exchangers and its performance.	3	Apply
CO2	**Select** and **Design** the double tube heat exchangers for process industry	3	Apply
CO3	**Design** the Shell & Tube Heat Exchangers for specified conditions	3	Apply
CO4	**Design** the condensers and evaporators for refrigeration applications	3	Apply
CO5	**Design** the compact heat exchangers	3	Apply
CO6	**Design** the Air-Cooled Heat Exchangers	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	1	1	3	3	-	1	-	1	2
CO2	3	2	1	-	-	-	1	1	3	3	-	1	-	1	2
CO3	3	2	2	-	-	-	1	1	3	3	-	1	-	1	3
CO4	3	2	2	-	-	-	1	1	3	3	-	1	-	1	3
CO5	3	2	1	-	-	-	1	1	3	3	-	1	-	1	3
CO6	3	2	2	2	2	-	1	1	3	3	-	1	-	1	2

Course Contents

Unit	Contents	No. of Hours	COs
1	**Introduction to Heat Exchangers:**		
	Introduction: Heat exchanger types and construction, heat transfer and fluid flow fundamentals. **Types of heat exchangers**: Derivations for counter flow and parallel flow heat exchangers, LMTD and ε-NTU method, double pipe heat exchangers, cross flow heat exchangers, shell-and-tube heat exchangers, and TEMA standards. **Fouling of Heat Exchanger**: Introduction, causes of fouling, types of fouling, effect of fouling, fouling factor, overall heat transfer coefficient with fouling, fouling factors for various process and services, methods to reduce fouling, cleaning process of fouled heat exchanger	6 Hrs.	CO 1
2	**Double Pipe Heat Exchanger**		
	Constructional features, Applications, Thermal and Hydraulic design of inner tube and annulus, hairpin heat exchanger with bare and finned inner tube, total pressure drop, overall heat transfer coefficient, Rating and sizing problem. Correlations for tube side pressure drop and heat transfer coefficients. Pressure drop and heat transfer coefficient correlations for shell side flow, different methods to enhance the heat transfer coefficient.	6 Hrs.	CO 2
3	**Shell & Tube Heat Exchangers**		
	Constructional features; Applications; Effectiveness-NTU method for heat exchanger design / analysis, ϵ-NTU method, P-NTU method, Rating and sizing	6 Hrs.	CO

	problem; Correlations for tube side pressure drop and heat transfer coefficients, Pressure drop; Kern's, and Bell Delaware's method, heat transfer coefficient correlations for shell side flow.		
4	**Design of Two Phase Heat Exchangers**		
	Design considerations of heat exchangers for refrigeration and air conditioning applications, thermal design of heat exchanger used for refrigeration applications, air cooled condenser, Design considerations of Evaporative condensers. **Evaporator**: Evaporator for refrigeration and air-conditioning, thermal analysis of evaporator, standards for evaporators and condensers,	6 Hrs.	CO 4
5	**Compact heat exchangers**		
	Classification of compact heat exchangers, Plate heat exchangers, plate fin heat exchanger, tube fin heat exchanger, coiled tube heat exchangers, mini and micro channel heat exchangers, factors affecting on design of heat exchanger, Thermal analysis in compact heat exchanger.	6 Hrs.	CO 5
6	**Air-Cooled Heat Exchangers:**		
	Air as coolant for industrial processes; custom-built units; fin-tube systems for air coolers; fin tube bundles; thermal rating; tube side flow arrangements; cooling air supply by fans; cooling air supply in natural draft towers. **Mechanical Design of Heat Exchangers:** Design standards and codes, key terms in heat exchanger design, and thickness calculation for major components such as tube sheet, shell, and tubes.	6 Hrs.	CO 6

Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Fundamentals of Heat Exchanger Design	Ramesh K Shah,	Wiley Publication	
2.	Compact Heat Exchangers	Kays, V.A. and London, A.L	McGraw Hill	
3.	Process Heat transfer	Donald Q Kern	McGraw Hill	
4.	Heat Exchanger Design Handbook	Kuppan, T, Macel Dekker	CRC Press	
5.	T.E.M.A. Standard			

MATERIAL HANDLING EQUIPMENT DESIGN [ME404B]

Teaching Scheme		Examination Scheme	
Lectures:	4 Hrs. / Week	**CIA**	20 Marks
Practical:	- Hrs./ Week	**In Sem Exam:**	30 Marks
Credits:	4	**End Sem Exam:**	50 Marks
		Total:	100 Marks

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Prerequisite Course: (if Any)

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Course Objectives:

1. To Understand the Fundamentals of Material Handling Equipment.
2. To Design various hoisting elements like, chains, Hemp and wire ropes, Pulley systems, Sprockets & drums, forged hooks and eye hooks and Girders.
3. To Design a Conveyors and Selection based on the Application.
4. To Design of Bucket and Cage Elevator

Course Outcomes (COs): At the end of the course, learner will be able to

COs	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	**Select** a proper material handling equipment suitable for applications	3	Apply
CO2	**Design** belt conveyor for an engineering application	3	Apply
CO3	**Design** cage and bucket elevator for an engineering application	3	Apply
CO4	**Design** of a hoist for an engineering application	3	Apply
CO5	**Design** of crane for an engineering application	4	Analyse
CO6	**Store** material with a suitable packaging material	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	-	2	-	-	2	2	2	-	2	2	-	-
CO2	2	2	2	-	2	-	-	2	2	2	-	2	2	-	-
CO3	2	2	2	-	2	-	-	2	2	2	2	2	2	-	-
CO4	2	3	2	-	2	-	-	2	2	2	-	2	2	-	-
CO5	3	2	2	-	2	-	-	2	2	2	-	2	2	-	-
CO6	3	3	2	-	2	-	-	2	2	2	2	2	2	-	-

Course Contents

Unit	**Contents**	No. of Hours	COs
1	**Materials Handling Equipment**		
	Objectives of material handling system, Principal groups of materials handling equipment and classification, Scope of Material Handling, Criteria for selection of Material Handling Equipment's, Basic kind of material handling problems, Various methods to analyze material Handling problems.	6 Hrs.	CO1
2	**Conveyors**		
	Conveyor Design: Introduction to Apron conveyors , Pneumatic conveyors, Belt Conveyors, Chain conveyors, Screw conveyors and vibratory conveyors and their applications, Design of Belt conveyor- Belt selection procedure and calculation of drop energy, Idler design.	6 Hrs.	CO2
3	**Design of bucket and Cage Elevator**		

	Design of bucket and Cage Elevator: Introduction, Types of Bucket Elevator, Design of Bucket Elevator- loading and bucket arrangements, Cage elevators, shaft way, guides, counter weights.	6 Hrs.	CO
4	**Design of Hoists**		
	Design of Hoists: Design of hoisting elements: Welded and roller chains – Hemp and wire ropes - Design of ropes, pulleys, pulley systems, sprockets and drums, Load handling attachments. Design of forged hooks and eye hooks – crane grabs - lifting magnets - Grabbing attachments - Design of arresting gear -Brakes: shoe, band and cone types	6 Hrs.	CO4
5	**Design of Cranes**		
	Design of Cranes: Hand-propelled and electrically driven overhead traveling cranes; Traveling mechanisms of cantilever and monorail cranes , goliath cranes; design considerations for structures of rotary cranes with fixed radius ; fixed post and overhead traveling cranes; Stability of stationary rotary and traveling rotary cranes.	6 Hrs.	CO5
6	**Packaging and storage of bulk materials**		
	Packaging and storage of bulk materials: Steps for design of packages, protective packaging, testing the physical characteristics of packaging, container testing, types of storage and industrial containers, Automatic guided vehicles, Automatic storage and retrieval system.	6 Hrs.	CO6

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Material Handling Equipment	N.Rundenko	Peace Publisher, Moscow	
2.	Material Handling Equipment	M.P. Alexandrow	MIR Publishers, Moscow	

3.	Belt conveyors for bulk materials Conveyor Equipment		Manufacturer's Association	
4.	Material Handling Handbook	Raymond A Kulwiec	John Wiley & Sons.	
5.	Engineering Science and application design for belt conveyor	Ishwar G Mulani and Mrs. Madhu I Mulani,		

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Materials Handling Equipments,	Alexandrov, M,	MIR Publishers.	
2.	Bulk Materials Handling Handbook	Jacob Fruchtbaum	Springer Science +Business Media	

WELDING APPLICATION TECHNOLOGY (ME404C)

Teaching Scheme		Examination Scheme	
Lectures:	4 Hrs. / Week	**CIA**	20 Marks
Practical:	-	**INSEM**	30 Marks
		End Sem Exam:	50 Marks
Credits:	**4**	**Total:**	100 Marks

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Prerequisite Course: (if Any)

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Course Objectives:

1. To impart a sound understanding of principles of different fusion welding processes.
2. To study welding materials, soldering and brazing
3. To study weld joint design
4. To study weld defects and their remedial techniques
5. To study welding testing methods
6. To study welding residual stresses, distortions and weld standards.

Course Outcomes (COs): At the end of the course, learner will be able to

COs	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Select the welding process for application	2	Understand
CO2	Select welding process to join metals and non-metals	1	Remember
CO3	Analyse and design weld joints	3	Apply
CO4	To find weld defects and weld failures	3	Apply
CO5	Test the welds using destructive and non-destructive methods	2	Understand
CO6	Use weld standards for welding applications	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	1	-	-	-	-	-	-	-	-	-	3
CO2	3	1	1	1	1	-	-	-	-	-	-	-	-	-	3
CO3	3	3	3	2	2	-	-	-	-	-	-	-	-	-	3
CO4	3	2	2	3	3	-	-	-	-	-	-	-	-	-	3
CO5	3	3	1	3	3	-	-	-	-	-	-	-	-	-	3
CO6	3	1	1	1	2	-	-	-	-	-	-	-	-	-	3

Course Contents

Unit	**Contents**	No. of Hours	COs
	Welding Processes		
1	Classification of welding processes; Gas welding; Arc welding; arc physics, power source characteristics, Manual metal arc welding, Gas tungsten arc welding, CO2 welding, pulsed and synergic MIG welding, FCAW, Submerged arc welding (SAW), Narrow gap submerged arc welding, Electro slag and Electro gas welding Plasma welding, Concepts, processes and applications, keyhole and puddle-in mode of operation, low current and high current plasma arc welding and their applications; Magnetically impelled arc butt (MIAB) welding, Resistance welding, Concepts, types and applications, Flash butt welding, Stud welding and under water welding	6Hrs.	CO1
	Welding materials, Soldering and Brazing		
2	Different types of materials, metals and non-metals, their applications and suitability for different applications. **Soldering:** Techniques of soldering, solders, phase diagram, composition, applications **Brazing:** Wetting and spreading characteristics, surface tension and contact angle concepts, brazing fillers, role of flux and characteristics, atmospheres for brazing, adhesive bonding	6Hrs.	CO2
	Analysis and Design of Welds		
3	Type of weld joints, joint efficiency, factor of safety, symbols, selection of edge	6Hrs.	CO3

	preparation, design considerations, types of loading Permissible stress, allowable defects, computation of stresses in welds, weld size calculation, code requirement for statically loaded structures, Design for fluctuating and impact loading - dynamic behaviour of joints - stress concentrations - fatigue analysis - fatigue improvement techniques - permissible stress- life prediction Concept of stress intensity factors - LEFM and EPFM concepts - brittle fracture- transition temperature approach - fracture toughness testing, application of fracture mechanics to fatigue		
4	**Weld Defects and Prevention**		
	Weld defects and their analysis- Cracks, Inclusions, Lack of fusion, Porosity, Undercut, Poor penetration, burn through, Under-fill, Excess reinforcement, Spatter, Over-roll/Overlap, Whiskers, Mechanical damage, methods to minimise weld defects.	6 Hrs.	CO4
5	**Inspection of Welding**	6 Hrs.	CO5
	Visual Inspection- tools, applications and limitations. Liquid Penetrant Inspection, Magnetic particle inspection**,** Magnetic particle inspection, Ultra sonic testing (UT), A, B and C scan - Time of Flight Diffraction (TOFD), Radiography testing (RT), X ray and gamma radiation sources, Fluoroscopy/Real- Eddy current testing, Thermography, Optical & Acoustical holography		
6	**Welding residual stresses, distortions and welding standards**		
	Welding residual stresses - causes, occurrence, effects and measurements - thermal and mechanical relieving; types of distortion - factors affecting distortion - distortion control methods - prediction - correction, jigs, fixtures and positioners **WELDING CODES AND STANDARDS:** Design requirements, allowable stress values, workmanship and inspection, introduction to welding codes and standards, AWS D1.1 Process and product standards for manufacturing of pipe - welding procedure and welder qualification, field welding and inspection, API 1104 and API5L Design requirements, fabrication methods, joint categories, welding and inspection, post weld heat treatment and hydro testing, ASME II, V, VIII and IX Welding procedure specification, procedure qualification records, performance qualification, variables Introduction to materials standards and testing of materials, consumables testing and	6 Hrs.	CO5

	qualification as per ASME/AWS requirements		

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1	Welding Technology and Design,	V. M. Radhakrishnan,	New age. 2002	
2	Welding Technology,	Dr. O. P. Khanna,	Reprint: 200	
3	Welding Engineering and Technology,	Parmar R S,	Khanna Publishers, 1997	
4	Advanced Welding processes-Vol-I, II, III	Jecob Kuran	Jaico Publications	

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1	Materials and Applications - Metal Joining Manual',	Schwartz M.	McGraw-Hill, 1979	
2	'Testing of Metallic Materials',	Suryanarayana,	Prentice Hall India, 1979	
3	Practical Non – Destructive Testing,	Baldev raj,	Narosa Publishing House(1997)	
4	'Design of Weldments',.	Omer W. B., James.F	Lincoln Arc Welding Foundation, 1991	
5	'Weldment Design',	Bhattacharya.M ,	Association of Engineers,1991	
6	Welding Codes: 1. AWS D1.1 Structural Welding Code 2. API 5L 3. API 1104 4. ASME Section VIII - Division 1 5. ASME Section IX 6. ASME Section II Part A and C			

DATA SCIENCE (ME404D)

Teaching Scheme		Examination Scheme	
Lectures:	4 Hrs. / Week	**CIA**	20 Marks
		INSEM	30 Marks
Practical:	-	**End Sem Exam:**	50 Marks
Credits:	4	**Total:**	100 Marks

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Prerequisite Course: Basic understanding of statistics and programming

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Course Objectives:

1. To introduce students to the basic concepts of data science and Python programming
2. Classify and recognize different types of data
3. To understand the data science techniques for different applications
4. To acquire an in-depth understanding of data exploration and data visualisation
5. Identify visualisation for the data analysis problem
6. Analyse different types of data for inferring meaning

Course Outcomes (COs): At the end of the course, learner will be able to

COs	Course Outcomes	Bloom's Taxonomy	
		Level	Descriptor
CO1	Describe fundamentals of data science, python programming	2	Understand
CO2	Discuss the mathematics and statistics involved in data science	2	Understand
CO3	Discuss the data visualization techniques like plots and graphs	3	Apply
CO4	Discuss the feature engineering techniques and their identification	2	Understand
CO5	Describe the machine learning algorithms and data regression models	2	Understand
CO6	Demonstrate the application of data science in mechanical engineering fields like design, production	2	Understand

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	-	3	-	-	-	2	2	-	3	-	3	-
CO2	2	1	2	-	3	-	-	-	2	2	-	3	-	3	-
CO3	2	1	2	-	3	-	-	-	2	2	-	3	-	3	-
CO4	2	1	2	-	3	-	-	-	2	2	-	3	-	3	-
CO5	2	1	2	-	3	-	-	-	2	2	-	3	-	3	-
CO6	2	1	2	1	3	-	-	-	2	2	-	3	1	3	1

Course Contents

Unit	Contents	No. of Hours	COs
1	**Introduction to Python for Data Science**		
	Definition, importance of data science, application of data science, Basics of Python, Introduction to Python libraries, advanced Python, Python for data science, Python for text processing	6	CO1
2	**Mathematical Foundation for Data Science**		
	Probability, Bayes Theorem, Normal distribution, Central limit theorem, hypothesis testing, derivative application theorem (maximisation)	6	CO2
3	**Data Visualisation Techniques**		
	Basic of data visualisation, types, mean, median, histogram, box plots, bar graphs, pair plots, scatter diagrams	6	CO
4	**Feature Engineering Techniques**		
	Types of bias systems, dummy variables, conversion techniques, standardisation, and normalisation, outlier identification and removing techniques, skewness identification and its treatment	6.	CO4
5	**Machine Learning Algorithms**		
	Introduction to machine learning (ML), their algorithms, unsupervised machine learning - clustering techniques, supervised machine learning - classification techniques, linear regression and its techniques	6	CO5
6	**Application of Data Science in Mechanical Engineering**		
	Data science case studies in manufacturing systems, thermal systems, design systems	6	CO6

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No/ISBN/ISSN No
1.	A Hands-On Introduction to Data Science	Chirag Shah	Cambridge University Press	ISBN: 9781108560412
2.	Data Science : Concepts and Practice	Vijay Kotu, Bala Deshpande	Morgan Kaufmann (Elsevier)	ISBN: 9780128147610
3	Foundations of Data Science	Avrim Blum, John Hopcroft, and Ravindran Kannan	Hindustan Book Agency	----------
4	Introduction to Machine Learning	Ethem Alpaydin	PHI Learning Pvt Ltd,	ISBN-978-81-203-5078-6

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No/ISBN/ISSN No
1.	Exploring Data Science with R and the Tidyverse : A Concise Introduction	Jerry Bonnell and Mitsunori Ogihara	CRC Press, Taylor and Francis Group	ISBN 9781032341705
2.	The Data Science Design Manual	Steven S. Skiena	Springer International Publishing AG	ISBN 978-3-319-55443-3

ENERGY AUDIT AND MANAGEMENT (ME405A)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**CIA** **Insem Exam:**	20 Marks 30 Marks
		End Sem Exam:	50 Marks
Credits:	**3**	**Total:**	100 Marks

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Prerequisite Course: Basic Thermodynamics and Heat Transfer.

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Course Objectives:

1. Understand and Analyze national and international energy scenario.
2. Calculate energy losses in process, equipment and plant.
3. Showcase energy conservation opportunities in various mechanical systems and suggest methods for energy savings.
4. Analyze the energy data of industries and utilize the technical skills attained to carry out energy Audit.
5. Perform energy audit and use energy management tools
6. Apply practices of energy conservation in various sectors like domestic and commercial Industries.

Course Outcomes (COs): At the end of the course, learner will be able to

COs	Course Outcomes	Blooms Taxonomy	
		Level	**Descriptor**
CO1	**Explain** the energy need and role of energy management	2	Understand
CO2	**Carry** out energy audit of the institute/industry/organization	3	Apply
CO3	**Assessment** of Energy saving opportunities using energy economics	3	Apply
CO4	**Analyze** the energy conservation in thermal utilities	3	Apply
CO5	**Analyze** the energy conservation in electrical utilities	3	Apply
CO6	**Analyze** energy conservation in various sectors like domestic, and commercial industry.	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	1	2	2	3	3	-	1	-	-	3
CO2	3	2	2	-	-	-	-	-	3	3	-	1	-	-	3
CO3	3	2	2	-	-	-	-	-	3	3	-	1	-	-	3
CO4	3	1	-	-	-	-	-	-	3	3	-	1	-	-	3
CO5	3	2	2	-	-	-	-	-	3	3	-	1	-	-	3
CO6	3	2	2	1	1	1	-	-	3	3	-	1	-	-	3

Course Contents

Unit	Contents	No. of Hours	COs
1	**Energy Scenario and Management**		
	Energy Scenario, Global Energy Scenario and Indian Energy Scenario in various sectors and Indian economy, Concerns of Energy Security in India. Basics of Energy and its various forms , Energy Management and Audit ,Material and Energy Balance , Energy Action Planning-Financial Management -Project Management , Energy Monitoring and Targeting , Global Environmental Concerns	6 Hrs.	CO1
2	**Energy Audit**		
	Need of Energy Audit, Types of energy audit, Energy audit methodology, Energy audit instruments, Analysis and recommendations of energy audit, Benchmarking, Energy audit reporting, Introduction to software and simulation for energy auditing, Current Energy Conservation Act and Electricity Act and its features.	6 Hrs.	CO2
3	**Energy Economics**		
	Simple Payback Period, Return on Investment, Dynamic value of money, Discount Rate Cash flow, Time value of money, Formulae relating present and future cash flow - single amount, uniform series; Payback period; Return on Investment (ROI); Life Cycle cost. Costing of Utilities- specific costs of utilities like; all fuels stream, compressed air, electricity, water.	6Hrs.	CO3
4	**Energy Efficiency in Thermal Utilities**		
	Heat exchangers, Cooling towers, Compressors, Compressed air systems Fuels and Combustion, Boilers Steam System , Furnaces, Insulation and Refractory, FBC Boilers	6 Hrs.	CO4

	Cogeneration: Need, applications, advantages, classification, Introduction to Trigeneration, Waste heat recovery		
5	**Energy Efficiency in Electrical Utilities**		
	Electrical Systems-Electric Motors, HVAC and Refrigeration System, Fans and Blowers, Pumps and Pumping System, Lighting System, Diesel Generating System, Energy Efficient Technologies in Electrical Systems.	6 Hrs.	CO5
6	**Energy conservation in Mechanical systems.**		
	Energy conservation in Buildings, Heating, Ventilation and Air Conditioning System, Energy conservation in Boilers, Performance testing, efficiency Energy conservation in Steam Systems– Aspects of steam distribution, Steam Traps, Condensate and Flash-steam utilization, Energy conservation opportunities **Case Studies:** Energy Audit of Institute/MSMEs/Organization, Guidelines for Energy Manager and Energy Auditor examination conducted by BEE	6 Hrs.	CO6

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Bureau of Energy Efficiency Study material for Energy Managers and Auditors Examination: Paper I to IV.			
2.	Guide to Energy Management	Barney L. Capehart, Wayne C. Turner and William J. Kennedy	The Fairmont Press Inc.	
3.	Energy Management Principles	Craig B. Smith	Pergamon Press	
4.	Energy Auditing and conservation; Methods, Measurements, Management and Case Study	Hamies	Hemisphere Publishers	
5.	Energy Management Handbook	Albert Thumann P.E. CEM, William J. Younger CEM	The Fairmont Press Inc.,	

PRESSURE VESSEL AND PIPING SYSTEM DESIGN (ME405B)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**CIA**	20 Marks
		In Sem	30 Marks
Practical:	- Hrs./ Week	**End Sem Exam:**	50 Marks
Credits:	**3**	**Total:**	100 marks

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Prerequisite Course: (if Any) Strength of Materials, and Applied Mechanics, Machine Design

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Course Objectives:

1. To provide knowledge of design considerations used for pressure vessels used in process industries.
2. To make them aware about design procedures used for design of low and high pressure vessels
3. To give exposure to the standard practice used for design of unfired pressure vessel as per IS 2825 code
4. To explore the fundamentals of piping used in process industries used for transportation of water, oil and gas.
5. To provide knowledge of design procedure of pipes as per ASME code
6. To make aware about the importance of designing supports for piping in proper handling of water, oil and gas.

Course Outcomes (COs): At the end of the course, learner will be able to

CO's	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Design thin cylinders and storage vessels	3	Apply
CO2	Design thick cylinders working under high pressure	3	Apply
CO3	Design unfired pressure vessels as per IS 2825 code	3	Apply
CO4	Explain design considerations of piping system and its components	2	Understand
CO5	Design of piping system as per ASME B31.1 piping code.	3	Apply
CO6	Design of supports for piping system	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	1	-	2	-	2	2	2	-	-	2	-	-
CO2	3	1	2	-	-	-	-	-	2	2	-	-	2	-	-
CO3	3	2	3	1	-	3	-	2	2	2	-	-	2	-	-
CO4	2	1	2	-	-	2	-	2	2	2	-	-	2	-	-
CO5	3	2	3	1	-	3	-	2	2	2	-	-	2	-	-
CO6	2	1	2	-	-	-	-	-	2	2	-	-	2	-	-

Course Contents

Unit	Contents	No.of Hours	COs
1	**Basic considerations in pressure vessel design**		
	General design procedure, Materials of constructions, design considerations, operating conditions, pressure vessel codes, design of shell and its components, thermal stresses in cylindrical shells, fabrication, inspection and testing. Design of thin cylinders, design of storage vessels	6Hrs.	CO1
2	**Design of high pressure vessel**		
	Materials for high pressure vessels, solid walled vessels, Lame's equation, Clavarino's, and Bernie's equations, Design of Pressure vessels subjects to internal pressure, external pressure, design of hydraulic and pneumatic cylinders, auto-frettage and compound cylinders, gasketed joints in cylindrical vessels. Process hazards and safety measures in equipment design	6 Hrs.	C02
3	**Design unfired pressure vessels**		
	Modes of failures in pressure vessels, unfired pressure vessels, classification of pressure vessels as per I. S. 2825 - categories and types of welded joints, weld joint efficiency, stresses induced in pressure vessels, materials for pressure vessel, thickness of cylindrical shells and design of end closures as	6 Hrs.	C03

	per code, nozzles and openings in pressure vessels, reinforcement of openings in shell and end closures - area compensation method, Supports for vessels-bracket, leg, skirt and saddle support		
4	**Fundamentals of piping design**		
	Codes & standards for piping engineering & design, piping material specifications and piping elements viz. pipes, fittings, flanges, gaskets, bolting, valves etc. Types of valves, Piping drawing layout and instruments diagram, Equipment layout, Basic of flow through pipes, Pipe sizing & piping hydraulics, Head sizing & piping hydraulics. Process mechanical equipments-Horizontal vessel, Vertical vessel, Storage tanks, Heat exchangers, Re-boiler, Towers and columns, Pumps, Compressors, Fans & Blowers, Steam & Gas turbines.	6 Hrs.	C04
5	**Piping Design**		
	Flow diagram, Piping layout and piping stress analysis; Flexibility factor and stress intensification factor; Design of piping system as per B31.1 piping code. Piping components - bends, tees, bellows and valves, design of process piping requirements as per ASME b31.3, protection of pipe and insulations, pipe design calculations, materials, size & wall thickness, hydraulic design of piping systems	6 Hrs.	C05
6	**Design of pipe supports**		
	Types and functions of support, Anchors, Pipe guides, Limit stops, Pipe shoe, Dummy leg/ Trunion, Field support/ Base support, Rigid hangers, Pipe Rack and Yard piping Design, Flexible & Resilient support, Variable & Constant load.	6 Hrs.	CO6

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No.
1	Process Equipment Design	M.V.Joshi & V.V. Mahajani	MacMillan, India Ltd., 1996	
2	Design of Piping Systems,	M. W. Kellogg Company		
3	Pipe Stress Engineering,	Liang-Chuan Peng and Tsen-Loong Peng	ASME Press	
4	Introduction to Pipe Stress Analysis,	Sam Kannappan	ABI Enterprise	
5	Pressure Vessels: Design and Practice	Somnath Chattopadhyay	CRC Press	

Reference Books

Sr. No.	Title of Book	Authors	Publication House
1	Pressure Vessel Design	Donatello Annaratone	
2	Pressure Vessels Design	J. F. Hanvey	Von Nostrand Co. Ind., 1963
3	ASME code Section 8th div 1, div 2		
4	Pressure Vessel Design Manual,	Demis R. Moss	Gulf Publishing Co., Houston, 1987
5	IS 2825		
6	Hand Book of Piping Design	Sahu G.K.	New Age International (P) Ltd. 1998,

INDUSTRIAL ENGINEERING AND OPERATION RESEARCH (ME405C)

Teaching Scheme		Examination Scheme	
Lectures:	**3** Hrs. / Week	**CIA:**	**20 Marks**
		In sem Exam:	**30 Marks**
Credits:	**3**	**End Sem Exam:**	**50 Marks**
		Total:	**100 Marks**

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Prerequisite Course: Physics, Mathematics, Basics' of Engineering Knowledge of machines used in manufacturing organizations.

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Course Objectives:

1. To understand and apply tools and techniques, management principles, management practices of industrial engineering, in to manufacturing organization.
2. To understand concepts of an Organization, Engineering Productivity, Productivity improvement programme, Wages and incentives, Concept of wages, factors affecting wages, Job evaluation, merit rating, Numerical on Productivity.
3. To understand and apply concepts of Method Study, Steps, Tools and Techniques used in the Method Study, outline Process Chart, Principles of motion economy.
4. To understand and apply various basic concepts of Work Measurement, Calculation of Standard Time. Work Sampling, CPM, PERT and its Numerical.
5. To understand and apply Motivation Theories and Leadership Theories Managerial grid, professional and business ethics.
6. To study and understand basic concepts of entrepreneurship development like characteristics of successful entrepreneurs, sources of finance, record keeping system, analysis financial performance, break even analysis, technology and business, strategies for business growth, concept related to start-up and intellectual property rights (IPR).

Course Outcomes (COs): On completion of the course, learner will be able to –

COs	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Summarize the contribution of peoples to management.	2	Apply
CO2	Determine, differentiate between two employees on the basis of productivity.	3	Apply
CO3	Apply best suitable method of doing job in selected organisation.	3	Apply
CO4	Calculate most optimum time of doing job in selected organization with selected method using work study's various tools and techniques.	3	Apply
CO5	Determine Various Motivation Theories And Leadership Styles Applicable To An Organization Under Consideration.	3	Apply
CO6	Apply various entrepreneurship development skill, characteristics, and strategies for business growth.	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	2	1	2	2	3	2	3	3	3	3	1	1	1	1	1
CO2	3	3	2	3	3	3	3	3	3	3	1	1	1		
CO3	3	3	2	2	3	3	3	3	3	3	1	2	1	1	1
CO4	3	2	2	2	2	3	2	2	2	2	1	2	2	2	3
CO5	1	2	2	3	2	3	2	3	3	2	3	1	1		
CO6	1	2	1	3	2	2	2	3	3	2	3	2	2		

Course Contents

Unit	Contents	No.of Hours	COs
1	**Unit-I**		
	Industrial Engineering: History, Development, Definition, Functions & Applications of Industrial Engineering. Tools and techniques of Industrial Engineering, Introduction to work study and work content. **Evolution of Management Practices:** Characteristics, objectives Functions, Principles and Types of Management., Scientific Management-Contribution of F. W. Taylor, Henry Fayol Gantt, Maynard and Indian contributors to the Management thought.	8 Hrs.	CO1
2	**Unit-II**		
	Organization: Definition, Principles, Function and Types of organization structure, Different forms of Business—Proprietor, Partnership Firm, Private & Public limited company, Cooperative, Private & Public Trusts. **Productivity Engineering Productivity**: factor productivity, total productivity; labor Productivity, measurement of Productivity, Productivity improvement techniques. Productivity improvement programme. Wages and incentives: Concept of wages, factors affecting wages, Job evaluation, merit rating, Numerical On Productivity.	6 Hrs.	CO2
3	**Unit – III**		
	Method Study Steps, Tools and Techniques used in the Method Study, outline Process Chart, Flow process Chart, Symbols, Flow Diagrams, Two Handed Chart, String diagram, Multiple Activity Chart, 5W and 1 H, Use of Motion Pictures and its analysis SIMO chart, cyclograph Chronocylegraph. Developing, Presentation, Installation & Maintenance of new Methods. Principles of motion economy.	6 Hrs.	CO3
4	**Unit – IV**		
	Work Measurement Time Study: Aim & Objectives, Terminology & Tools, and Use of stopwatch procedure in making Time Study. Time Study Forms, Performance rating, allowances and its types. Calculation of Standard Time. Work Sampling: Introduction to work sampling. Determinations of Standard time using work Sampling. Synthetic & Standard data Methods: Concepts, Introduction to PMTS, MTM1, WFS, and Basic Motion Time Study. MTM2 & Other second Generation Methods, MOST and other	6 Hrs.	CO4

Unit	Contents	No.of Hours	COs
	advanced work measurement techniques. **CPM, PERT And its Numerical.**		
5	**Unit –V**		
	Motivation: Human Needs and Types of Motivation, Theories of Motivations- Maslow's theory, McGregor's Theory of X and Theory of Y, Herzberg's Theory of two factor, David C .McClelland's, Theory of Achievement, Expectance/valence Theory of Victor Vroom, Porter & Lawler's Model. Group dynamics: Types, characteristics, objectives of Group Dynamics **Leadership:** Definition, styles & functions of leadership, qualities for good leadership, role of the leader, Theories of leadership, Managerial grid, professional and business ethics.	6 Hrs.	CO5
6	**Unit –VI**		
	Entrepreneurship development: Characteristics of successful entrepreneurs, communications skill, problem solving skill and process, Basic element of Business plans, Sources of finance, Selection of Business location, Record keeping system, Analysis financial performance, Break even analysis, Technology and Business, Strategies for Business Growth, Concept related to start-up and Intellectual Property Rights (IPR).	8 Hrs.	CO6

Text Books:-

Sr. No.	Title of Book	Authors	Publication House	Accession Number
1.	Industrial Engineering and Production Management	M. Telsang	S. Chand Publication	ISBN 81 219 1773 5.
2.	Work Study	O. P. Khanna	Dhanpat Rai Publications	
3.	Industrial Organisation & Engg. Economics	Banga & Sharma	Khanna Publishers	ISBN 81-7409-078-9.

4.	Principles & Practices of Management	Chabra T. N.	Dhanpat lal & compony	
5.	Industrial Engineering and Production Management	Mahajan M.	Dhanpat Rai and Sons Publishers	ISBN-81-7700-047-0.

Reference Books:

Sr. No.	Title of Book	Authors	Publication House	Accession Number
1.				
2.	Introduction to Work Study		ILO Universal Pub	ISBN 81 85027 06
3.	Motion and Time Study: : Design and Measurement of Work	Ralph M. Barnes	J. Wiley & Sons.	
4.	Essentials of management	Koontz Harold and Weihrich Heinz	Tata McGraw Hill publishing	ISBN 0-07-0623030-x.
5.	Organizational Behaviour	Luthans f**.**	McGraw-Hill Company	ISBN 81-317-05021
6.	Entrepreneurship: Ideas in Action	Cynthia L. Greene	Thomson	ISBN-981-243-257-1

ADVANCED MATERIALS AND TECHNOLOGY (ME405D)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**CIA**	20 Marks
		Insem Exam:	30 Marks
		End Sem Exam:	50 Marks
Credits:	**3**	**Total:**	100 Marks

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Prerequisite Course: Material Science and Metallurgy

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Course Objectives:

1. To study the nonferrous metals and alloys.
2. To understand different composite materials for engineering applications.
3. To make aware of various methods in Surface Modification Technology.
4. To understand Powder Metallurgical Technology and its engineering applications.
5. To study the different nanomaterials and their applications.
6. To study the biomaterials for various biomedical applications.

Course Outcomes (COs): At the end of the course, learner will be able to

COs	Course Outcomes	Blooms Taxonomy	
		Level	**Descriptor**
CO1	**Discuss** Classification, importance, composition, properties and applications of nonferrous metals and alloys.	2	Understand
CO2	**Apply** the rule of mixtures to calculate the mechanical properties such as modulus of elasticity of composite Materials.	2	Understand
CO3	**Predict** suitable surface modification methods for a stated application.	3	Apply
CO4	**Explain** various steps involved in powder metallurgical technology and its engineering applications.	3	Apply
CO5	**Describe** various synthesis and processing methods and applications of nanomaterials.	3	Apply
CO6	**Predict** suitable biomaterials for various biomedical applications.	2	Understand

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	-	-	1	2	2	-	1	1	-	-
CO2	2	1	-	-	-	-	-	1	2	2	-	1	1	-	-
CO3	2	-	-	-	-	-	-	1	2	2	-	1	1	-	-
CO4	2	1	-	-	-	-	-	1	1	2	-	1	1	-	-
CO5	2	1	-	-	-	-	-	1	2	1	-	1	1	-	-
CO6	2	1	-	-	-	-	-	1	2	2	-	1	1	-	-

Course Contents

Unit	**Contents**	No. of Hours	COs
1	**Non Ferrous Metals and Alloys**		
	Classification of nonferrous metals. Importance of nonferrous metals in engineering applications & compositions, study of different mechanical properties: Cu & Cu based alloys, Al and Al based alloys, Ni and Ni based alloys, Co and Co based alloys, Titanium & its alloys, Tin & Lead base alloys, Bearing materials: important properties & applications.	6 Hrs.	CO1
2	**Composite Materials**		
	Introduction to Composite Materials, Classification, Particle reinforced composites, fiber reinforced composites-influence of fiber length, influence of fiber orientation and concentration, fiber phase, matrix phase, Polymer matrix composites, Metal matrix composites, Ceramic matrix composites,Carbon carbon composites, Hybrid composites, Structural composites-Laminar, sandwich panel, Numericals.	6 Hrs.	CO2
3	**Surface Modification Technology**		
	Importance of surface modification, classification of different methods & factors affecting : electroplating , PVD , CVD ,IVD, powder coating, shot blasting, ion implantation, plasma nitriding , anodizing, Surface preparation before coating & coating defects.	6 Hrs.	CO3
4	**Powder Metallurgical Technology**		
	Basic steps of powder metallurgy process, classification & methods of powder manufacturing, characteristics of metal powders, Conditioning of metal powders (Screening, Blending & mixing, annealing), Compaction techniques (cold compaction, hot compaction, Isostatic compaction & powder rolling) , mechanism & importance of sintering , Pre-sintering & sintering secondary operations Advantages, limitations and applications of powder metallurgy. Production of typical P/M components (with flow charts), self-lubricated bearing, cemented carbides, cermets, refractory metals, electrical contact materials, friction materials, and diamond impregnated tools, friction plate,	6 Hrs.	CO4

	clutch plate, commutator brushes.		
5	**Nanotechnology and Nanomaterials**	6 Hrs	CO5
	Introduction to nanotechnology and nanomaterials, Classification of Nanomaterials, nanomaterial synthesis and processing, Methods for creating nanostructures-Mechanical grinding, Sol-gel process, Gas Phase synthesis of nanomaterials: Furnace method, Gas Condensation Processing, Laser ablation, Properties of Nanomaterials-Optical properties, Electrical Properties, Mechanical Properties, Magnetic properties, Selected Application of nanomaterials-Fuel cells, Nanocatalysts, Nanosensors, Tougher and harder cutting tools, high energy density batteries for electric vehicles, Advantages and disadvantages of Nanomaterials		
6	**Biomaterials**	6 Hrs	CO6
	Introduction Requirements for biomaterials Dental materials Cavity fillers Bridges, crowns and dentures Dental implants The structure of bone and bone fractures Replacement joints Hip joints Shoulder joints Knee joints Finger joints and hand surgery Reconstructive surgery Plastic surgery Maxillofacial surgery Ear implants Biomaterials for heart repair Heart valves.		

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Material Science and Metallurgy	Kodgire V. D.	Everest Publishing House	
2.	Material Science & Engg	Raghvan V	Prentice Hall of India, New Delhi	

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Materials Science and Engineering	William D. Callister, R.Balasubramanium	Wiley India (P) Ltd.	
2.	Mechanical Metallurgy	G.E. Dieter	McGraw Hill International New Delhi	
3.	Materials Science & Engineering	Donald Askeland and Pradeep Fulay	Cengage Learning	

LAB-I FINITE ELEMENT ANALYSIS (ME406)

Teaching Scheme		Examination Scheme	
Practical:	2 hrs/week	**Practical Exam:**	50 Marks
Credits:	**1**	**Total:**	50 Marks

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Prerequisite Course: Numerical Methods, Solid Mechanics, Theory of Elasticity, Engineering Mathematics, Statistical Methods

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Course Objectives:

1. To familiarize students with the displacement-based finite element method for displacement and stress analysis and to introduce related analytical and computer tools.
2. It provides a bridge between hand calculations based on mechanics of materials and machine design and numerical solutions for more complex geometries and loading states.
3. It provides some experience of using commercial finite element analysis software to solve complex problems in solid mechanics

Course Outcomes (COs): At the end of the course, learner will be able to

COs	Course Outcomes
CO1	Examine and calculate element stiffness matrices and load vectors for 1-D and 2-D element to analyze displacements and stresses in 1-D and 2-D structures
CO2	Carry out Stress and Deflection Analysis of 1-D and 2-D structures like plate, beam and bars using FEA software
CO3	Carry out Buckling, vibration and thermal analysis of simple engineering structures.

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	1	1	2	2	2	--	2	3	3	--
CO2	3	2	2	2	3	1	1	2	2	2	--	2	3	3	--
CO3	3	2	2	2	3	1	1	2	2	2	--	2	3	3	--

Course Contents

Sr. No.	List of Experiments
	Any Six from following List 1. Stress and Deflection Analysis of 1D Beam using FEA software 2. Stress and Deflection Analysis of 2D /3D truss using FEA software 3. Stress and Deflection Analysis of stepped bar/beam using FEA software 4. Stress and deflection analysis of 2D plate [Plain stress FEA] 5. Stress and deflection analysis of 2D axisymmetric component {Cylindrical Pressure vessel analysis] 6. Modal analysis of any machine component using FEA software 7. Buckling analysis of beam using FEA software 8. 2D Steady state Thermal analysis using FEA software [Composite Plate]
	Software based assignments: 9. Computer program for stress analysis of 2-D truss subjected to plane forces 10. Computer program for 1-D temperature analysis

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1	A First Course in the Finite Element Method	Daryl L. Logan	Logan, 2007	
2	Finite Element Analysis	G Lakshmi Narasaiah	B S Publications	
3	Text book of Finite Element Analysis	P. Seshu	PHI Learning Private Ltd. , Delhi	
4	Introduction to Finite Elements in Engineering	Chandrupatla T. R. and Belegunda A. D	Prentice Hall India	

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Fundamental of Finite Element Analysis	David V. Hutton	Tata McGraw-Hill	
2.	Finite Element Procedures	Bathe K. J.,	PHI (P) Ltd., New Delhi	
3.	Concepts and Applications of Finite Element Analysis	R. D. Cook	Wiley, India	

LAB-II HEATING, VENTILATION AND AIR CONDITIONING (ME407)

Teaching Scheme		Examination Scheme	
Practical:	2 Hrs./ Week	**PR Exam:**	50 Marks
Credits:	**1**	**Total:**	50 Marks

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Prerequisite Course: Basic Thermodynamics and Heat Transfer

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Course Objectives:

1. To Demonstrate the working of domestic refrigerator and Split Air conditioning systems.
2. To Estimate and analyze the cooling capacity, COP, Power of a VCR system.
3. To Estimation of COP of vapour absorption refrigeration system.
4. To Estimate cooling and heating load of building.
5. To Design of a duct and selection of air terminal devices for air conditioning systems.
6. To Demonstrate the working of Variable Refrigerant Volume/ Variable Refrigerant Flow Systems.

Course Outcomes (COs): At the end of the course, learner will be able to

CO's	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	**Demonstrate** working of domestic refrigerator and Split Air conditioning systems.	2	Understand.
CO2	**Estimate** and analyze the cooling capacity, COP, Power of a VCR system	3	Apply
CO3	**Determine** cooling and Heating load of building using software.	3	Apply
CO4	**Determine** duct sizes and selection of air terminal devices using software	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	3	3	-	-	-	-	3
CO2	3	2	-	-	-	-	-	-	3	3	-	-	-	-	3
CO3	3	2	-	-	2	-	-	-	3	3	-	-	-	-	3
CO4	3	2	-	-	2	-	-	-	3	3	-	-	-	-	3

List of Practicals

Pr No	**Description**	**No.of Hours**	**COs**
1.	Demonstration of a domestic refrigerator and Split Air conditioner along with different auxiliary systems associated with a refrigerator and Split Air conditioner.	02 Hrs.	CO1
2.	Trial on Vapour Compression Refrigeration System to determine cooling capacity and coefficient of performance.	02 Hrs.	CO2
3.	Trial on Ice Plant test rig to determine Coefficient of Performance.	02 Hrs.	CO2
4.	Trial on Air conditioning test rig to study the psychrometric processes.	02 Hrs.	CO2
5.	Trial on Vapour Absorption Refrigeration System.	02 Hrs.	CO2
6.	Cooling and Heating load calculation of Building using suitable software. (Hourly Program Analysis,E-20 Sheet, Energy plus Software)	02 Hrs.	CO3
7.	Calculation of Duct Sizes and selection of Air Terminal Devices by Using suitable software.	02 Hrs.	CO3
8.	Demonstration of Variable Refrigerant Volume/ Variable Refrigerant Flow Systems	02 Hrs.	CO2
9.	Visit to cold storage plant.	02 Hrs.	CO2

Books

S.N.	Title of Book	Authors	Publication House	Accession No
1.	Refrigeration and Air conditioning	Arora, C.P	Tata-McGraw Hill	
2.	Basic Refrigeration and Air Conditioning	P .N. Ananthanarayanan	McGraw Hill	
3.	Refrigeration and Air conditioning.	Manohar Prasad	New Age International	
4.	Elementary Refrigeration and Air-conditioning	Stoecker, W.F., and Jones, J.W.,	McGraw Hill , 2002	
5.	Principle of Refrigeration	Roy J.Dossat	Wiley Eastern limited, 1987 Third Edition	

LAB-III DYNAMICS OF MACHINES (ME408)

Teaching Scheme		Examination Scheme	
Practical:	2 Hrs./ Week	OR Exam :	50 Marks
Credits:	1	Total:	50 Marks

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Prerequisite Course: (if Any) Machine Design, Strength of Materials, and Applied Mechanics, Kinematics of Machines

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Course Objectives:

1. To Provide fundamentals of vibration and noise so that the students can solve real engineering problems and design engineering systems.
2. To Make students able to prepare a mathematical model of the mechanical system in the form of spring, mass and damping elements.
3. To Provide knowledge of gyroscope, flywheel and governor
4. To Make aware about the instrumentation used for measurement of vibration and noise
5. To Provide fundamentals of balancing of rotating and reciprocating masses
6. To Provide knowledge of free and forced vibrations

Course Outcomes (COs):At the end of the course, learner will be able to

CO's	Course Outcomes	Blooms Taxonomy	
		Level	**Descriptor**
CO1	Demonstrate the experimental verification of dynamic balancing and gyroscopic couple/governor/moment of inertia	4	Apply, Mechanism
CO2	Perform analysis of vibratory system to determine its natural frequency	5	Apply, Complete overt response
CO3	Conduct measurement and analysis of vibration and noise for machines and equipment	4	Apply, Mechanism

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	3	2	-	-	1	2	2	-	2	2	-	-
CO2	3	2	3	2	2	2	-	2	2	2	-	2	3	-	-
CO3	3	3	2	2	2	2	-	2	2	2	-	2	2	-	-

List of experiments

Pr. No	Description	CO	PO
1.	Balancing of wheel / rotor on computerized balancing machine and experimental verification of dynamic balancing of rotating masses in different planes	CO1	PO1-5.8-10,12,PSO1
2.	Verification of principle of gyroscope and determination of gyroscopic couple magnitude	CO1	PO1-5.8-10,12,PSO1
3.	Determine the effect of varying mass on the centre of sleeve in Governor	CO1	PO1-5.8-10,12,PSO1
4.	Determination of moment of Inertia by using compound pendulum method	CO1	PO1-5.8-10,12,PSO1
5.	Determination of natural frequency of damped vibration of single degree freedom system and to find it‘s damping coefficient.	CO2	PO1-6.8-10,12,PSO1
6.	Determination of critical speed of shaft with single rotor.	CO2	PO1-6.8-10,12,PSO1
7.	Verification of natural frequency of torsional vibration of two rotor system and position of node	CO2	PO1-6.8-10,12,PSO1
8.	Determination of natural frequency of transverse vibration of beam using vibration analyzer and using virtual lab.	CO3	PO1-6.8-10,12,PSO1
9.	Measurement and analysis of noise using vibration analyzer.	CO3	PO1-6.8-10,12,PSO1
10.	Simulation of free response of SDOF damped system to demonstrate different damping conditions using suitable software numerically.	CO2	PO1-6.8-10,12,PSO1

At least eight experiments should be performed from the above list

Text Books

Sr. No.	Title of Book	Authors	Publication House
1	Theory of Machines	S. S. Rattan	McGra-Hill
2	Theory of Machines	T Beven	CBS Publishers
3	Mechanical Vibrations	Grover G. K.	New Chand and Bros. , Roorke
4	Mechanical Vibrations	S. S. Rao	Pearson Education Inc. New Delhi.
5	Mechanical Vibrations	V. P. Singh	Dhanpat Rai and Co.
6	Vibration and Noise for Engineers	Kewal Pujara	Dhanpat Rai and Co.

Reference Books

Sr. No.	Title of Book	Authors	Publication House
1	Vibration of Mechanical System	Alok Sinha	Cambridge university Press , India
2	Vibration Problems in engineering.	Weaver	Wiley India Pvt. Ltd, New Delhi.
3	Mechanical Vibration	William J Palm III,	Wiley India Pvt. Ltd, New Delhi
4	Engineering Vibration	Daniel J. Inman	Pearson Education Inc.

MANDATORY LEARNING COURSE-VII - FINANCIALLY SMART (MC410)

Teaching Scheme		Examination Scheme	
Lectures:	1 Hrs. / Week	**CIA**	-
Practical:	-	**In Sem Exam:**	-
Credits:	**Non Credit**	**End Sem Exam:**	-
		Total:	-

Personal Financial Literacy Program for Young Adults - Being Financially Smart	
•A- Google Survey – Pre-session (via email)	
•Unit 1 - Behavioural Finance - 3 hours	**•Unit 2 -Money Management Skills - 3 hours**
•Section 1 – Let's Talk Money	•Section 1 – Important Concepts
•1. Psychology of Money	•1. Saving vs Investing
•2. Your Relationship with Money	•2. Inflation
•3. Human Behaviour in Financial Markets	•3. Power of Compounding
•Section 2 –Why Financial Literacy?	•Section 2 – Money Management Techniques
•4. Importance of Financial Literacy	•4. S.M.A.R.T.E.R way to Wealth
•5. Costly Money Mistakes	•5. 6 - Money Jar Method
Micro-Project 1 - Exercise	
•Unit 3 - Steps of Financial Planning - 3 hours	**•Unit 4 – Risk & Investment Management - 3 hours**
•Section 1 – Let's Start Planning	•Section 1 - Risk Management
•1. Need & Components of Financial Planning	•1.Understanding Risk Management
•2. Personal Income Statement– Cashflow Mgt & NetWorth Mgt.	•2. Life Insurance
•3. S.M.A.R.T Goal Setting	•3. Health Insurance
•Section 2 - Goal Based Investment Planning	•Section 2 - Investment Management
•4. Contingency/Emergency Fund Planning	•4. Asset Allocation
•5. Lifestyle/ Retirement Planning	•5. Mutual Funds - Overview
•6. Estate Planning	•5. Review & Action
Micro-Project 2 - Case Study	
• Unit 5 – Introduction to Business Finance - 3 hours	
•How to Read an Income Statement	
•How to Read a Balance Sheet	
Micro-Project 3 - Case Study	
B- Google Survey (via email)	
Post -session: - 1. Evaluation 2. Feedback 3. Certification	