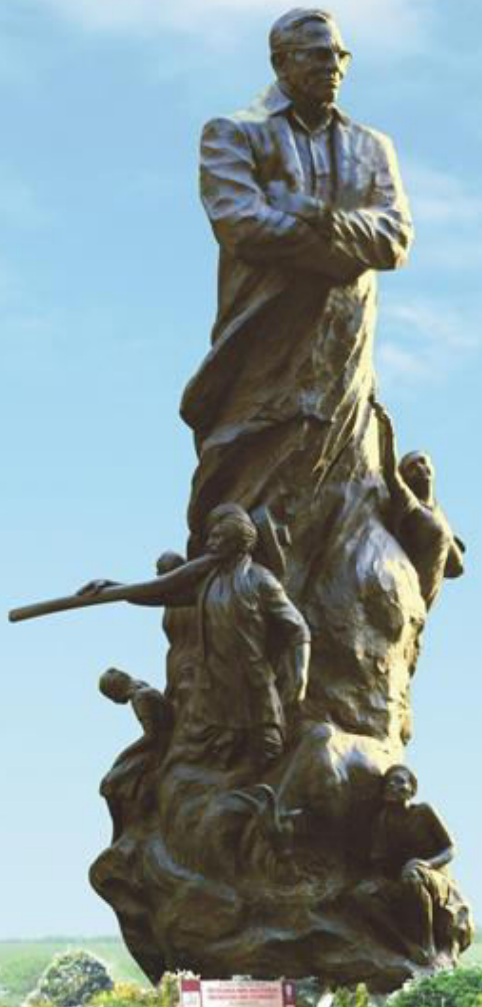
An Autonomous Institute

Shree Warana Vibhag Shikshan Mandal's

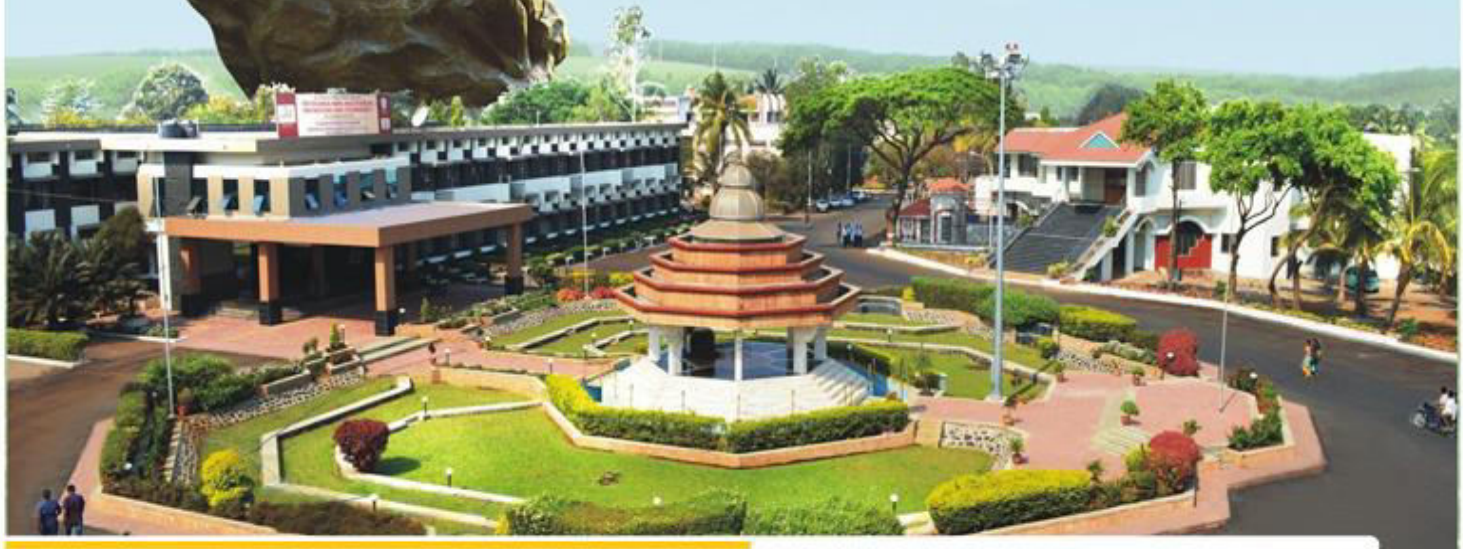
Tatyasaheb Kore Institute of Engineering And Technology, Warananagar

NBA Accredited Institute



Department of Mechanical Engineering

Final Year B. Tech. Mechanical Engineering - 2023-24



B. Tech. In Mechanical Engineering

Syllabus Structure and Curriculum under Autonomy

SWVSM'S

Tatyasaheb Kore Institute of Engineering and Technology, Warananagar

An Autonomous Institute

Abbreviations

Sr.No.	Acronym	Definition
1	ISE	In-Semester Examination
2	ISE-I	In-Semester Examination-I
3	ISE-II	In-Semester Examination-II
4	ESE	End Semester Examination
5	ISA	In-Semester Assessment (Term Work)
6	L	Lecture
7	T	Tutorial
8	P	Practical
9	CH	Contact Hours
10	C	Credit

Course/ Subject Categories

Sr.No.	Acronym	Definition
1	BSC	Basic Science Course
2	HSC	Humanity Science Course
3	ESC	Engineering Science Course
4	PCC	Professional Core Course
5	OEC	Open Elective Course
6	MC	Mandatory Course
7	PEC	Professional Elective Course
8	PW	Project Work (Mini and Major Project)
9	II	Industrial Internship

Course/ Subject Code

M	E	7	0	1
Branch Code		Semester	Course Number	

Course Term work and POE Code

M	E	7	0	1	T/P / A
Branch Code		Semester	Course Number		T- Term work P- POE A- Audit Course

Tatyasaheb Kore Institute of engineering and Technology, Warananagar
An Autonomous Institute
Department of Mechanical Engineering

❖ Vision

To become an academy of excellence in technical education and human resource development.

❖ Mission

- To develop engineering graduates of high repute with professional ethics.
- To excel in academics and research through innovative techniques.
- To facilitate the employability, entrepreneurship along with social responsibility.
- To collaborate with industries and institutes of national recognition.
- To inculcate lifelong learning and respect for the environment.

❖ Quality Policy

To promote excellence in academic and training activities by inspiring students for becoming competent professionals to cater industrial and social needs.

Tatyasaheb Kore Institute of engineering and Technology, Warananagar
An Autonomous Institute
Department of Mechanical Engineering

PROGRAM EDUCATIONAL OBJECTIVES

Graduates will be able to,

[1] Make successful careers in Indian and multinational companies
[2] Be competent with strong technological background to solve industrial and societal problems
[3] Succeed in a post graduate as well as research programs.
[4] Be sensitive towards professional ethics and environmental issues.
[5] Lead teams for executing multidisciplinary projects

PROGRAM OUTCOMES

After completion of the Program, graduates will have,

[1] An ability to apply knowledge of mathematics, science and engineering fundamentals to solve complex Mechanical engineering problems
[2] An ability to analyze the mechanical problem, interpret data through synthesis and evaluate to make conclusion
[3] Capability to solve complex engineering problems and design system components or processes as per specified requirements addressing public health, safety, cultural, societal and environmental issues
[4] An ability to identify the problems and apply the research methodology to formulate, investigate and validate the outcomes.
[5] An ability to make use of advanced techniques and tools necessary in engineering practices
[6] An ability to understand societal, health, safety, legal and cultural issues while providing solutions for mechanical engineering problems
[7] An ability to develop sustainable solutions and identify with their effects on society and environment
[8] An apply ethical principles and commit to professional ethics and responsibilities of the engineering practice
[9] An ability to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
[10] An ability to comprehend technical ideas, communicate through effective design documentation and oral presentation.
[11] An ability to lead and manage multidisciplinary teams by applying engineering and management principles.
[12] An ability to engage in independent and life - long learning in the broadest context of advancement in technology.

PROGRAM SPECIFIC OUTCOMES

[1] Graduates will be able to model and analyze the machine design problems.
[2] Graduates will be able to demonstrate the working of energy conversion devices.
[3] Graduates will be able to manufacture the products using different machine tools.

Final Year B. Tech. In Mechanical Engineering

Syllabus Structure under Autonomous Status of TKIET, Warananagar

2023-24

Tatyasaheb Kore Institute of Engineering and Technology,Warananagar

Final Year B. Tech. (Mechanical Engineering)

Semester-VII

(To be implemented from 2023-24)

Credit Scheme

Course Code	Category	Course Title	Teaching and Credit Scheme					Examination & Evaluation Scheme		
			L	T	P	CH	C	Component	Marks	Min for Passing
ME701	PCC	Refrigeration and Air Conditioning	2	--	--	2	2	ESE	60	24
								ISE	40	16
ME702	PCC	Mechanical System Design	3	--	--	3	3	ESE	60	24
								ISE	40	16
ME703	PCC	Finite Element Analysis	3	--	--	3	3	ESE	60	24
								ISE	40	16
ME7041	PEC-III	Automobile and Electric Vehicles Engineering	2	--	--	2	2	ESE	60	24
								ISE	40	16
ME7042		Production Management						ESE	60	24
								ISE	40	16
ME7043		Computational Fluid Dynamics						ESE	60	24
								ISE	40	16
ME7051	PEC-IV	Industrial Product Design	2	--	--	2	2	ESE	60	24
								ISE	40	16
ME7052		Total Quality Management						ESE	60	24
								ISE	40	16
ME7053		Research Methodology						ESE	60	24
								ISE	40	16
ME701T	PCC	Refrigeration and Air Conditioning Lab	--	--	2	2	1	ISA	25	10
								POE	25	10
ME702T	PCC	Mechanical System Design Lab	--	--	2	2	1	ISA	25	10
								POE	25	10
ME703T	PCC	Finite Element Analysis Lab	--	--	2	2	1	ISA	25	10
ME7041T	PEC-III	Automobile and Electric Vehicles Engineering Lab	--	--	2	2	1	ISA	25	10
ME7042T		Production Management Lab						ISA	25	10
ME7043T		Computational Fluid Dynamics Lab						ISA	25	10
ME706T	IT	Industrial Training -II	--	--	2	2	1	ISA	25	10
ME707T	HSC	Professional Skill Development Lab	--	--	2	2	1	ISA	25	10
ME708T	PW	Project Work Phase-I	--	--	6	6	3	ISA	50	20
								POE	50	20
ME709A	--	Audit Course – VII	--	--	--	--	--	--	--	--
			12	**0**	**18**	**30**	**21**	**--**	**800**	**320**

Tatyasaheb Kore Institute of Engineering and Technology, Warananagar

Final Year B. Tech. (Mechanical Engineering)

Semester-VIII

(To be implemented from 2023-24)

Track – 1 Capstan /Academic Pattern

Credit Scheme

Course Code	Category	Course Title	Teaching and Credit Scheme					Examination & Evaluation Scheme		
			L	T	P	CH	C	Component	Marks	Min for Passing
ME801	PCC	Mechatronics	3	--	--	3	3	ESE	60	24
								ISE	40	16
ME802	PCC	Noise and Vibration	3	--	--	3	3	ESE	60	24
								ISE	40	16
ME8031	PEC-V	Industrial Engineering	3	--	--	3	3	ESE	60	24
								ISE	40	16
ME8032		Energy & Power Engineering						ESE	60	24
								ISE	40	16
ME8033		Tribology						ESE	60	24
								ISE	40	16
ME8041	PEC-VI	Cryogenics	3	--	--	3	3	ESE	60	24
								ISE	40	16
ME8042		Industrial Maintenance Engineering						ESE	60	24
								ISE	40	16
ME8043		Introduction to Drone Technology						ESE	60	24
								ISE	40	16
ME801T	PCC	Mechatronics Lab	--	--	2	2	1	ISA	25	10
								POE	50	20
ME802T	PCC	Noise and Vibration Lab	--	--	2	2	1	ISA	25	10
								POE	50	20
ME805T	PCC	Engineering Economics and Costing	--	--	2	2	1	ISA	50	20
ME806	PW	Project Work Phase- II	--	--	8	8	4	ISA	100	40
								POE	100	40
ME807	PCC	Audit Course VIII	--	--	--	--	--	--	--	--
			12	**--**	**14**	**26**	**19**	**--**	**800**	**320**

Tatyasaheb Kore Institute of Engineering and Technology, Warananagar

Final Year B. Tech. (Mechanical Engineering)

Semester-VIII

(To be implemented from 2023-24)

Track -2 Industrial Internship Pattern

Credit Scheme

Course Code	Category	Course Title	Teaching and Credit Scheme					Examination & Evaluation Scheme		
			L	T	P	CH	C	Component	Marks	Min for Passing
ME801	PCC	Mechatronics	3	--	--	3	3	ESE	60	24
								ISE	40	16
ME802	PCC	Noise and Vibration	3	--	--	3	3	ESE	60	24
								ISE	40	16
ME810	PCC	Industrial Internship	--	--	10	10	5	ISE	75	30
								POE	75	30
ME811	PCC	Industrial Engineering Lab	--	--	2	2	1	ISA	50	20
ME801T	PCC	Mechatronics Lab	--	--	2	2	1	ISA	25	10
								POE	50	20
ME802T	PCC	Noise and Vibration Lab	--	--	2	2	1	ISA	25	10
								POE	50	20
ME805T	PCC	Engineering Economics and Costing	--	--	2	2	1	ISA	50	20
ME806	PW	Project Work Phase- II	--	--	8	8	4	ISA	100	40
								POE	100	40
ME807	PCC	Audit Course VIII	--	--	--	--	--	--	--	--
			6	**--**	**26**	**32**	**19**	**--**	**800**	**320**

ME701 - REFRIGERATION AND AIR CONDITIONING

Lectures	:	2 Hrs/Week	**Evaluation Scheme**		
Credits	:	2	**ISE**	**:**	40 Marks
Tutorials	:	---	**ESE**	**:**	60 Marks

Course Objectives: The objective of the course is to

1. To understand the fundamentals of refrigeration and air conditioning.
2. Study of various refrigeration cycles and evaluate performance using PH charts and/or refrigerant property tables.
3. Understand the basic air conditioning processes on psychrometric charts, calculate cooling load for its applications in comfort and industrial air conditioning

Course Outcomes:

Cos	At the end of successful completion of the course, the student will be able to	Blooms Taxonomy
CO1	Know the working principle of different types refrigeration system	Knowledge
CO2	Explain different air conditioning systems & Air distribution system with its components and functions	Knowledge
CO3	Compare the different types of refrigerants with their thermodynamic, physical, economical properties and their effects on environment	Understand
CO4	Calculate performance parameters of Vapour compression refrigeration cycle at different operating conditions	Apply
CO5	Find the suitable combinations of psychrometric processes for different air conditioning applications.	Analyze
CO6	Estimate cooling and heating load calculations for the air conditioning system design by using psychrometric principle	Apply

Description:

The refrigeration process removes heat from an enclosed space to reduce and maintain the temperature for the contents of that space while Air conditioning is the heating, cooling, dehumidification, humidification, ventilation, and sterilization of air,

This Course covers different types of refrigeration systems with respect to application as well as conventional and unconventional refrigeration systems. Thermodynamically analyzes refrigeration and air conditioning systems and evaluates performance parameters. Apply the principles of Psychometrics to design the air conditioning loads for the industrial applications.

Prerequisites:	1:	Applied Thermodynamics
	2:	Heat and Mass Transfer
	3:	Fluid properties and Fluid dynamics,

Unit 1	**Application of second law of thermodynamics: Introduction to refrigeration**	
	Refrigeration definition, Applications of second law of thermodynamics: Heat engine, refrigerator, Heat pump. Performance Index of these machines, Thermal Efficiency, COP, EER, Refrigeration Capacity, Ton of refrigeration Numerical on second law of thermodynamics.	**05 Hrs**
Unit 2	**Refrigeration Systems**	
	(A) Air refrigeration system Open cycle And Closed cycle air refrigeration, Reversed Carnot cycle operating on air refrigeration system, Bell Coleman Cycle/Reversed brayton cycle, advantages and limitations of Air refrigeration system. Need of cooling for aircraft, refrigeration systems for aircraft **(B) Vapour Compression Refrigeration system** Simple vapor Compression refrigeration system, PH Chart, VCR cycles, Theoretical Analysis of VCR cycle, Effects of condenser pressure, evaporator pressure on the performance of VCR cycle, Effect of superheating and subcooling on performance of VCR cycle. Actual VCR Cycle Advantages and limitations of VCR System, Numericals on performance of VCR cycle **(C) Vapour Absorption Refrigeration System** required properties for selection of Refrigerant and Absorbent pair, Aqua ammonia absorption refrigeration system Li- Br absorption refrigeration system, PTX Chart, VAR Cycle, difference between VCR system and VAR system	**09 Hrs**
Unit 3	**Refrigerant**	
	Functions, Generations of refrigerant, Classification of refrigerants, ideal refrigerant properties, Desirable properties Thermal and physical properties, refrigerantnomenclature, ODP, GWP, common refrigerants used, future refrigerants	**06 Hrs**
Unit 4	**Psychrometric Properties of Air and Human Comfort**	
	Dry air, Wet Air, Psychrometric properties, derivations of Psychrometric properties, Psychrometric Chart, Psychrometric process	**06 Hrs**

	Sensible heating, cooling Humidification Dehumidification ADP, Coil Condition lime, Sensible heat factor, Bypass factor, Air washer and its applications. Concept of human comfort and effective temperature, Comfort Chart	
Unit 5	**Air Conditioning System and Heating and Cooling Load Calculations**	
	Air-conditioning systems: Classification, system components, Comfort Air conditioning – Industrial air conditioning and Requirements – Air conditioning Load Calculations: Design of air conditioning systems, different Heat sources, - Adiabatic mixing of two air streams, sensible heat factor, RSHF, GSHF, ERSHF, Room apparatus dew point and coil apparatus dew point, Ventilation and infiltration, Inside and Outside Design condition. Cooling Load estimation	**07 Hrs**
Unit 6	**Air Distribution System**	
	Re-circulated air, Ventilation air, Duct work, Use of friction loss and rectangular equivalent of round duct chart, duct system, principle of duct sizing, diffusers, dampers, layout, duct systems for theaters, auditorium, hospitals, assembly shop etc. Energy Conservations and Green Buildings, Freeze drying, Pharmaceutical and hospital air conditioning, textile, car air conditioning (plant layout, system components and design conditioning)	**07 Hrs**

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO110	PO111	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	3	--	--	--	--	--	--	--	--	--	--	--	--	2	--
CO2	3	--	--	--	--	--	--	--	--	--	--	--	--	2	--
CO3	3	2	2	--	--	2	--	--	--	--	--	--	--	2	--
CO4	3	3	2	--	--	--	--	--	--	--	--	--	--	2	--
CO5	3	3	2											2	
CO6	3	3	2											2	

References:

Text Books	
1	"Refrigeration and Air conditioning", Khurmi R. S., Gupta J. K, S. Chand Publication (Fifth edition)
2.	" Refrigeration and Air conditioning ", Arora C. P. , Khanna Publishers, New Delhi, 27th Edition.
3.	"Refrigeration and Air conditioning", Manohar Prasad., Willey Eastern Ltd, 1983
4.	"Refrigeration and Air conditioning", Ballaney P.L, Khanna Publishers, New Delhi, 1992
5.	"Basic Refrigeration and Air Conditioning", Ananthanarayanan, McGraw Hill Education 2013
6.	"Refrigeration and Air conditioning", R.K Rajput, S K KATARIA & SONS-NEW DELHI 2013
Reference Books	
1	"Principles of refrigeration,", Dossat Ray J, Willey Eastern Ltd, 2000
2	"Refrigeration and Air conditioning", Stockers W.F and Jones J.W, McGraw Hill International editions 1982.
3	"Air Conditioning Principles and Systems", Edward G. Pita, PHI 2002.
4	ASHRAE & ISHRAE handbook .

Video Lectures 1 to 40. https://archive.nptel.ac.in/courses/112/107/112107208/

ME702 - MECHANICAL SYSTEM DESIGN

Lectures	**:**	3 Hrs/Week	**Evaluation Scheme**		
Credit	**:**	3	**ISE**	**:**	40 Marks
Tutorials	**:**	----	**ESE**	**:**	60 Marks

Course Objectives: The objective of the course is to	
1	To develop understanding of the various design parameters of mechanical Systems
2	To introduce the students about concept of aesthetics, ergonomics and creativity considerations in product design.
3	To provide the knowledge of design of gear box and elaborate the significance of stepped regulation in design of machine tool speed box
4	Study design of various mechanical systems such as pressure vessel, brakes, clutches, I.C. Engine components and material handling systems.
5	To prepare the students to analyze design parameters to design various mechanical systems.
6	List different material handling systems and design of conveyor system.

Course Outcomes:		
COs	**At the end of successful completion of the course, the student will be able to**	**Blooms Taxonomy**
CO1	Identify various design parameters of mechanical Systems	Remember
CO2	Discuss the concept of aesthetics, ergonomics and creativity considerations in product design.	Understand
CO3	Apply engineering principles to design various mechanical systems such as brakes, clutches, I.C. Engine components etc.	Apply
CO4	Explain the theory of material handling systems.	Analyze
CO5	Determine the design parameters to design various mechanical systems.	Evaluate
CO6	Develop working drawing of various mechanical systems such as design of Machine Tool Gear Box, pressure vessel design etc.	Create

Description:		
Mechanical System Design is the course related to design of various systems such as pressure vessel, machine tool gearbox and IC engine components which will help students to design systems related to industries.		
Prerequisites:	1	Engineering Mechanics, Engineering Mathematics.
	2	Analysis of Mechanical Elements
	3	Theory of Machines, Machine design, and IC Engine.

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Section – I		
Unit 1	**Aesthetic and Ergonomic Consideration in Design:** Basic types of product forms, Designing for appearance, shape, Design features, Materials, Finishes, proportions, Symmetry, Contrast etc. Morgon' scolour code. Ergonomic considerations- Relation between man, machine and environmental factors. Design of displays and controls. Practical examples of products or equipment's using ergonomics and aesthetic design principles.	**6 Hrs**
Unit 2	**Pressure Vessel Design** Thin and thick cylinders; Failure criteria of vessels; Lame's equation; Clavarino's and Birnie's equation; Autofrettage and compound cylinders; Types of pressure vessels Horizontal and vertical; Classification of pressure vessel as per IS2825, 1969, Introduction to design of pressure vessels as per IS Codes. Shell and end closures. Effect of opening and nozzles in shell and covers. Types of pressure vessel support.	**7 Hrs**
Unit 3	**Design of Braking and Clutch System** **Brakes:** Design consideration in brakes, Band, Internal expanding shoe, External contracting shoe. Thermal consideration and rating of brakes. **Clutches:** Design requirement of friction clutches, Selection criteria. Torque transmitting capacity of single plate, Multi disc clutch, Cone clutch and Centrifugal clutch	**7 Hrs**
Section – II		
Unit 1	**Design of Gear boxes for machine tool applications** Determination of variable speed range- Graphical representation of speeds- Structure diagram Deviation diagram- Ray diagram- Selection of optimum ray diagram- Difference between number of teeth of successive gears in a change gear box- Analysis of twelve speed gear box Compound ray diagram	**7 Hrs**
Unit 2	**Design of I. C. Engine Components** Introduction to selection of material for I. C. engine components, Design of cylinder and cylinder head, Design of cylinder liners, Design of piston and piston-pins, Piston rings, Design of connecting rod, Design of crank-shaft and crank-pin.	**7 Hrs**
Unit 3	**Design of Material Handling System** Design of belt and chain conveyors – Power requirement, Selection of belt and chain, Design of tension take up unit, Idler pulley.	**6 Hrs**

Mapping of POs & COs:

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

References:	
Text Books	
1	"Design of machine element", V. B. Bhandari, Tata Mc-Graw Hill Publication, 3rd Edition.
2	"Mechanical Engineering Design", Shigley and C. R. Miscke, Tata Mc-Graw Hill Publication.
3	"Machine Tools Design", N. K. Mehta, Tata Mc- Graw Hill Publication, 5thEdition.
Reference Books	
1	"Process Equipment Design", M. V. Joshi ,Macmillal Publication, 3rdEdition.
2	"Mechanical System Design", S. P. Patil, Jaico Publication House, New Delhi, 2nd Edition.
3	Material Handling Equipment's by N. Rudenko, Peace Publication.
Video Link	
1	https://www.udemy.com/course/learning-concepts-of-mechanical-system-design
2	*https://onlinecourses.nptel.ac.in/noc20_ch17/preview*
3	*https://archive.nptel.ac.in/courses/112/105/112105124/*

ME703 - FINITE ELEMENT ANALYSIS

Lectures : 3 Hrs/Week
Credits : 3
Tutorials : ---

Evaluation Scheme
ISE : 40 Marks
ESE : 60 marks

Course Objectives: The objective of the course is to
1. Understand the fundamentals of FEA and its procedure. 2. Solve various types of Engineering problems using various forms of FEA technique. 3. Interpret the results obtained and approach to improve them.

Course Outcomes:

COs	**At the end of successful completion of the course the student will be able to**	**Bloom'sTaxonomy**
CO1	Define the fundamental entities, terminologies and processes involved in FEA.	Knowledge
CO2	Elaborate different types of Elements, their properties and domain of application in FEA.	Understand
CO3	Correlate the parameters of Elements and the desired accuracy of the solution.	Apply
CO4	Implement the conceptsin FEA to formulate the engineering problem.	Apply Analyse
CO5	To solve an engineering problem using FEA approach.	Apply Evaluate
CO6	Interpret the obtained results and improvise on them if necessary.	Apply, Analyse Evaluate

Description:

The course, Finite Element Analysis is offered as the Engineering Science course. The subject deals with simulation of engineering problem using finite element technique and finding out the solution to the problem under consideration. Basically, it determines the behavior of a component under given type of loads and boundary conditions well before its actual manufacturing. This aspect of the subject makes it one of the most essential subject for Mechanical Engineering. It has six unitsnamely, i)Fundamental concepts of FEA ii) One dimensional element iii) Two dimensional element iv) Axisymmetric formulation v) Analysis of Planar Truss and vi) Scalar field problems

Prerequisites:	1:	Basics of Matrices and Heat Transfer
	2:	Analysis of Mechanical elements.
	3:	Design of Machine Elements

SECTION-I		
Unit 1	**Fundamental concepts of FEA**	
	Introduction to FEA, General FEM procedure, Simplification of problem through Symmetry, Various terminologies associated with FEA (Discretization, nodes and element) Stiffness matrix and its properties. Application of FEM in various fields. Advantages and Disadvantages.	**6 Hrs.**
Unit 2	**One dimensional element**	
	Introduction to One dimensional element, Types of One dimensional element, Derivation of Stiffness matrix and Shape function for one dimensional Linear element. Stress analysis of a Stepped bar and Torsion analysis of a shaft using 1 D element.	**8 Hrs.**
Unit 3	**Two dimensional element**	
	Introduction to 2-dimensional element, Derivation of Stiffness matrix and Shape function for 2 dimensional linear elements. Numericals on 2-Dimensional analysis using 2Delements (Constant Strain Triangle)	**8 Hrs.**
SECTION-II		
Unit 4	**Axisymmetric formulation**	
	Introduction & applications of Axisymmetric elements, axisymmetric formulation, finiteelement modeling using triangular element.	**4 Hrs.**
Unit 5	**Analysis of Planar Truss**	
	Introduction to Planar truss, Local and Global coordinate systems, Derivation of Global stiffness matrix, Formulae for calculating L and M, element stiffness matrix and global stiffness matrix, Stress Calculations.	**8 Hrs.**
Unit 6	**Scalar field problems**	
	One dimensional thermal analysis of a Composite Wall, two dimensional steady state heat transfer in two dimensional fins.	**6 Hrs.**

Mapping of POs & COs:

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

References:

Text books	
1	"Introduction to Finite Elements in Engineering"; Chandrupatala-Belgundu, Prentice-Hall India.
2	"Textbook of Finite Elements Analysis", P. Sheshu, Prentice-Hall of India Private Limited, New Delhi.
3	Finite Element Analysis – Theory and Practice"; M.J. Fagan, Longman Scientific &Technical
4	"Finite Element Analysis", UdaiBorker, Nandu Printers & Publishers Pvt. Ltd.Mumbai.
5	"An Introduction to Finite Element Method"; J. N. Reddy; 2/e, McGraw Hill International Editions, ISBN 0-07-112799-2
Reference Books	
1	"Practical Finite Element Analysis", N.S. Gokhale, S.S. Deshpande, S.V. Bedekar, A.N.Thite,Finite to Infinite Publication
2	"Finite Elements Analysis – Theory and Application with ANSYS, Sawed Mouveni, Prentice HallInc.
3	Concepts of Finite Element Methods", ManickaSelvam, SCITECH publication
4	"Applied Finite Elements Analysis", Larry J. Segerlind, BSP Books Pvt. Ltd.

Links for NPTEL Video Lectures and VLAB Experiments in Finite Element Analysis:

Link for Video Lectures:

1. **https://archive.nptel.ac.in/courses/112/105/112105308/#**

ME7041-AUTOMOBILE AND ELECTRIC VEHICLES ENGINEERING

Lectures	**:**	2 Hrs/Week	**Evaluation Scheme**		
Credit	**:**	2	**ISE**	**:**	40 Marks
Tutorials	**:**	--	**ESE**	**:**	60 Marks

Course Objectives: The objective of the course is to

1. Describe importance and basic knowledge of automobiles and electric vehicles.
2. Classify various automobile layouts, bodies, types of transmission system, steering system, braking system, suspension system, EV batteries and motors.
3. Enable students to analyze and solve problems on performance of automobiles and EVs.
4. Create awareness about automobile pollution and its effect on environment.
5. Motivate students to do research in the field of electric vehicles.

Course Outcomes:

COs	At the end of successful completion of the course, the student will be able to	Blooms Taxonomy
CO1	Explain components of automobiles, types of automobile layouts as per drive and different EV configurations.	Remember Understand
CO2	Demonstrate various automobile systems and Electrical- Electronic systems of automobile.	Apply
CO3	Select different power sources for Automobiles and EVs.	Evaluate
CO4	Compare performance of engine powered vehicle and Electric vehicle.	Analyze
CO5	Solve problems on performance of automobiles & EVs and distinguish their performance.	Apply Analyze
CO6	Explain modern trends and techniques in Automobiles and EVs.	Understand

Description:

Automobile and Electric vehicle engineering is offered as professional elective course. In this course students will learn about automobile systems and electric vehicles. Students will get knowledge of automobile layouts, EV configurations, transmission system, suspension system, brakes, wheels, tyres, selection of batteries and motors for electric vehicles, performance of automobiles and EVs.

Prerequisites:	1:	I.C.Engines
	2:	Theory of Machines
	3:	Electrical Technology

Unit 1	**Introduction and transmission system**	
	Automobile history and development, Classification, vehicle layouts- engine location and drive arrangement, specifications of vehicles, Type of vehicle bodies, Clutch – Function and requirements, Classification, Construction and working of Single-plate, Multi-plate, Diaphragm spring and centrifugal clutches, Fluid flywheel. Gear Box – Necessity, classification, construction of manual gear box like Synchromesh, Epicyclic gear train, Automatic transmission, Torque convertor, Electronic transmission control, Overdrive. Propeller shaft, Differential and final drive.	**5 Hrs**
Unit 2	**Steering and Suspension Systems**	
	Live and dead axles, live axle arrangement Steering systems, function, principle of steering, steering gearbox, power steering, collapsible steering. Suspension system- Functions, Sprung and un sprung mass, Types of suspension linkages, types of spring - leaf, coil, air springs, telescopic shock absorber, Air suspension	**5 Hrs**
Unit 3	**Brakes, Wheels and Tyres**	
	Brakes: Need, principle, types, Mechanical, hydraulic and pneumatic brakes disc and drum types, airbrakes, servo and power braking, ABS, Electronic Brake Distribution (EBD). Wheels and Tyres: Wheel construction, alloy wheel, Types, tyre construction, tread design, specification	**4 Hrs**
Unit 4	**Performance and recent trends in Automobiles and Electric Vehicles**	
	Resistance to vehicle motion, Air, Rolling and Gradient resistance, Acceleration, Gradability and draw bar pull, Traction and Tractive effort, Comparison of Traction power requirement for engine powered and electric vehicle propulsion under different road and speed condition, Power required for vehicle propulsion (Numericals on Vehicle resistance, engine power, power to wheels, tractive effort, draw bar pull, overall gear ratio, engine and vehicle speed), Recent Trends : Cruise Control, Adaptive Cruise Control (ACC), Electronic Stability Program (ESP), Traction Control System (TCS), TPMS, ADAS, Hill hold Assist, Park Assist etc.	**5 Hrs**
Unit 5	**Introduction and Batteries for Electric Vehicles**	
	Energy crises, Need of future transportation, Introduction and overview of Electric Drive Technologies and Configurations, Traction power requirement for vehicle propulsion under different road and speed condition. Electrochemical Batteries – Reactions and Thermodynamic, Voltage, Specific power and Energy, Working of Pb-Acid batteries, Ni-Fe, Ni- Cd, Ni-MH Batteries, Li- Polymer, Li-ion, Regenerative Braking for battery charging.	**5 Hrs**

Unit 6	**Electric Motors in Electric Vehicles**	
	Electric Motors used in electric vehicles, DC motors, Induction motors, Permanent Magnet motors, Switched Reluctance motors., Torque –speed characteristics of above mentioned motors, Comparison and its layout in EV, Selection of motor for EV, Motor location and drive from motor to wheels.	**4 Hrs**

Mapping of POs & COs:

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

References:

Text Books	
1	"Automotive Mechanics", William Crouse, Donald Anglin, 10th Edition, McGraw Hill, India.
2	"Automobile Engineering", G.B.S. Narang., 3rd Edition, Khanna Publication
3	"Automobile Mechanics", Dr. N.K.Giri
4	"Modern Electric, Hybrid Electric & Fuel Cell vehicles" Mehrdad Ehsani, 2nd edition, CRC press.
5	"Electric & Hybrid Vehicles" Design fundamentals, Iqbal Husain, CRC press.
Reference Books	
1	"The Motor Vehicle", T.K. Garrett, K. Newton, W. Steeds, 13th Edition, Butterworth Heinemann, New Delhi.
2	"Automotive Mechanics", Joseph Heitner, 2nd Edition, Affiliated Eastern Law House, 1967.
3	"Electric cars: Technology" DelftX eCARS2x, Pavol Bauer, Marnix Wagemaker, TU Delft, The Netherlands
4	"ELECTRIC VEHICLE TECHNOLOGY EXPLAINED" 2nd Edition, James Larminie & John Lowry, WILEY, A John Wiley & Sons, Ltd., Publication.

Web Links/ Video Lectures

Sr. No.	Link
1	https://archive.nptel.ac.in/courses/107/106/107106088/
2	https://www.youtube.com/watch?v=Z8i1ClGy-ak
3	https://www.youtube.com/watch?v=LZ82iANWBL0
4	https://www.youtube.com/watch?v=UgtjRob5qMg&list=PLyqSpQzTE6M9spod-UH7Q69wQ3uRm5thr
5	https://www.youtube.com/watch?v=3E1SXG7VkQk&list=PLyqSpQzTE6M9spod-UH7Q69wQ3uRm5thr&index=2
6	https://www.youtube.com/watch?v=3E1SXG7VkQk&list=PLyqSpQzTE6M9spod-UH7Q69wQ3uRm5thr&index=2
7	https://www.youtube.com/watch?v=FXpAhoZ13r0&list=PLyqSpQzTE6M9spod-UH7Q69wQ3uRm5thr&index=3

ME7042- PRODUCTION MANAGEMENT

Lectures	**:**	2 Hrs/Week	**Evaluation Scheme**		
Credit	**:**	2	**ISE**	**:**	40 Marks
Tutorials	**:**	--	**ESE**	**:**	60 Marks

Course Objectives: The objective of the course is to

1. Understand the product design and development procedure.
2. Study and Analyze different sales forecasting techniques.
3. Study of modern production management tools.

Course Outcomes:

COs	At the end of successful completion of the course, the student will be able to	Blooms Taxonomy
CO1	Prepare the product design procedure of an existing product and judge it on the basis of other products	Remember
CO2	Analyze and point out different sales forecasting techniques.	Understand
CO3	Identify meaning of quality by inferring different parameters to prioritize product value to adopt new changes in a changing circumstance.	Apply
CO4	Anticipate use of modern production management tools.	Understand
CO5	Identify different pillars of TPM in manufacturing industry.	Remember
CO6	Prepare product demand and supply curve.	Understand

Description:

This course is designed to provide basic knowledge of Production planning and productivity improvement Techniques.

Prerequisites:	1:	Knowledge of Industrial management functions.
	2:	Knowledge of mathematical Calculations

Section – I		
Unit 1	**Introduction to Production Management**	
	Production types, Objectives and scope of Production Management, Production Planning and Control (PPC)- Definition and elements and activities of production planning and production control Relevance, Strategy formulation process, Order qualifiers and order winners,	**5 Hrs**
Unit 2	**Product and Process Design**	
	Determinants of process characteristics- Volume, Variety, Flow, Types of processes, Choice of Process, Equipment selection, Use of BEP in selection process- Product matrix. Estimation of Demand- Time series Analysis and causal forecasting techniques, Least square method, Moving average and exponential smoothing forecasting method Role of Product Development in competitiveness, Product Life Cycle (PLC).	**4 Hrs**
Unit 3	**Capacity and Scheduling of Operations**	
	Capacity- Definition, Measure of Capacity, Capacity strategies, Estimation of number of machines, Overcapacity and under capacity factors, Aggregate Planning, Aggregate Planning Strategies, Use of transportation model approach to aggregate planning Loading, scheduling and sequencing, Priority sequencing rules. Sequencing problems, n job 2 machines, n Job '3'machines.	**4 Hrs**
Section – II		
Unit 4	**Supply Chain Management and Advanced Manufacturing Techniques**	
	Concept of supply chain and supply chain management, Manufacturing supply chain, SCM activities, Supply chain strategies, Managing supply chain, Measuring supply chain performance, JIT Philosophy, Origin and core logic of JIT, Elements of JIT, Kanban System-Design of Kanban containers, JIT .Implementation issues and performance.	**5 Hrs**
Unit 5	**Total Productive Maintenance and Replacement**	
	Introduction, Definition, Six big losses, Stages of maintenance, Pillars stages of TPM Development, Overall Equipment Effectiveness (OEE) Computation Replacement - need, Replacement of items whose maintenance cost increases with time (with and without considering time value of money).	**4 Hrs**
Unit 6	**Production Economics**	
	Demand and supply, Demand curve and supply curve, Equilibrium of supply and demand, Elasticity of demand Production function, Factors of production, Review - Time value of money, Cash flows, Evaluation criteria for capital projects.	**4 Hrs**

Mapping of POs & COs:

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

References:

Text Books	
1	"Industrial Engineering and Production Management", Martand Telsang, S Chand and Company New Delhi,(2009).
2	"Production and Operation Management", S. N. Chary, Tata Mcg Graw Hill, 5thEdition.
Reference Books	
1	"Production and Operation Management", Everett E. Adam and Ebert, PHI Publication, ISBN no.9788120308381.
2	"Production and Operations Management", Buffa. Elwood modern Wiley India, 8thEdition.
3	"Techniques of Value Analysis and Engineering", Miles Lawrence.
4	"Operation Management Theory and Practice", Mahadevan B Pearson Education,(2007)

ME7043-COMPUTATIONAL FLUID DYNAMICS

Lectures	**:**	2 Hrs/Week	**Evaluation Scheme**		
Credit	**:**	2	**ISE**	**:**	40 Marks
Tutorials	**:**	--	**ESE**	**:**	60 Marks

Course Objectives: The objective of the course is to

1. Provide Fundamental fluid dynamic principles and their applications.
2. Introduction to computational modeling and numerical methods – Finite Difference Method; Finite Volume Method & Finite Element Methods.
3. Introduce the students to widely used techniques in the numerical solution for the field of heat transfer and fluid dynamics.

Course Outcomes:

COs	At the end of successful completion of the course, the student will be able to	Blooms Taxonomy
CO1	Understand of the basic theory of Computational Fluid Dynamics,	Knowledge,
CO2	Illustrate principles of grid generation and discretization methods	Understand
CO3	Identify and apply specific boundary conditions relevant to specific application	Apply
CO4	Decide solution parameters relevant to specific application	Analyze/Evaluate/Create
CO5	Analyze the results and draw the appropriate inferences	Analyze/Evaluate/Create
CO6	Demonstrate basic principles of FVM	Understand

Description:

An introduction to the fundamentals of Computational Fluid Dynamics (CFD) that are used to solve complex fluid dynamics problems (weather prediction, aircraft flight, turbo machinery) by researchers, scientists and engineers around the world. The course will cover introductory aspects of Computational Fluid Dynamics (CFD) focused on most commonly used to numerically solve partial differential equations (PDEs), with particular focus on the equations governing fluid flows. Finite difference, finite volume, and finite element methods are studied as different means of discretizing a range of equations central to applications in science and engineering.

Prerequisites:	1:	Fluid Mechanics
	2:	Heat and Mass Transfer
	3:	Applied Numerical Methods

Section - I		
Unit 1	**Introduction**	
	What is CFD, Scope and Application of CFD, Methods of Predictions like Experimental and theoretical, Working of Commercial CFD Software, Solution methodology-Preprocessing, Solver, Post processing.	**6 Hrs**
Unit 2	**Mathematical description of Physical Phenomenon**	
	Governing Differential Equations, Meaning of Differential equation, The Continuity Equation, A Momentum equation, The Energy Equation, The General Differential Equation, Boundary Conditions, Initial and Boundary Conditions, Initial and Boundary Value problems	**7 Hrs**
Unit 3	**Grid Generation and Discretization Methods**	
	Structured and unstructured Grids: O-type, H-type, C-type of Structured Grid Generation, Mesh Adaptation. The Nature of Numerical Methods: The Discretization Concept, The Structure of the Discretization Equation. Basic discretization techniques applied to model equations and systems of equations: finite difference, finite volume and finite element methods	**7 Hrs**
Section – II		
Unit 4	**Heat Conduction, Convection and Diffusion**	
	Steady One-dimensional Conduction, Unsteady One-dimensional Conduction, Two and Three-dimensional Situations, Over relaxation and Under relaxation, Steady One-dimensional and Two Dimensional Convection Diffusion, Unsteady One-dimensional Convection.	**6 Hrs**
Unit 5	**Incompressible Fluid Flow**	
	Governing Equations, Stream Function- Vorticity Method, Determination of Pressure for Viscous Flow, The SIMPLE, SIMPLER Algorithm, Introduction to Turbulence Modeling, Basic Theories of Turbulence, The Time-Averaged Equations for Turbulent Flow.	**7 Hrs**
Unit 6	**Finite Volume Methods**	
	FVM solutions to steady one, two and three dimensional diffusion problems and unsteady one and two dimensional diffusion problems, FVM solutions to convection-diffusion problems - one and two dimensional, steady and unsteady	**7 Hrs**

Mapping of POs & COs:

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

References:

Text Books	
1	"Computational Fluid Dynamics: The Basics with Applications" John D. Anderson., McGraw-Hill.
2.	"Numerical Heat Transfer and Fluid Flow" S.V. Patankar McGraw-Hill.
3.	"Computational Fluid Flow and Heat Transfer", Muralidhar, K., and Sundararajan, Narosa Publishing House, New Delhi, 1995.
Reference Books	
1	"Computational Fluid Dynamics", T. J. Chung, Cambridge, University Pres
2	"Computational Fluid Dynamics: Principles and Applications", J. Blazek, Elsevier
3	"Computational Fluid Dynamics for Engineers"' Hoffmann, K. A. and Chiang ,4th Edition, Engineering Education Systems (2000)

Web Links

1. https://nptel.ac.in/courses/112/105/112105045/ (Computational Fluid Dynamics - Video course)
2. https://nptel.ac.in/courses/112/107/112107080/ (Introduction to CFD)

ME7051- INDUSTRIAL PRODUCT DESIGN

Lectures	**:**	2 Hrs/Week	**Evaluation Scheme**		
Credit	**:**	2	**ISE**	**:**	40 Marks
Tutorials	**:**	--	**ESE**	**:**	60 Marks

Course Objectives: The objective of the course is to	
1	Study the various parameters in product design and development like a) Finding Customer Needs b) Creativity , Innovation , Invention and Patenting c) Doing Market Research in various parameters for product d) Product Specifications criteria e) Product Architecture and Prototyping f) Cost and Value Engineering g) Design for Manufacturing and Assembly h) Standards in Ergonomics and Industrial Safety
2	Practice exposure to Case Studies and CAD Software with a product case.

Course Outcomes:		
COs	**At the end of successful completion of the course, the student will be able to**	**Blooms Taxonomy**
CO1	Identify the customer needs for a quality product through market research.	Understand
CO2	Product conceptualization selection and testing.	Create Evaluate
CO3	Elaborate Product Architecture.	Understand
CO4	Explain various principle and technologies used for the preparation of prototype.	Evaluate Analyze
CO5	Design products with improved function ergonomics and aesthetics.	Apply
CO6	Build and implement industry safety parameters in Product Design Development.	Understand Apply

Description:		
Prerequisites:	1	Machine Design
	2	Manufacturing Engineering.
	3	Marketing

Section – I		
Unit 1	**Introduction** Challenges to product development, Identify customer needs, Successful product development, Quality aspect of product design, Market Research, Survey.	**6 Hrs**
Unit 2	**Product Development Process and Planning** Innovation and Creativity in Product Design, Product Planning Processes, Product specifications: Process of setting specifications, Invention and Introduction to Patenitng (Concept Generation–Selection–Testing)	**7 Hrs**
Unit 3	**Product Architecture** Product Architecture: Implication of architecture, Establishing the architecture, Related system level design issue, Product Data Management, Use of Computerized Data Management and `Process, Industrial Design: Overview.	**7 Hrs**
Section – II		
Unit 4	**Design for Manufacturing and Assembly** Tolerance, Design of Gauges, Design for Environment, Prototyping, Engineering Materials, Concurrent Engineering, Product Costing, Value engineering.	**7 Hrs**
Unit 5	**Aesthetics:** Aesthetic Considerations, Visual Effects of Form and Color in Product Design. Ergonomics: Ergonomics and product design and automated systems, anthropomorphic data and its applications in ergonomic design, Limitations of Anthropomorphic data, General approach to the Man-Machine Relationship Work station Design and environment (working position and posture). Control and Displays: Configurations and sizes of various controls and displays, Design of controls in automobiles, machine tools etc., Design of instruments and controls.	**8 Hrs**
Unit 6	**Industrial Safety:** An approach to Industrial Design, Elements of Design, Structure for Industrial Design in engineering applications in manufacturing systems. Personal protective Equipment and Environment Control, Prevention and specific safety measures for manufacturing and processing industry and chemical industry.	**5 Hrs**

Mapping of POs & COs:															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	--	3	3	2	2	2	1	1	--	2	--	1	1	--	1
CO2	--	--	2	1	3	--	--	--	--	--	1	1	1	--	1
CO3	3	2	--	--	--	--	--	--	--	1	--	--	1	--	1
CO4	2	2	2	1	2	1	1	--	--	1	--	1	1	--	1
CO5	1	2	3	1	3	3	2	-	--	2	--	-	1	--	1
CO6	--	--	-	--	--	3	3	--	--	--	--	1	1	--	1

References:	
Text Books	
1	"Product Design and Development", Karl T. Ulrich, Steven G. Eppinger ; Irwin Tata McGraw Hill, 3rdEdition.
2	"Product Design and Manufacturing", A. C. Chitale and R.C.Gupta, Prentice Hall of India, 3rdEdition.
3	"Product Design", Otto and Wood, Pearson education.
4	"Human Factor Engineering", L P Singh ,Galgotia Publication Pvt.Ltd,1st Edition.
Reference Books	
1	"New Product Development", Tim Jones, Butterworth, Heinemann, Oxford,(1997).
2	"Assembly Automation and Product Design", Geoffrey Boothroyd, Marcel Dekker, CRC Press.
3	"Industrial Product Design", C W Flureshem.
4	"Industrial Design for Engineers", Mayall W.H, London, Hiffee books Ltd.
5	"Introduction to Ergonomics" ,R.C. Bridger, Tata McGraw Hill Publication

ME7052 - TOTAL QUALITY MANAGEMENT

Lectures	**:**	2 Hrs/Week	**Evaluation Scheme**		
Credit	**:**	2	**ISE**	**:**	40 Marks
Tutorials	**:**	--	**ESE**	**:**	60 Marks

Course Objectives: The objective of the course is to	
1	Know the concept of total quality and role of quality assurance.
2	Understand planning and controlling techniques for quality
3	Understand the key issues and some popular approaches to TQM implementation
4	Know the reliability approach for quality
5	Understand the current trends in TQM

Course Outcomes:

COs	**At the end of successful completion of the course, the student will be able to**	**Blooms Taxonomy**
CO1	Comprehend the concepts of total quality and quality assurance approaches.	Remember/ Understand
CO2	Identify and solve issues in quality related problems in manufacturing or service sector at various stages by using various TQM tools and techniques,	Understand Apply
CO3	Compare vendor rating and select suitable vendor	Analyze
CO4	Interpret various quality attributes and discuss the various quality approaches.	Apply Analyze
CO5	Calculate reliability of system	Apply
CO6	Review and resolve issues in industries using the various techniques of TQM such as 5S, JIT, TPM, Reliability Engineering, Quality Circle etc.	Understand Apply

Description:

Total Quality Management (TQM) is a management framework based on the belief that an organization can build long-term success by having all its members -- from low-level workers to its highest-ranking executives -- focus on improving quality and, thus, delivering customer satisfaction.

Main principles of TQM are as follows:

(i) Quality can and must be managed.
(ii) Everyone has a customer and is a supplier.
(iii) Processes, not people are the problem.
(iv) Every employee is responsible for quality.

Prerequisites:	1. Basic understanding of the concept of product and process.
	2. Basic understanding of the concept of quality management.

Section – I		
Unit 1	**Quality Assurance System:** Concept of total quality, role and objectives of Q.A. Q.A. cycle, process approach to Q.A. (input-process-output), Information feedback, Significance of internal customer approach, Defect prevention programs for Q.A.	**5 Hrs**
Unit 2	**Planning and Controlling Techniques for Quality** Planning for quality – The dimensions of Quality (quality of Design, conformance, performance and service) Quality planning with vendors, Vendor control procedures, Vendor-rating. Controlling techniques for quality – Seven statistical tools, Process capability analysis, Problem solving new management tools, Why-why analysis, Six sigma- Concept, Need, Implementation.	**5 Hrs**
Unit 3	**Robust and Reliable Product Approach for Quality** Product and system reliability: Basic concepts, Prediction and evaluation of parallel, Series and combined system reliability, Reliability tests (life testing, burn-in test, accelerated life testing), FMEA; and FTA, Taguchi's quality Philosophy, System design, Parameter design, Tolerance design, Orthogonal arrays, S/N ration, Loss functions.	**5 Hrs**
Section – II		
Unit 4	**Principles and Approaches to TQM:** Basic concepts: definition of TQM, TQM and traditional management approach, Principles, characteristics, and benefits of TQM. Approaches to TQM: Deming's approach, Juran's triology, Crosby and quality improvement, Ishikawa's CWQC.	**5 Hrs**
Unit 5	**The Essentials of TQM:** Customer Focus,- Customer perception of quality, Quality policy deployment, Quality function deployment, Voice of customer, Customer satisfaction, Kano's model of satisfaction, Customer retention. TQM Leadership- Role and commitment and accountability of leadership, Quality policy and objectives, Organizational structure for TQM, Role of HR in TQM, Training for TQM, Developing quality culture. Tools and Techniques for TQM: 5-S campaign, KAIZEN	**5 Hrs**
Unit 6	**Current Trends in TQM:** TQM in service sector: Definition and meaning and service, problems in defining service quality, attributes of service quality, SERVQUAL model, Implementing TQM in service industries, Measurement system for service quality. Quality Management Systems: ISO 9001:2008 Series Standards – Clauses, contents, interpretation and implementation, audit Sector Specific Standards – AS 9100, ISO/ TS 16949, TL9000, Quality Awards: National and International quality awards, Criteria and case studies.	**5 Hrs**

Mapping of POs & COs:															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	1	1	--	1	1	--	--	--	1	--	--	1	--	--	1
CO2	3	3	3	3	3	--	--	--	--	1	--	1	--	--	2
CO3	1	3	1	--	--	--	--	--	--	1	1	1	--	--	2
CO4	2	2	2	2	1	--	--	--	1	1	2	1	--	--	2
CO5	3	3	3	3	3	--	--	--	--	--	--	1	--	--	2
CO6	3	3	3	3	3	--	--	--	--	--	--	1	--	--	2

References:

Text Books	
1.	"Practical Reliability Engineering", Patrick D.T. O' connor, , Wiley India, (ISBN 978-81-265-1642-1), 4th Edition.
2.	"Total Quality Management – Text and cases", Jankiraman and Gopal, Prentice Hall India Publication. (ISBN 978-81-203-2995-9).
3.	"Total Quality Management" Dr. Suri and Dr. Sharma, Wiley Publication, (ISBN 978-93-5004-317-2).
Reference Books	
1.	"Total Quality Management", Dale H. Besterfiled, et.al. ,Pearson Education, Asia (ISBN 978-81-317-3227-4).
2.	"Total Quality Management", Dr. Poornima Charantimath Pearson Education, Asia (ISBN 978-81-317-3262-5) ,2nd Edition.
3.	"Quality Planning and Analysis", Juran J.M and Gryna.
4.	"Handbook of Total Quality Management" Dr. R.P.Mohanti, R.R. Lakhe Jaico Publishing House , (ISBN 81-7224-833-44).
5.	"Inspection, Quality Control and Reliability", Sharma S.C., Khanna Publishers (ISBN 81-7409-022-3).
6.	"Global Management Solutions Demystified", Dinesh Seth, Subhash C. Rastogi, Ceneage Education (Former Thomson Asia Pvt. Ltd.) (ISBN 981-265-142-X).
7.	"Managing Quality", Barrie G Dale, Wiley India Pvt .Ltd. (ISBN 978-81-265-2246-0), 5thEdition..
Video Link	
1	*https://tkiet.digimat.in/nptel/courses/video/110104080/L01.html*
2	*https://tkiet.digimat.in/nptel/courses/video/110104085/L01.html*
3	*https://tkiet.digimat.in/nptel/courses/video/110104085/L02.html*
4	*https://tkiet.digimat.in/nptel/courses/video/110104080/L07.html*
5	*https://tkiet.digimat.in/nptel/courses/video/110104080/L12.html*

ME7053 - RESEARCH METHODOLOGY

Lectures	**:**	2 Hrs/Week	**Evaluation Scheme**		
Credit	**:**	2	**ISE**	**:**	40 Marks
Tutorials	**:**	--	**ESE**	**:**	60 Marks

Course Objectives: The objective of the course is to	
1	Understand some basic concepts of research and its methodologies
2	Select and define appropriate research problem
3	Learn methods of data collection and analyze it using appropriate research analysis tools
4	Learn different types of experimental designs and select appropriate one for research work
5	Learn how to write a research report orpaper considering ethical practices in research
6	Understand different types of Intellectual properties and filing process

Course Outcomes:		
COs	**At the end of successful completion of the course, the student will be able to**	**Blooms Taxonomy**
CO1	Understand some basic concepts of research and itsmethodologies	Understand
CO2	Identify, define a research problem, and select appropriate research methodology	Understand Apply
CO3	Collect, analyze, and infer meaningful conclusions	Apply Analyze
CO4	Select appropriate design for the experimental work	Apply
CO5	Draft well-structured research report/paper and understand importance of ethical practices in conducting and disseminating research work	Understand Apply
CO6	Explore on various IPR components and process of filing	Understand

Description:		
Prerequisites:	1	Basic statistical knowledge
	2	English writing skills

Section – I		
Unit 1	**Meaning of Research** Meaning, definition, and objectives of research; Types of research; Steps in research process; Research approaches – qualitative vs. quantitative; Defining and formulating research problems	**03**
Unit 2	**Literature Survey** Importance and conduction of literature survey; Searching for literature; Primary and secondary sources; Writing literature review; Identifying gap areas from literature survey	**03**
Unit 3	**Data collection, analysis, and its interpretation** Data collection methods – primary data and secondary data. Mathematical tools for analysis; Statistical analysis of data – regression analysis, correlation analysis, analysis of variance (ANOVA), concept of best fit and exact fit;	**10**
Section – II		
Unit 4	**Design of Experiments** Strategy of experimentation; Statistical design of experiments; replication; randomization and blocking. Guidelines for designing experiments; Factorial designs. Two-factor factorial design; statistical analysis of factorial design; Taguchi design.	**10**
Unit 5	**Report Writing and Publication Ethics** Structure and components of research report; Guidelines for writing the abstract, introduction, methodology, results and discussion, conclusion sections of a report; References, and citation. Ethics of Research- Scientific Misconduct- Forms of Scientific Misconduct. Plagiarism, Unscientific practices in thesis work.	**08**
Unit 6	**Intellectual Property Rights** Overview and importance of IPR; Patents and its basics; process of filing patent at national and international level; Copyrights – their definition; Searching and filing for copyrights; Trademarks and their role in commerce.	**06**

Mapping of POs & COs:															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CO2	3	1	--	1	--	--	--	--	--	--	--	--	--	--	--
CO3	1	3	--	--	1	--	--	--	--	--	--	--	--	--	--
CO4	3	1	--	--	1	--	--	--	--	--	--	--	--	--	--
CO5	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CO6	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--

References:

Text Books	
1	Research Methodology:Methods and Techniques - C.R.Kothari, 2nd Edition,New AgeIntonational Publishers.
2	Research Methodology: A Step-by-Step Guide For Beginners- Ranjit Kumar, SagePublications (Available As pdf On Internet)
3	J W Creswell, Research Design, Sage South Asia Edition
4	Wadehra, B.L. 2000. Law relating to patents, trade marks, copyright designs and geographical indications. Universal Law Publishing.
Reference Books	
1	*Research Methodology and Statistical Tools. —P.Narayana Reddy AndG.V.R.KAcharyulu, 1st Edition,Excel Books, New Delhi.*
2	*Scientist Must Write – RoboertBarrass(Available As pdf On Internet)*
3	*Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction toResearch Methodology, RBSA Publishers.*
4	*Leedy, P.D. and Ormrod, J.E., 2004 Practical Research: Planning and Design, Prentice Hall.*
5	*Day, R.A., 1992.How to Write and Publish a Scientific Paper, Cambridge University Press.*
6	*Satarkar, S.V., 2000. Intellectual property rights and copy right. EssEss Publications.*

ME-P-302. REFRIGERATION AND AIR CONDITIONING LAB

Practicals	:	2 Hrs/Week	**Evaluation Scheme**		
Credits	:	1	**ISA**	**:**	25 Marks
Tutorials	:	---	**POE**	**:**	25 Marks

Course Objectives: The objective of the course is to

1. Learn about various conventional and non-conventional refrigeration systems
2. Study of the various equipment-operating principles, operating and safety controls employed in refrigeration air conditioning systems
3. Apply basic concepts and analyze the performance of refrigeration and air conditioning system

Course Outcomes :

Cos	At the end of successful completion of the course, the student will be able to	Blooms Taxonomy
CO1	Memorize classification,construction,working of different types of refrigeration system	Knowledge
CO2	Explain various equipments-operating principles, operating and safety controls employed in refrigeration air conditioning systems	Understand
CO3	Calculate cooling capacity and coefficient of performance by conducting test on vapor compression refrigeration system and Heat Pump	Apply, Analyze
CO4	Calculate cooling capacity and coefficient of performance by conducting test on air conditioning test rig system	Apply, Analyze,

Description:

This Course covers different conventional and unconventional refrigeration methods with respect to applications. Different types of compressors, condensers, expansion devices & evaporators used in vapor compression refrigeration systems Thermodynamically analyzes refrigeration and air conditioning systems and evaluates performance parameters.

Prerequisites:	1:	Applied Thermodynamics
	2:	Heat and Mass Transfer
	3:	Fluid properties and Fluid dynamics,

Practicals:

Number	Practical/Experiment/Tutorial Topic	Hrs.	Cognitive levels of attainment as per Bloom's Taxonomy
1	Different refrigeration systems	2	Knowledge/Understand
2	Study and Demonstration of Domestic refrigerator and Water cooler	2	Knowledge/Understand
3	Trial on heat Pump	2	Apply /Analyze
4	Trial on Refrigeration test rig	2	Apply /Analyze
5	Trial on Air conditioning Test rig	2	Apply /Analyze /
6	Study different Compressors and Expansion devices used in Vapour compression refrigeration system	2	Knowledge/Understand
7	Study different types of condensers and evaporators used in vapor compression refrigeration system	2	Knowledge/Understand
8	Industrial visit	2	Knowledge/Understand

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO110	PO111	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	3	2	--	--	--	--	--	--	--	--	--	--	--	2	--
CO2	3	2	--	--	--	--	--	--	--	--	--	--	--	2	--
CO3	3	3	2	2	--	--	--	--	--	--	--	--	--	2	--
CO4	3	3	2	2	--	--	--	--	--	--	--	--	--	2	--

References:

Text Books	
1	"Refrigeration and Air conditioning", Khurmi R. S., Gupta J. K, S. Chand Publication (Fifth edition)
2.	" Refrigeration and Air conditioning ", Arora C. P. , Khanna Publishers, New Delhi, 27th Edition.
3.	"Refrigeration and Air conditioning", Manohar Prasad., Willey Eastern Ltd, 1983
4.	"Refrigeration and Air conditioning",Ballaney P.L, Khanna Publishers, New Delhi, 1992
5.	"Basic Refrigeration and Air Conditioning",Ananthanarayanan, McGraw Hill Education 2013
6.	"Refrigeration and Air conditioning",R.K Rajput, S K KATARIA & SONS-NEW DELHI 2013

Reference Books	
1	"Principles of refrigeration,", Dossat Ray J, Willey Eastern Ltd, 2000
2	"Refrigeration and Air conditioning", Stockers W.F and Jones J.W, McGraw Hill International editions 1982
3	"Air Conditioning Principles and Systems", Edward G. Pita, PHI 2002
4	ASHRAE & ISHRAE handbook

Web Links/ Video Lectures

Lectures 1 to 40. https://archive.nptel.ac.in/courses/112/107/112107208/

ME702T - MECHANICAL SYSTEM DESIGN LAB

Practical's : 2 hrs/ week
Credits : 1

Examination Scheme
ISA : 25 Marks
POE : 25Marks

Course Objectives: The objective of the course is to
The course aims to: 1. Study the concept of aesthetics, ergonomics and creativity considerations in product design. 2. Study design of various mechanical systems such as pressure vessel, brakes, clutches, machine tool gear box, I.C. Engine components and material handling systems.

CourseOutcomes:

COs	**At the end of successful completion of the course, the student will be able to**	**BloomsTaxonomy**
CO1	Define various aspects and principal about aesthetics and ergonomics	Remember
CO2	Explain the theory of pressure vessels and gearbox design and material handling system.	Understand
CO3	Determine the design parameters in clutch, brakes and I C engine Components.	Evaluate
CO4	Construct the working drawing of detail and assembly of various mechanical systems.	Create

Description:

This lab course is introduced to have insight of complete design procedure of mechanical systems such as gear box, pressure vessel, clutch, brakes and I. C. Engine components. It is very important at this stage to understand all design activities for designing and developing successful mechanical system. Students will prepare the drawing sheets for different mechanical system components.

Prerequisites:	1:	Design of Machine Elements
	2:	Theory of Machines

Practical's:

Sr. No.	Practical Topic	Hrs.	Bloom's Taxonomy
1	Assignment based on :Aesthetics and Ergonomics (A case Study)	2	Remember
2	Assignment based on Design of I.C.Engine Components	2	Understand
3	Assignment based on Clutches and Brakes	2	Apply Analyze
4	Assignment based on Design of Material Handling System	2	Evaluate
5	A detail design report and A2 size sheet containing working drawing of detail and assembly of i) Design of Machine Tool Gear Box. (Three Stage, Twelve speed gear Box) **Note: Compulsory to all.**	2	Create
6	A detail design report and A2 size sheet containing working drawing of detail and assembly of i. Pressure vessel design / Brake design or Clutch design **(Note: Any one sheet from the above)**	2	Create

Mapping of POs & COs:

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

References:

Text Books	
1	"Design of Machine Element" V. B. Bhandari, TataMc-GrawHillPublication,3rdEdition.
2	"MechanicalEngineeringDesign",ShigleyandC.R.Miscke,TataMc-GrawHillPublication
3	"Machine Tools Design",N.K. Mehta, Tata Mc- Graw Hill Publication, 5thEdition.
4	. "Design of Machine Tools", S.k. Basu and D.K. Pal Oxford and IBH Publication, 6thEdition
Reference Books	
1	I.S.:2825 Code for Unfired Pressure Vessels
2	"Handbook of Gear Design", Jitin Maitra, TataMc-Graw Hill Publication.
3	"Mechanical Design Synthesis with Optimization Applications" ,Johnson R.C.,Von-Nostrand Reynold Publications.
4	"Engineering Design", Dieter G.E., Tata Mc- Graw Hill Publication, 4thEdition.
5	"Theory and Design of Pressure Vessels", by John F Harvey.

ME703T - FINITE ELEMENT ANALYSIS LAB

Practical's : 2 Hrs/Week **Evaluation Scheme**
Credits : 1 **ISA** : 25 Marks
Tutorials : --- **POE** : ---

CourseObjectives: Theobjectiveofthecourseisto

1. To use ANSYS to perform FEA of engineering component.
2. To formulate the FE model of the given component in ANSYS.
3. Write a program in APDLto prepare FE model as given in the problem.
4. To obtain and improvise the results till safe values.

CourseOutcomes:

COs	Attheendofsuccessfulcompletionofthecoursethestudentwillbeableto	Bloom's Taxonomy
CO1	Understand the software interface used for FEA.	Remember, Understand,
CO2	Understand the concept of Discretization and Finite Element model.	Remember, Understand, Application
CO3	Formulate the complete FE model in ANSYS, graphically as well as by APDL.	Remember, Understand, Application, Create
CO4	Evaluate the required engineering quantities and improvise the results if necessary.	Remember, Understand, Application, Synthesis

Description:

The course, Finite Element Analysis Lab is offered as the Engineering Science course. The Lab deals with simulation of engineering problem using finite element technique and finding out the solution to the problem under consideration using CAE Software like ANSYS. Basically, it determines and displays the behavior of a component under given type of loads and boundary conditions in terms of visually observable graphical results. This aspect of the subject makes it one of the most essential subjects for Mechanical Engineering. Performing CAE Analysis of various types of engineering components using ANSYS is the of prime focus in this Lab. Through 5 Practicals students will understand the fundamentals of FEA & ANSYS and will carry out FEA of the components like Beams of various types, Bars, Composite walls, Thin plates, Shafts under torsion, Trusses, Fins. The Lab also exposes the students to solve these problems using APDL, a programming language used with ANSYS.

Prerequisites:	1:	Basics of Software operation
	2:	Heat transfer, Analysis of Mechanical elements.
	3:	Design of Machine Elements

Practicals:

Number	Practical/Experiment/TutorialTopic	Hrs.	Cognitivelevelsof attainment according to Bloom's Taxonomy.
1	**Assignment on Discretization** Types of elements, choice of element and type of meshing – automatic, mapped, meshing in criticalareas.	**2**	Remember, Understand
2	**Finite Element Analysis of Stepped bar (Two or Three Steps only) using:** a) Finite Element Approach(Theory) b) Finite Element Software (ANSYS) and compare the results obtained.	**2**	Apply, Evaluate Analyse
3	**Finite element analysis of STEPPED BAR in ANSYS using APDL.**	**2**	Understand, Apply, Create
4	**Finite element analysis of Composite wall (Minimum three slabs)** a) Finite Element Approach(Theory) b) Finite Element Software ANSYS Compare the results obtained by abovemethods.	**2**	Apply, Evaluate Analyse
5	**Use of a standard CAE software like ANSYS toperform FEA of ANY TWO of the following:** Shaft under torsion, Planar Truss, Simply Supported/Cantilever/Fixed Beam A Composite wall under Convection &Conduction.	**4**	Apply, Evaluate

Mapping of POs & COs:

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

References:

Textbooks	
1	"Introduction to Finite Elements in Engineering"; Chandrupatala-Belgundu, Prentice-Hall India.
2	"Textbook of Finite Elements Analysis", P. Sheshu, Prentice-Hall of India Private Limited, New Delhi.
3	Finite Element Analysis – Theory and Practice"; M.J. Fagan, Longman Scientific &Technical
4	"Finite Element Analysis", UdaiBorker, Nandu Printers & Publishers Pvt. Ltd.Mumbai.
5	"An Introduction to Finite Element Method"; J. N. Reddy; 2/e, McGraw Hill International Editions, ISBN 0-07-112799-2
ReferenceBooks	
1	"Practical Finite Element Analysis", N.S. Gokhale, S.S. Deshpande, S.V. Bedekar, A.N.Thite,Finite to Infinite Publication
2	"Finite Elements Analysis – Theory and Application with ANSYS, Sawed Mouveni, Prentice HallInc.
3	Concepts of Finite Element Methods", ManickaSelvam, SCITECH publication
4	"Applied Finite Elements Analysis", Larry J. Segerlind, BSP Books Pvt. Ltd.

ME7041T AUTOMOBILE & ELECTRIC VEHICLES ENGINEERING LAB

Practicals : 2 hrs/ week
Credits : 1

Examination Scheme
ISA : 25 Marks

Course Objectives: The objective of the course is to

1. Learn different parts of Automobiles and Electric Vehicles.
2. Study various Automobile layouts and EV configurations.
3. Study various Automobile systems.
4. Study various types of electric vehicle batteries and motors.

Course Outcomes:

COs	At the end of successful completion of the course, the student will be able to	Blooms Taxonomy
CO1	Identify & locate different components of Automobile and Electric Vehicle.	Understand
CO2	Demonstrate various automobile layouts, EV configurations and various electric vehicle batteries and motors.	Understand Apply
CO3	Demonstrate various automobile systems, steering geometry and steering mechanism.	Apply
CO4	Distinguish modern trends, techniques and skills by arranging visit to automobile servicing centre Or EV manufacturing industry.	Analyze

Description:

Automobile & Electric Vehicles Engineering Lab consists of a practical study of Automobiles and Electric Vehicles (different parts and systems) with help of demonstration. During Lab course students will demonstrate and compare various automobile systems, EV batteries and EV motors.

Prerequisites:	1:	I. C. Engines
	2:	Theory of Machines
	3:	Electrical Technology

Practicals: (All experiments are to be performed)

Sr. No.	Practical Topic	Hrs.	Bloom's Taxonomy
1	Study and demonstration of four wheeler chassis layout, EV configurations, vehicle body parts and its materials.	2	Understand & Apply
2	Study and Demonstration of working of single plate automobile clutch and clutch plate lining materials.	2	Understand & Apply
3	Study and demonstration of synchromesh gearbox. (necessity, interlocking mechanism, gear shifting mechanism(Troubleshooting)	2	Understand & Apply
4	Study and demonstration of final drive and differential. (Types of final drive gear, Troubleshooting)	2	Understand & Apply
5	Study and demonstration of front wheel steering geometry, steering mechanism, wheel alignment, wheel balancing (Troubleshooting).	2	Knowledge Understand
6	Study and demonstration of suspension system of a four-wheeler. (Any one suspension system from conventional or independent, trouble shooting)	2	Analysis Evaluate
7	Study and demonstration of working Hydraulic braking system. (Air bleeding of hydraulic brake, Trouble shooting)	2	Analysis Evaluate
8	Study and demonstration of different types of EV batteries.	2	Understand & Apply
9	Study and demonstration of different types of EV motors.	2	Understand & Apply
10	Visit to servicing station for study of vehicle maintenance, repairs and report OR Visit to EV manufacturing industry.	2	Analysis Evaluate

Mapping of POs & COs:

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

References:

Text Books	
1	"Automotive Mechanics", William Crouse, Donald Anglin, 10th Edition, McGraw Hill, India.
2	"Automobile Engineering", G.B.S. Narang., 3rd Edition, Khanna Publication
3	"Automobile Mechanics", Dr. N.K.Giri
4	"Modern Electric, Hybrid Electric & Fuel Cell vehicles" Mehrdad Ehsani, 2nd edition, CRC press.
5	"Electric & Hybrid Vehicles" Design fundamentals, Iqbal Husain, CRC press.
Reference Books	
1	"The Motor Vehicle", T.K. Garrett, K. Newton, W. Steeds, 13th Edition, Butterworth Heinemann, New Delhi.
2	"Automotive Mechanics", Joseph Heitner, 2nd Edition, Affiliated Eastern Law House, 1967.
3	"Electric cars: Technology" DelftX eCARS2x, Pavol Bauer, Marnix Wagemaker, TU Delft, The Netherlands
4	"ELECTRIC VEHICLE TECHNOLOGY EXPLAINED" 2nd Edition, James Larminie & John Lowry, WILEY, A John Wiley & Sons, Ltd., Publication.

Video Lectures / Practical

Sr. No.	**Link**
1	**https://www.youtube.com/watch?v=Sh6qZ-Sh7Jk**
2	**https://www.youtube.com/watch?v=A3fHQsIkYeU&list=PLyqSpQzTE6M9spod-UH7Q69wQ3uRm5thr&index=5**
3	**https://www.youtube.com/watch?v=pk-xvzuxMPA&list=PLyqSpQzTE6M9spod-UH7Q69wQ3uRm5thr&index=6**
4	**https://www.youtube.com/watch?v=2CGPfkvCpXw&list=PLyqSpQzTE6M9spod-UH7Q69wQ3uRm5thr&index=8**

ME7042T - PRODUCTION MANAGEMENT LAB

Practicals : 2 hrs/ week
Credits : 1

Examination Scheme
ISA : 25 Marks

Course Objectives: The objective of the course is to

1. Understand the product design and development procedure.
2. Study and Analyze different sales forecasting techniques.
3. Study of modern production management tools.

Course Outcomes:

COs	At the end of successful completion of the course, the student will be able to	Blooms Taxonomy
CO1	Prepare the product design procedure of an existing product and judge it on the basis of other products	Knowledge
CO2	Analyze and point out different sales forecasting techniques.	Understand
CO3	Identify meaning of quality by inferring different parameters to prioritize product value to adopt new changes in a changing circumstance.	Apply
CO4	Anticipate use of modern production management tools.	Understand

Description:

This course is designed to provide basic knowledge of Production planning and productivity improvement Techniques.

Prerequisites:	1:	Knowledge of Industrial management functions.
	2:	Knowledge of mathematical Calculations

Practicals:

Sr. No.	Practical Topic	Hrs.	Bloom's Taxonomy
1.	Presentation on Product Design and Development	2	Understand
2.	Problems on Sales Forecasting Techniques	2	Understand Evaluate
3.	Presentation on Case study on "Design for Manufacturing and Assembly".	2	Understand
4.	Problems on Job sequencing- Single Machine Scheduling, Priority Sequence and Johnson's Algorithm.	2	Evaluate
5.	Presentation on Case study on "Implementation of JIT in a small/ medium company".	2	Remember Apply
6.	Problems on Estimate OEE and Replacement Analysis.	2	Evaluate
7.	Exercises on Analyzing tools in Project preparation.	2	Analysis
8.	Case Study On TPM	2	Remember Analysis

Mapping of POs & COs:

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

References:

Text Books	
1	"Industrial Engineering and Production Management", Martand Telsang, S Chand and Company New Delhi,(2009).
2	"Production and Operation Management", S. N. Chary, Tata Mcg-Graw Hill, 5thEdition.
Reference Books	
1	"Production and Operation Management", Everett E. Adam and Ebert, PHI Publication, ISBN no.9788120308381.
2	"Production and Operations Management", Buffa. Elwood modern Wiley India, 8thEdition.
3	"Techniques of Value Analysis and Engineering", Miles Lawrence.
4	"Operation Management Theory and Practice", Mahadevan B Pearson Education,(2007)

ME7043T - COMPUTATIONAL FLUID DYNAMICS LAB

Practical's	**:**	2 Hrs/Week	**Evaluation Scheme**		
Credit	**:**	1	**ISA**	**:**	25 Marks

Course Objectives: The objective of the course is to

1. To provide students with the necessary skills to use any CFD packages
2. To build up the skills in the actual implementation of Computational methods (e.g. boundary conditions, loads and turbulence modeling etc.) in using any CFD MATLAB, FEM & CFD codes.
3. To solve a variety of flow situations and heat transfer tutorials using any **CFD** software.

Course Outcomes:

COs	At the end of successful completion of the course, the student will be able to	Blooms Taxonomy
CO1	Understand of the basic theory of Computational Fluid Dynamics	Knowledge
CO2	Introduction to the use of modern CFD software, including geometry building, mesh generation, solution techniques, and flow visualization.	Understand
CO3	Solve engineering problems using CFD software	Apply/Analyze
CO4	Writing codes in C/ C++/ MATLAB for solution of simple CFD Problem	Create

Description:

In this course the set of tutorials are designed to provide the students with the necessary tools for using any CFD software.

Prerequisites:	1:	Fluid Mechanics
	2:	Heat and Mass Transfer
	3:	Applied Numerical Methods

Practicals:

Number	Practical/Experiment/Tutorial Topic	Hrs.	Cognitive levels of attainment as per Bloom's Taxonomy
1	Introduction to ANSYS Fluent, its features and different options	2	Knowledge/Understand
2	Generation of structured and unstructured mesh over simple objects	2	Knowledge/Understand
3	Boundary layer resolution and grid independence test	2	Knowledge/Understand /Apply
4	Numerical simulation of Flat plate boundary layer using commercial software	2	Apply /Analyze /Create /Evaluate
5	Numerical simulation of Laminar flow through pipe using commercial software	2	Apply /Analyze /Create /Evaluate
6	Numerical simulation of flow through nozzle using commercial software	2	Apply /Analyze /Create /Evaluate
7	Numerical simulation of Steady heat conduction 2D - in rectangular domain using commercial software	2	Apply /Analyze /Create /Evaluate
8	Solution for the one dimensional heat conduction equation using explicit method using finite difference method (Writing codes in C/ C++/ MATLAB)	2	Knowledge/Understand /Apply

Mapping of POs & COs:

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

References:

Text Books	
1	"Computational Fluid Dynamics: The Basics with Applications" John D. Anderson., McGraw-Hill.
2.	"Numerical Heat Transfer and Fluid Flow" S.V. Patankar McGraw-Hill.
3.	"Computational Fluid Flow and Heat Transfer", Muralidhar, K., and Sundararajan, Narosa Publishing House, New Delhi, 1995.

Reference Books	
1	"Computational Fluid Dynamics", T. J. Chung, Cambridge, University Pres
2	"Computational Fluid Dynamics: Principles and Applications", J. Blazek, Elsevier
3	"Computational Fluid Dynamics for Engineers"' Hoffmann, K. A. and Chiang , 4th Edition, Engineering Education Systems (2000)

Web Links:

1. https://nptel.ac.in/courses/112/105/112105045/ (Computational Fluid Dynamics - Video course)
2. https://nptel.ac.in/courses/112/107/112107080/ (Introduction to CFD)

ME706T–INDUSTRIALTRAINING-II

Practical's :2 Hrs.
Credits :1

Examination Scheme
ISA :25 Marks
POE : --

Course Objectives : The objectives of the course are:

1. To familiarize the students to realize an industrial work culture.
2. To provide students with opportunities for practical, hands-on training, learning from practitioners in the students' areas of specialization.
3. To expose students to a work environment, common practices, employment opportunities and work ethics in the irrelevant field.

Course Outcomes:

COs	At the end of successful completion of the course, the student will be able to	Blooms Taxonomy
CO1	Comprehend and correlate the knowledge gained in the Course.	Understand
CO2	Learn to implement appropriate techniques, resources and modern engineering tools.	Apply
CO3	Develop the capability to work in team.	Apply
CO4	Write detailed technical report.	Apply and Analyze

Description:

The students have to undergo an industrial training of minimum two weeks in an industrypreferablydealingwithMechanicalengineeringduringthesemesterbreakaftersixthsemester and complete within 15 calendar days before the start of seventh semester. The students have to submit a report of the training undergone and present the contents of the report before the evaluation committee constituted by the department. An internal evaluation will be conducted for examining the quality and authenticity of contents of the report and award the marks at the end of the semester.

It is expected that students should undertake small assignment or work related to any of the course related aspect. Report is based on compilation of work carried out related to facility and layout planning, Industrial engineering- time study and motion study, Line efficiency evaluation and improvement, process capability evaluation, Industrial automation, processor Machinery modification as identified.

Industrial Training Report Format	Maximum fifteen students in one batch, involving three groups of maximum five students, shall work under one teacher. The same group shall work for project under the same guide. However, each student should have different industrial training and its presentation. The report should be of 30 to 35 pages. For standardization of the report the following format should be strictly followed. 1. PageSize:TrimmedA4 2. Top Margin: 1.00Inch 3. BottomMargin:1.32 Inches 4. LeftMargin:1.5Inches 5. RightMargin:1.0Inch 6. ParaText:TimesNewRoman12Pt.font 7. LineSpacing:1.5lines 8. PageNumbers:Rightalignedatfooter.Font12Pt.TimesNewRoman 9. Headings:NewTimesRoman,14Pt.,Boldface 10. Certificate: All students should attach standard format of Certificate as prescribed by the department. Certificate should be awarded preferably to batch and not for individual student. However, certificate for individuals in exceptional cases with permission of concern guide will be considered. It should have Signatures of Guide, Head of Department and Principal.

Mapping of Pos & COs:

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

ME707T -PROFESSIONAL SKILL DEVELOPMENT LAB

Practical's : 2 Hrs/Week **Evaluation Scheme**

Credits : 1 **ISA** : 25 Marks

Tutorials : --- **POE** : ---

Course Objectives: The objective of the course is to	
1	To Communicate effectively for employment and workplace.
2	To develop good technical writing and presentation skills.
3	To prepare presentations as per the audience and context requirements.
4	Utilize collaborative and management skills in a team context

Course Outcomes:		
COs	**At the end of successful completion of the course, the student will be able**	**Blooms Taxonomy**
CO1	To Identify the Common Errors in Writing and Speaking of English.	Understand
CO2	To read Technical proposals properly and able to write good technical reports.	Apply
CO3	To Acquire Employment communication skills.	Apply, Analyze
CO4	To Acquire Workplace communication skills.	Apply, Analyze
CO5	To Develop the skill to be a team member and manage time.	Apply
CO6	To Acquire Corporate Etiquettes	Apply

Description:		
Prerequisites:	1	Adequate knowledge of basic grammar of English language.
	2	Intermediate level of vocabulary of English language.
	3	Ability to communicate moderately in English

Section – I		
Unit 1	**Technical Writing and Business Communication:**	
	Quotations, purchase orders, enquiry letter, invitation, and acceptance letter.Notice of meeting, circular, agenda and minutes of meeting.Introduction to Technical reports writing, Types of technical reports. Scientific Writing Process.	**4hrs**

Unit 2	**Communication for Employment**	**4hrs**
	Components of a formal letter, formats and types of business letters, model letter of application (cover letter) with resume, email writing.	
Unit 4	**Professional Communication at Workplace:**	**4hrs**
	Group Discussion and Professional Interviews, Characteristics and Strategies of a GD and PI's, Intra and Interpersonal Communication Skills at workplace, Non-Verbal Communication Skills and its importance in GD and Interview.	
Unit 5	**Professional Computer Skills:**	**8hrs**
	Basics of MS Tools like Word, Excel, and PowerPoint.Formal report, presentation and analysis performed by students using MS Tools.	
Unit 6	**Corporate Etiquettes:**	**4hrs**
	Business dress and grooming, office etiquettes, telephone etiquettes, dining etiquettes, meeting etiquettes, travel etiquettes.	

Mapping of POs & COs:

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

References:	
Text Books	
1	"Professional Writing Skills in English" published by Fillip Learning – Education (ILS), Bangalore – 2022.
2	"Functional English" (As per AICTE 2018 Model Curriculum) (ISBN-978-93-5350-047-4) Cengage learning India Pvt. Limited 2019
Reference Books	
1	English for Engineers by N.P.Sudharshana and C.Savitha, Cambridge University Press – 2018.
2	"Technical English", Dr. M. Hemamalini, Published by Wiley India Pvt. ltd.
3	Technical Communication by Gajendra Singh Chauhan and Et al, (ISBN-978-93-5350-050-4), Cengage learning India Pvt. Limited - 2019.
4	Technical Communication – Principles and Practice, Third Edition by Meenakshi Raman and Sangeetha Sharma, Oxford University Press 2017.
5	High School English Grammar & Composition by Wren and Martin, S Chandh& Company Ltd – 2015.
6	Effective Technical Communication – Second Edition by M Ashraf Rizvi, McGraw Hill Education (India) Private
Video Link	**Reference NPTEL and SWAYAM Courses**
1	https://www.youtube.com/watch?v=Af9RoDvhTLE&t=4s (Soft skill development by IIT Kharagpur)
2	https://www.youtube.com/watch?v=oZWViNKmyZU&t=1s (Soft Skills by IIT Roorkee)
3	https://www.youtube.com/watch?v=y-IPi4KMArQ&t=1s (Developing Soft Skills and Personality by IIT Kanpur)

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning	
1	Contents related activities (Activity-based discussions)
2	Instructing students to prepare Flowcharts and Handouts for their active participation.
3	Conducting Group wise discussions Connecting to placement activities
4	Conducting individual interviews Connecting to placement activities
5	Quizzes and Discussions, Seminars, assignments and presentations

ME708T - PROJECT WORK PHASE-I

Practical's : 6 Hrs/Week
Credits : 3
Tutorials : ---

Evaluation Scheme
ISA : 50 Marks
POE : 50 Marks

Course Objectives : The objective of the course is to

1. Embed the skill in group of students to work independently on a topic/ problem/ experimentation selected by them and encourage them to think independently on their own to bring out the conclusion under the given circumstances of the curriculum period in the budget provided with the guidance of the faculty.

2. Encourage creative thinking process to help them to get confidence by planning and carrying out the work plan of the project and to successfully complete the same, through observations, discussions and decision making process.

CourseOutcomes:

COs	Attheendofsuccessfulcompletionofthecoursethestudentwillbeableto	Bloom's Taxonomy
CO1	think creatively on real life engineering problem.	Knowledge, Understand,
CO2	engineering knowledge to deduce proper solution to real life engineering problems.	Knowledge, Understand, Application
CO3	work in a team and acquire collaborative skills to achieve common goals.	Knowledge, Understand, Application
CO4	learn independently, reflect on their learning and take appropriate actions to improve it.	Knowledge, Understand, Application, Synthesis
CO5	communicate effectively and present ideas clearly with specific audience in written and oral forms.	Knowledge, Understand, Application, Synthesis
CO6	plan for activities in order to complete the task in predefined time.	Knowledge, Understand, Application, Create

Description:		
The project work phase I can be a design project / experimental project and or computer simulation project or any of the topics related with Mechanical engineering stream. The project phase I work is allotted in groups on different topics. The students' groups are required to undertake the project Phase-I during the seventh semester and the same is continued in the eighth semester (Phase-II). Project Phase-I consists of reviews of the work carried earlier and the submission of preliminary report. Report should highlight scope, objectives, methodology, approach and tools to be used like software and others, outline of project and expected results and outcome along with timeframe. The project phase I work is to be extended for project phase II at B. Tech. (Mech.) Sem. VIII with same group working under guidance of same Faculty member assigned for project phase I.		
Prerequisites:	1:	Fundamentals of Mechanical Engineering
	2:	Report writing and Presentations Skills
	3:	Basic Communication skills

Project Work Phase I Load:
A batch of maximum three groups of four to five students per group, shall work under one Faculty member of department. The group of one student is strictly not allowed.

Project work Phase I Term Work:
The term work under project submitted by students shall include
1. Work Diary: Work Diary maintained by group and countersigned by the guide weekly. The contents of work diary shall reflect the efforts taken by project group for a. Searching suitable project work b. Brief report preferably on journals/ research or conference papers/ books or literature surveyed to select and bring up the project. c. Day to day activities carried out related to project work for entire semester. d. Synopsis. The group should submit the synopsis in following form. i. Title of Project ii. Names of Students iii. Name of Guide iv. Relevance v. Present Theory and Practices vi. Proposed work vii. Expenditure viii. References
2.Synopsis: The synopsis shall be signed by each student in the group, approved by the guide and endorsed by the Head of the Department
3. Presentation: The group has to make a presentation in front of the Faculty members of department at the end of semester. Project Phase I Report Format: Project Phase I report should be of 20 to 25 pages (typed on A4 size sheets).
4. Project Work Phase I Report Format:
The following format should be strictly followed.
1. Page Size: Trimmed A4
2. Top Margin: 1.00 Inch
3. Bottom Margin: 1.32 Inches
4. Left Margin: 1.5 Inches
5. Right Margin: 1.0 Inch
6. Para Text: Times New Roman 12 Pt. font
7. Line Spacing: 1.5 lines
8. Page Numbers: Right aligned at footer. Font 12 Pt. Times New Roman
9. Headings: New Times Roman, 14 Pt., Bold face

10. References: References should have the following format
For Books: “Title of Book”, Authors, Publisher, Edition
For Papers: “Title of Paper, Authors, Conference Details, Year

Important Notes:

1.Each Project group should continue maintaining a diary for project and should write (a) Book/s referred (b) Company/ies visited (c) Person/s contacted (d) Computer work done (e) Papers referred (f) Creative thinking.

2. The Diary along with Project Work Phase I Report shall be assessed at the time of oral examination

3. One copy of the report should be submitted to Institute/ Department, one copy to Guide and one copy should remain with each student of the project group.

In-Semester Assessment (ISA):

Department will constitute an Evaluation Committee to review the project phase I work. The evaluation committee consists of faculty members of which internal guide and another expert in the specified area of the project. The completion of work, the submission of the report and assessment should be done at the end of Part-I (Seventh semester).

Mark Distribution:

Concept – 15 Marks, Work Done – 25 Marks, Presentation – 20 Marks, Report – 15 Marks

Practical Oral Examination (POE):

Oral examination shall be conducted with presentation of the project phase I.

The distribution of marks shall be

- 10 marks for contribution of the student in the project work
- 20 marks shall be awarded for achieving the objectives of the project set forth.
- 20 marks for Question/ Answer

*The external examiner shall be preferably an Industrial expert from the same field.

Mapping of POs & COs:

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

ME709A –AUDIT COURSE-VII

Lectures	**:**	--	**Evaluation Scheme**		
Credit	**:**	--	**ISE**	**:**	--
Tutorials	**:**	--	**ESE**	**:**	--

Course Description:

There is huge competition in the job market. There are more job seekers and lesser job opportunities. Whether you are a fresh college pass out or an employed professional, there are many struggles of landing a suitable job.

Is there a way to enhance student's job prospects and make students resume better than the others? Yes, certainly! The professional certification courses can add immense value to student's job profile. While a formal educational degree is very important, but such courses will provide, the industry and practical training to the students. With everyone being armed with a college degree, there needs to be something extra to show on students CV. As future technocrats, it is the need of the day, to give exposure to the practical knowledge by participating in different certification courses.

Students have to submit course completion certificate to the department.

Course Particulars :

Certificate course in any one, in Institute such as HYPER MESH/CFD software/ANSYS/CATIA/SOLIDWORKS/C++/PDMS/ offered by the respective program.

ME709A –AUDIT COURSE-VII

Lectures	:	--	**Evaluation Scheme**		
Credit	:	--	**ISE**	:	--
Tutorials	:	--	**ESE**	:	--

Course Description:

There is huge competition in the job market. There are more job seekers and lesser job opportunities. Whether you are a fresh college pass out or an employed professional, there are many struggles of landing a suitable job.

Is there a way to enhance student's job prospects and make students resume better than the others? Yes, certainly! The professional certification courses can add immense value to student's job profile. While a formal educational degree is very important, but such courses will provide, the industry and practical training to the students. With everyone being armed with a college degree, there needs to be something extra to show on students CV. As future technocrats, it is the need of the day, to give exposure to the practical knowledge by participating in different certification courses.

Students have to submit course completion certificate to the department.

Course Particulars :

Certificate course in any one, in Institute such as HYPER MESH/CFD software/ANSYS/CATIA/SOLIDWORKS/C++/PDMS/ offered by the respective program.

TATYASAHEB KORE INSTITUTE OF ENGINEERING & TECHNOLOGY ★ Autonomous Warananagar

Member Secretary
Board of Studies

Chairman
Board of Studies

Chairman
Board of Studies
MECHANICAL ENGG. DEPT.
Tatyasaheb Kore Institute of Engg.
& Technology (Autonomous)
Warananagar, Dist. Kolhapur

Academic Dean
T.K.I.E.T., Warananagar

Dean, Academic
Tatyasaheb Kore Institute of Engg.
& Technology (Autonomous)
Warananagar, Dist. Kolhapur

Seal of Institute

Principal
T.K.I.E.T., Warananagar

PRINCIPAL
Tatyasaheb Kore Institute of Engg.
& Technology (Autonomous)
Warananagar, Dist. Kolhapur

PCC-ME801-MECHATRONICS

Lectures	**:**	3 Hrs/Week		**Evaluation Scheme**	
Credit	**:**	3	**ISE**	**:**	40 Marks
Tutorials	**:**	-	**ESE**	**:**	60 Marks

Course Objectives: The objective of the course is	
1	To learn how to apply the principles of Mechatronics and automation for the development of system.
2	To learn the automation technology and applications industrial automation in various manufacturing systems
3	To supply qualified personnel to meet the requirement of specialist in multidisciplinary fields.
4	To prepare Mechanical Engineering students for advanced graduate studies in Mechatronics, Robotics & Control system designs.

Course Outcomes:

COs	**At the end of successful completion of the course, the student will be able to**	**Blooms Taxonomy**
CO1	Understand and identify mechatronics system and its basic components	Understand/Remember
CO2	Study of signal conditioning process	Understand
CO3	Design a mechatronic system with sensors, transducers, microprocessor or microcontroller.	Create
CO4	Understand and identify PLC and its input, output devices , PLC wiring diagram and their basic sketches	Understand
CO5	Design and develop PLC and its programming for problem under consideration or any industrial applications.	Create
CO6	Study and analyze of human machine interface, SCADA, VFD , DCS for mechanical and electronic system interface	Analyze

Description:

Mechatronics engineering also called mechatronics is an interdisciplinary branch of engineering that focuses on the integration of mechanical, electrical and electronic engineering systems, and also includes a combination of robotics, electronics, computer science, telecommunications, systems, control, and product.

Prerequisites:	1	Basics of Electrical wiring
	2	Basics of Electronics
	3	Instrumentation and Automation

Section – I		
Unit 1	Introduction to Mechatronics, multi discipline scenario Transducers & Sensors, Position Sensors: Limit switch, photoelectric switches, proximity sensors, incremental & absolute encoders, decoders. Displacement: Potentiometer sensors, capacitive displacement sensors. Velocity sensors: Tacho-generator, use of encoders, Applications of sensors, advances in sensors.	**6**
Unit 2	Signal conditioning process, Operational amplifier (inverting amplifier, non-inverting amplifier, summing, integrating amplifier, differtianting amplifier, logarithmic amplifier), protection, filtering, data acquisition, multiplexer, analog to digital converter (ADC), digital to analog converter (DAC). Sample and hold, demultiplexing.	**7**
Unit 3	Introduction to Digital logic gates, Boolean algebra, application of logic gates, Combinational and sequential logic, Introduction to flip flop, Introduction Comparison between microprocessor and micro controller, organization of a microprocessor and microcontroller system, instruction types and set, Introduction to Rasbery Pi	**7**
Section – II		
Unit 4	Introduction, definition, PLC system and components of PLC input output module, PLC advantages and disadvantages. Ladder diagram & PLC programming fundamentals, update – solve ladder – update, physical components Vs. program components.	**7**
Unit 5	Internal relays, light control example, disagreement circuit, majority circuit, oscillator, holding (sealed or latches) contacts, always ON always OFF contacts, fail safe circuits, PLC timer and counter functions – Introduction and types. Industrial applications – Automatic liquid filling system, liquid mixture, traffic control etc	**7**
Unit 6	Introduction Human machine Interface (HMI), Difference between HMI and PLC, Introduction to SCADA and its industrial applications, Introduction to DCS and VFD	**6**

Mapping of POs & COs:

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

References:	
Text Books	
1	Mechatronics – Nitaigour P. Mahalik Mahalik, ISBN 1259082318, 9781259082313 Publisher Tata McGraw-Hill Education
2	Microprocessor Architecture, Programming, and Applications with the 8085, by Ramesh Gaonkar (Author) Publisher : Penram International Publishing (1 December 2000) ISBN-10 : 8187972092
3	Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering by W. Bolton (Author), Publisher : Pearson Education; 4th edition (1 January 2010) ISBN-10 : 8131732533
Reference Books	
1	Introduction to Mechatronics (Oxford Higher Education) by Dr K. K. Appukuttan Publisher : Oxford University Press (2 August 2007), ISBN-10 : 0195687817
2	Programmable Logic Controllers: Principles and Applications, by John W. Webb, Ronald A. Reis, Publisher : Prentice Hall India Learning Private Limited; 5th edition (25 March 2002), ISBN-10 : 013041672X
3	SCADA: Supervisory Control and Data Acquisition, by Stuart A Boyer, International Society of Automation; 4th edition (15 February 2016)
4	Programmable Logic Controllers: Programming Methods and Applications by John R. Hackworth (Author), Frederick D. Hackworth Jr. (Author), Publisher : PHI; Har/Com edition (11 April 2003) ISBN-10 : 0130607185
5	Human Machine Interaction by Dhananjay R. Kalbande, Prashant Kanade, Sridari Iye Publisher: Wiley's India
Video Link	
1	**https://nptel.ac.in/courses/112107298 (For Mechatronics)**
2	**https://nptel.ac.in/courses/112103174 (For PLC)**

PCC–ME-802 NOISE & VIBRATIONS

Lectures	**:**	3 Hrs/Week	**Evaluation Scheme**		
Credit	**:**	3	**ISE**	**:**	40 Marks
Tutorials	**:**	2Hr/Week	**ESE**	**:**	60 Marks

Course Objectives: The objective of the course is to

1. Introduce students the concepts, principles and framework of Vibrations
2. Understand vibration analysis techniques for different types of vibrations.
3. Acquaint with the principles of vibration measuring instruments.
4. Create awareness about principles of sound level measurement and noise.

Course Outcomes:

COs	At the end of successful completion of the course, the student will be able to	Blooms Taxonomy
CO1	Understand the various types of vibrations and their principles	Understand
CO2	Apply various methods for solving single Degree of Freedom (DOF) vibration problems.	Apply
CO3	Analyze the problems on Two DOF system	Analyze
CO4	Analyze the problems on multi DOF system	Analyze
CO5	Understand different types of Vibration Measuring Instruments.	Understand
CO6	Demonstrate the Noise and its various standards	Apply

Description:

Most of failures are takes place due to mechanical vibrations and life of the machine and vibration are closely related. Therefore knowledge of Noise and vibrations is essential for Mechanical Engineering students.

Prerequisites:	1	Analysis of Mechanical Element
	2	Theory of Machine II

Unit 1	**Introduction**	
	Vibration and oscillation, Causes and effects of vibrations, Vibration parameters – spring, mass, damper, Degree of freedom, Static equilibrium position ,Vibration classification , Steps involved in vibration analysis, Simple harmonic motion. Equivalent stiffness of spring combination.	**7 Hrs**
Unit 2	**Single DOF System**	
	a) Methods of finding Natural Frequency, Introduction to Single DOF System, single DOF Un-damped free vibrations Damped free vibrations, Types of damping, Logarithmic decrement. **b)** Forced Vibrations: Introduction, Forced damped vibrations with constant harmonic excitation, Force transmissibility and motion transmissibility, Vibration isolation	**8Hrs**
Unit 3	**Two DOF System**	
	Free undamped vibrations– Introduction to free undamped longitudinal vibrations of two DOF system, Principal modes and natural frequencies, free torsional vibration of two rotor system, Double pendulum,	**6Hrs**
Unit 4	**Introduction to Multi DOF System**	
	Free vibrations of Multi DOF System, stiffness influence coefficient matrix, Rayleigh's method, Holzer's method.	**6Hrs**
Unit 5	**Vibration Measuring Instruments**	
	Vibration measurement process, Classification of vibration measuring instrument, Instruments for measurement of displacement, velocity, acceleration and frequency of vibration, Vibration exciters & FFT analyzer. Introduction to Condition Monitoring and Fault Diagnosis. .	**6Hrs**
Unit 6	**Introduction to Noise**	
	a) Introduction to sound, Sound Level & Decibels. b) Introduction to Noise, Sources of Noise, Non auditory effects of noise on people, Auditory effects of noise ,Noise standards and limits ,Ambient emission noise standards in INDIA.	**7Hrs**

Mapping of POs & COs:

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

References:

TextBooks:	
1	Mechanical Vibrations", Singiresu S. Rao, PearsonEducation, ISBM–81-297-0179-0-(2004).
2	Mechanical Vibrations", G. K. Grover, Published by Nemchand and Brothers, Roorkee.
3	Mechanical Vibrations", G. K. Grover, Published by Nemchand and Brothers, Roorkee.
4	Theory of Vibrations with Applications, W. Thomson, Pearson Education, 2nd Edition. .
5	Mechanical Vibration", Dr. Debabrata Nag, Wiley India Pvt. Ltd, ISBN 978-81-265-3090-8.
Reference Books:	
1	MechanicalVibration,AustinChurch,WielyEastern.2nd Edition
2	Mechanical Vibrations", J. P. Den Hartog, Tata McGrawhill Book Company Inc., 4th Edition.
3	Vibrations and Noise for Engineers, Kewal Pujara Dhanpat Rai and Sons, (1992)
4	Mechanical vibration", William J Palm III Wiley India Pvt. Ltd., ISBN 978-81-265-3168-4,1st Edition

ME-8031 PEC–V Industrial Engineering

Lectures	**:**	3 Hrs/Week	**Evaluation Scheme**		
Credit	**:**	3	**ISE**	**:**	40 Marks
Tutorials	**:**	--	**ESE**	**:**	60 Marks

Course Objectives: The objective of the course is

1. To introduce students with the concepts, principles and framework of Industrial Engineering and various productivity enhancement techniques.
2. To understand Method study and Time study techniques.
3. To make the students aware about types of plant layout, tools and techniques of material handling.
4. To teach the students, concepts of value engineering, job evaluation and merit rating.

Course Outcomes:

COs	At the end of successful completion of the course, the student will be able to	Blooms Taxonomy
CO1	Explain the concepts, principles, and framework of Industrial Engineering and Productivity enhancement approaches.	Understand
CO2	Describe different time study and work measurement techniques for productivity improvement.	Remember
CO3	Study various principles of motion economy related to Productivity improvement.	Understand
CO4	Measure and calculate basic time, standard time for a component.	Evaluate
CO5	Describe different types of plant layouts and material handling equipments.	Understand
CO6	Explain the role of value analysis, job evaluation and merit rating in improving productivity.	Understand

Description:

In order to sustain in today's competitive world and to satisfy customers every industry is adopting cost reduction techniques to enhance the productivity. In order to achieve it industries use techniques like method study, work measurement, work sampling, principles of motion economy, plant layout and material handling and value analysis etc. Students must be acquainted with these techniques so as to be able to apply them in the industries.

Prerequisites:	1	Industrial Management and Operation Research
	2	Metrology & Quality Control

Section – I		
Unit 1	**Introduction to Industrial Engineering & Productivity**	
	A) **Introduction to Industrial Engineering**: Definition, objectives & role of industrial engineering, functions of industrial engineering department, Scope & responsibilities of industrial engineering, qualities & responsibilities of an industrial engineer, Tools and techniques of industrial engineering. B) **Productivity**: Concept, objectives, Factors affecting productivity, techniques to improve productivity, Productivity measurement models, problems on productivity.	**6 Hrs**
Unit 2	**Method Study**	
	Historical background, role of work study in improving productivity, method study procedure, Recording techniques in method study-**a)Indicating process sequence-** i) Outline process chart ii) Flow process chart (man, machine and material type) iii) Two handed process chart, **b) Using a time scale-**i) Multiple activity chart **c) Diagrams indicating movements-**i) Flow diagram, ii)String diagram, iii) Cyclegraph, iv) Chronocycle graph, v) Travel chart, templates, models, critical analysis.	**8 Hrs**
Unit 3	**Motion Study & Human Factor Engineering (Ergonomics)**	
	A) **Motion Study:** Principles of motion economy, micro motion study, Therbligs, SIMO charts, MEMO motion study. B) **Human Factor Engineering (Ergonomics):** Introduction, objectives definition, man machine system, physiological work measurement, design of controls.	**6 Hrs**
Section – II		
Unit 4	**Work Measurement (Time Study)**	
	Definition, objectives & techniques of work measurement, procedure, time study equipment, performance rating, different types of allowances, concept of normal time, basic time and standard time, calculation of standard time, work sampling, procedure of work sampling, advantages and limitations of work sampling techniques.	**8 Hrs**
Unit 5	**Facility Design**	
	A)**Plant Layout:** Plant site selection, factors influencing the selection, objectives for pre-planning of a plant layout, types of plant layout, advantages and disadvantages of layout, principles of	**6 Hrs**

	plant layout, tools and techniques of layout planning. **B)Material handling:** Objectives of material handling system, functions and principles of material handling, factors to be considered for selecting material handling equipment, types of material handling equipments.	
Unit 6	**Value analysis & Job evaluation and merit rating**	
	A) **Value analysis:** Definition, basic concept of value analysis and engineering, steps, evaluation, applications of value analysis, role of value analysis towards improvement in productivity. B)**Job evaluation and merit rating:** **Job evaluation:** Definition, objectives, steps in job evaluation, Methods of job evaluation (a) Ranking method, b) Job classification method, c) Factor comparison method, d) Point rating method, with their advantages and disadvantages. **Merit rating:** Introduction, objectives, different methods of merit rating a) Ranking scale method, b) Employee comparison method, c) Check list method with their advantages and disadvantages.	**6 Hrs**

Mapping of POs & COs:

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

References:

Text Books:	
1	M. Telsang, “Industrial Engineering and Production Management”, S. Chand Publication.
2	O.P. Khanna, “Work Study” Dhanpat Rai Publi. New Delhi.
3	M Mahajan, Industrial Engineering and Production Management, DhanpatRai and Co.
4	Banga and Sharma, Industrial Organization & Engineering Economics, Khanna publication.
5	Introduction to Work Study, ILO, Geneva and Oxford and IBH Publi. Co. Pvt.Ltd.
Reference Books:	
1	R.M. Barnes, “Motion and time study design and measurement of work” John Willey &Sons Inc. 7th Edition.
2	H.B. Maynard and others, “Industrial Engg. Handbook” IVth Edi. McGraw Hill Publication.
3	David Sumanth, “Productivity Engg. And Management”, Tata McGraw Hill, New Delhi.

ME8032-Energy and Power Engineering

Lectures	**:**	3 Hrs/Week	**Evaluation Scheme**		
Credit	**:**	3	**ISE**	**:**	40 Marks
Tutorials	**:**	--	**ESE**	**:**	60 Marks

Course Objectives: The objective of the course is to

- Develop an understanding, the potential and usage of various renewable and non-renewableenergy resources.
- Learn about solar geometry, various energy conversion techniques and their comparison.
- Introduce the students about different power plants, energy audit and power plant economics.
- Prepare the students to analyze the power plant capacity, generation cost, unit selection.
- Impart the knowledge about the new trends of energy generation from Biogas, bio fuel and hydrogen.

Course Outcomes:

COs	At the end of successful completion of the course, the student will beable to	Blooms Taxonomy
CO1	Understand the importance of nonconventional energy sources, theirgeneration and utilization in the present world energy scenario along with their limitations and applications.	Remember Understand
CO2	Outline the importance of Solar radiation, illustrate its conversion and Analyze different solar collectors.	Apply Analyze
CO3	Understand the wind power conversion technology and fuel cell electric vehicles (FCEV's).	Understand
CO4	Explain Biomass, bio fuels & Hydrogen energy formation processes and its methods of energy conversion.	Analyze
CO5	Assess the performance and economic analysis of power plants.	Apply Analyze
CO6	Understand the need of energy conservation, audit and waste heat Utilization.	Understand

Description:		
Energy and power Engineering is fundamental course offered to the students, in order to impart the knowledge of various Nonrenewable and renewable energy sources, current energy scenario of India and world, their conversion technologies, limitations. The course also provides the knowledge of various power plants, its economic analysis and comparison. It also provides an insight in new trends of energy sources, energy conservation, environmental impacts of renewable energy sources.		
Prerequisites:	1:	Basic Mechanical Engineering
	2:	Knowledge of different sources of nonrenewable and renewable energy and their effective energy conversions in general.

Section – I		
Unit 1	**Introduction to Non-Conventional Energy Sources**	
	Introduction, Indian and global energy scenario, fossil fuels, India energy production, consumption and demand of energy, solar energy and other non- conventional energy resources, role of alternate energy sources for worlds power generation in future. Role of NTPC, NHPC and private firms in power generation in India.	**4 Hrs**
Unit 2	**Solar Radiation & Photovoltaic Conversion:**	
	Solar potential, Solar radiation geometry, Solar radiation data, Solar Collectors - flat plate, evacuated tube, Cylindrical parabolic, Concentrating paraboloid Effect of various parameters on the collector performance: collector orientation, selective surface, fluid inlet temperature, and dust. Modern thermal energy storage - Ultra capacitors / Super capacitors, Super conducting materials, New generation batteries. Photovoltaic Conversion: Description, principle of working, application and characteristics, materials used for photovoltaic cells, applications Maximum power point tracking, Study of standalone system with battery and AC or DC load, Hybrid systems (Diesel-PV & Wind-PV).	**9 Hrs**
Unit 3	**Wind Energy Conversion Systems & Fuel cell**	
	Wind parameters and wind data, principle of working, Site selection, Wind energy conversion systems and their classification, Construction and working of typical wind mill. Fuel cell: Introduction, Design and Principle of operation, classification and types of fuel cell, applications advantages and disadvantages. Introduction to fuel cell electric vehicles (FCEV'S)	**7 Hrs**

Section – II		
Unit 4	**Energy from Bio Mass, Bio fuels & Hydrogen Energy:**	
	Photosynthesis, photosynthetic oxygen production, energy plantation, bio gas production from organic wastes by anaerobic fermentation, factors affecting bio- gas generation, description of bio-gas plants, advantages, disadvantages and applications of Bio-gas. Bio fuels its types and applications. Hydrogen Energy: Properties of Hydrogen with respect to its utilization as a renewable form of energy, sources of hydrogen, production of hydrogen, electrolysis of water, thermal decomposition of water, thermo chemical production and bio-chemical production. Advantages and disadvantages. Application of hydrogen energy.	**7 Hrs**
Unit 5	**Power plants and Power plant Economics :**	
	Different types of power plants – Thermal, Hydro, IC Engine, Gas Turbine, Nuclear, Combined Cycle and their characteristics, Comparison of Power plants with respect to various parameters, Introduction to grids, national grid. Load curve, different terms and definitions, Cost of energy production, selection of plant, performance and operating characteristics of power plants tariffs methods of electrical energy. (Numerical treatment on Load curves).	**7 Hrs**
Unit 6	**Energy, Economics and Environment**	
	Life cycle costing, present worth factor, present worth of capital and maintenance cost, energy conservation opportunities, energy audit, co-generation systems, waste heat utilization, impact of conventional energy use on environment.	**6 Hrs**

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	1	--	--	--	--	--	--	---	--	--	--	--	--	3	--
CO2	2	--	--	--	--	--	--	--	--	1	--	--	--	3	--
CO3	2	--	--	--	--	--	--	--	--	--	--	--	--	3	--
CO4	2	--	--	--	--	--	--	--	--	1	--	--	--	3	--
CO5	3	3	3	--	--	--	--	--	--	2	--	--	--	3	--
CO6	2	--	1	--	--	3	3	2	--	3	2	3	--	3	--
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High															

References:

Text Books	
1	"EL-Wakil, "Power plant Technology", M.M., McGraw Hill, 1st Edition, 2017
2	"P.K. Nag , "Power Plant Engineering", Tata McGraw Hill,4th Edition 2017
3	"Domkundwar, Arora, "Power plant Technology", Dhanpat Rai and Co. sixth edition 2013
Reference Books	
1	"Weisman, J., and Eckert, L., "Modem Power Plant Engineering", Prentice Hall,1st edition.1999
2	"Kam W. Li and A. Paul Priddy, "Power Plant System Design", John Wiley, 1st edition, 2018.
3	Recent reports of agencies: International Energy Agency (IEA), Ministry of New and Renewable energy (MNRE), Technology and Action for Rural Advancement (TARA)

Useful links/Web Links/

Video LecturesLecture:

No.	Link
1	**NPTEL Course on POWER PLANT ENGINEERING, Department of Mechanical Engineering IIT Roorkee - https://nptel.ac.in/courses/112/107/112107291/**
2	**NPTEL Course on Physics of Renewable Energy Systems, IIT Kharagpur https://nptel.ac.in/courses/115105127**
3	**SWAYAM Course Renewable Energy Engineering: Solar, Wind and Biomass Energy Systems IIT Guwahati https://nptel.ac.in/courses/103103206**
4	**https://mnre.gov.in/**
5	**https://beeindia.gov.in/**
6	**https://ascelibrary.org/journal/jleed9**

ME8033-Tribology

Lectures	**:**	3 Hrs/Week		**Evaluation Scheme**	
Credit	**:**	3	**ISE**	**:**	40 Marks
Tutorials	**:**		**ESE**	**:**	60 Marks

Course Objectives: The objective of the course is to

1. Study and measure the different types of surface features associated with the friction of metals and non-metals.
2. Study the different types of wear mechanism and surface modification techniques.
3. Analyze the various types of lubricants and lubrication system in the tribology.
4. Develop the methodology for deciding lubricants and lubrication regimes for different operating conditions.
5. Study the different types of high-pressure contacts and rolling bearings.
6. Understand the recent trends in tribological application in industries.

Course Outcomes:

COs	**At the end of successful completion of the course, the student will be able to**	**Blooms Taxonomy**
CO1	Understand the knowledge on the surface features and its role on the friction behavior of Metals and Non-metals.	Understand
CO2	Recognize the properties of lubricants used in different bearings and industrial processes.	Remember/Analyze
CO3	Explain laws of friction, topology of surfaces, modes of wear and the wear-mechanism .	Remember
CO4	Apply mathematical models of Hydrodynamic, Hydrostatic and Elasto-Hydrodynamic bearings.	Apply
CO5	Identify the application of Air/Gas lubrication bearing	Analyze
CO6	Design the system with good tribological behaviour	Apply/Create

Description:
Tribology is the study of the science and technology of interacting surfaces in relative motion and encompasses the study and application of friction, wear, lubrication and related to design aspects.

Prerequisites:

1. Analysis of Mechanical Elements
2. Fluid Mechanics
3. Design of Machine Elements

	Section – I	
Unit 1	**Introduction:** Tribology in design, industry, economic considerations, Flow of fluids, Viscosity and temperature variation, Viscosity index, determination of viscosity and different viscometers, Lubrication, lubricants, types of lubricants and properties of lubricants, SAE classification, recycling, and disposal of oils, lubricant additives, and selection.	**06**
Unit 2	**Surface Topography:** Terminological considerations nature of surfaces and their contact, Physio-mechanical properties of surface layer, geometrical properties of surfaces, Methods of studying surfaces, study of contact of smoothly and rough surfaces, Thermal effects on surface, Statistical analysis of surface. Friction and Wear: Friction - Laws of friction - Friction classification – Causes of friction, Theories of Dry Friction, Friction Measurement, Stick-Slip Motion and Friction Instabilities, various friction models. Wear - Wear classification - Wear between solids - Wear between solid and liquid - Factors affecting wear - Measurement of wear, Theories of Wear, Approaches to Friction Control and Wear Prevention, Boundary Lubrication Bearing Materials and Bearing Construction.	**06**
Unit 3	**Hydrodynamic Lubrication:** Principle of hydrodynamic lubrication, Mechanism of pressure development in oil film and lubrication regimes, Reynolds's equation for hydrodynamic bearing, hydrodynamic journal bearing and its analysis, hydrodynamic thrust bearing. Elasto-Hydrodynamic Lubrication: Principles and Applications, Pressure viscosity term in Reynolds's equation, Hertz's Theory, Ertel-Grubin equation, Lubrication of spheres, Gear teeth bearings, Rolling element bearings.	**07**
	Section – II	
Unit 1	**Hydrostatic Lubrication:** Principle of hydrostatic lubrication, Arrangement of hydrostatic lubrication systems , Advantages ,limitation and applications of hydrostatic lubrication, Viscous flow through rectangle and circular slot , Hydrostatic step bearings, Energy losses in hydrostatic step bearing, Optimum design of hydrostatic step bearing, Temperature rise in hydrostatic step bearing. Hydrostatic squeeze- film bearings, Squeeze Film Lubrication - Basic concept - Squeeze action between circular and rectangular plates - Squeeze action under variable and alternating loads, Application to journal bearings , Piston Pin Lubrication.	**09**

Unit 2	**Air/Gas Lubrication:** Introduction to Gas lubrication and requirements of gas lubrication, Advantages, limitations and applications of gas lubrication, Reynolds's equation for Gas lubrication, Principle, advantages, limitations and applications of Air bearings.	**05**
Unit 3	**Case Studies on Tribology with recent trends in research:** Tribology in Design - Mechanical design of oil seals and gasket – tribological design of oil seals and gasket, Tribology in Industry Maintenance, Nano tribology, Tribological Aspects of Rolling Motion: The mechanics of tire-road interactions, Road grip and rolling resistance, Tribological aspects of wheel on rail contact, Magneto-Rheological (MR) Fluids.	**07**

Mapping of POs & COs:

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

References:

	Text Books
1	H.G. Phakatkar, R.R. Ghorpade , "Tribology ", 4th edition, Nirali Prakashan
2	S.K. Basu, S. N. Sengupta, "Fundamental of Tribology ", PHI Learning Pvt. Ltd.
3	Sushil Kumar Srivatsava, "Tribology in Industry", S. Chand & Co
4	Arun kumar "A text book of Tribology" ,S. K. Kataria & Sons.
	Reference Books
1	V. Kragelsky and V.V. Alisin, "Friction Wear Lubrication: Tribology Handbook" Vol. I, II and III - MIR Publishers.
2	Theo Mang, Kirsten Bobzin and Thorsten Bartels, "Industrial Tribology: Tribo systems,Friction, Wear and Surface Engineering", Wykeham Publications Ltd.
3	Cameron and C.M. Mc. Ettles, "Basic Lubrication Theory", Wiley Eastern
	Video Link
1	https://www.youtube.com/@iit
2	https://www.youtube.com/watch?v=Gh89PxS-3Ok

ME8041 CRYOGENICS

Lectures:3 hrs per week
Credits: 3
Tutorials: __

Evaluation Scheme: ISE: 40 Marks
ESE: 60 marks (Duration 3 Hr)
Total Credits: 3

Course Objectives: The objective of the course is to

1. Describe various methods to produce low temperature phenomena at cryogenic temperature.
2. Understand the working principle of different cryogenic liquefaction and separation systems.
3. Study various Cryogenic refrigeration systems
4. Understand the application of Cryogenic technology in engineering in research and Industry.

Course Outcomes:

Cos	At the end of successful completion of the course, the student will be able to	Blooms Taxonomy
CO1	Know the working principle of different types liquefaction system with its components and function	Remember
CO2	Summarize the applications of Cryogenics in different areas	Understand
CO3	Calculate performance parameters of different liquefaction systems	Evaluate
CO4	Describe gas separation and Purification systems	Remember
CO5	Explain Working of different types of Cryo coolers	Understand
CO6	Understand the different insulations and vacuum system used in cryogenic system.	Understand

Description:

Cryogenic engineering is a sub stream of mechanical engineering dealing with cryogenics, and related very low temperature processes such as air liquefaction, cryogenic engines, cryosurgery. Generally, temperatures below cold come under the purview of cryogenic engineering The cryogenic temperature range has been defined as from −150 °C (−238 °F) to absolute zero (−273 °C or −460 °F)

Prerequisites:	1:	Basic Remember of thermodynamics
	2:	Fundamental Remember of refrigeration
	3:	Heat and Mass Transfer

Section - I		
Unit 1	**Introduction: Cryogenics**	
	Introduction: Cryogenics, Cryogenic Temperature scale, Historical Development of Cryogenics, Properties of cryogenic Fluids, Applications of cryogenics in different areas such as Space, Medical and Biological, Manufacturing processes. Behavior of Structural Materials at Cryogenic Temperature: Mechanical properties, Thermal properties.	**06Hrs**
Unit 2	**Liquefaction of Cryogenic Gases**	
	Ideal cycle, System performance parameters, Production of low temperature methods in Cryogenics (Joule Thomson effect, Adiabatic expansion), Liquefaction systems; Simple LindeHampson system, Pre-cooled Linde-Hampson system, Cascade system, Claude system, Comparison Of Above Systems.	**09Hrs**
Unit 3	**Liquefaction Systems for Neon, Hydrogen, Helium and Heat Exchanger**	
	Maximum Inversion temperature, Limitations of Linde -Hampson System for liquefaction of Neon,HydrogenandHelium,PrecooledLinde-HampsonsystemforNeonandHydrogen, Claudesystemfor Hydrogen, Collins HeliumLiquefaction system, Heat exchanger used in liquefaction systems	**06Hrs**
Section - II		
Unit 4	**Cryogenic Refrigeration Systems**	
	Ideal refrigeration systems, Philips refrigerator, Vuilleumier refrigerator, Solvay refrigerator, Gifford McMahon refrigerator, Pulse tube refrigerator.	**06Hrs**
Unit 5	**Gas Separation and Purification**	
	Thermodynamic Ideal separation system, Temperature composition diagram, Principles of Gas separation, Principles of Rectifiers column, Air Separation Systems (Linde Single Column system,)	**07Hrs**
Unit 6	**Insulation &Vacuum Technology**	
	Cryogenic fluid storage, Vacuum insulation, Fibrous materials, Solid foams, Gas Filled powder, Comparison. Importance, Pump downtime, FlowRegimes, Components vacuum systems, Mechanical Vacuum pumps, and Ion pumps	**07Hrs**

Mapping of POs & COs:

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

COs vary with course code

References:

TextBooks	
1	"CryogenicSystems",BarronF.Randall,OxfordUniversityPress,NewYork
2.	"Fundamental of Cryogenics",Mamata Mukhopadhyay, PHI, 2010
3.	"Introduction to Cryogenics Engineering and Gas liquefaction",P. K Bose, Everest Publishing house,2005
ReferenceBooks	
1	"Cryogenic Research and Applications", Marshall Sitting and Stephen Kidd, D. Van Nostrand,IncUSA,(1963)
2	"Cryo-Cooler:FundamentalsPart-I",G.Walker,PlenumPress,NewYork.
3	"ExperimentalTechniquesinlowTemperaturePhysics' ', Guy, K White, Clarendon Press, Oxford, (1987).

Web Links/ Video Lectures are to be provided to Theory and Practical /Experiments (If Available)

https://archive.nptel.ac.in/courses/112/101/112101004/

PCC-ME8042-INDUSTRIAL MAINTANANCE ENGINEERING

Lectures	**:**	3 Hrs/Week	**Evaluation Scheme**		
Credit	**:**	3	**ISE**	**:**	40 Marks
Tutorials	**:**		**ESE**	**:**	60 Marks

Course Objectives: The objective of the course is to	
1	Learn the basic concepts of IME.
2	Understand different maintenance models.
3	Study Total Productive Maintenance techniques.
4	Study establishment of basic policies, goals and implementation of IME.
5	Understand maintenance logistics.
6	Study different online monitoring tools.

Course Outcomes:		
COs	**At the end of successful completion of the course, the student will be able to**	**Blooms Taxonomy**
CO1	Define the concept of Industrial Maintenance (IM).	Remember
CO2	Explain Maintenance Models strategies	Understand
CO3	Develop the roles and responsibilities of people in organization in context of Industrial Maintenance Engineering	Apply
CO4	Compare the benefits of Industrial maintenance processes.	Analyze
CO5	Evaluate Maintenance Logistics process in the organization	Evaluate
CO6	Originate Online Monitoring in the organization	Create

Description:		
Prerequisites:	1	Industrial Management
	2	Operation Research
	3	

Section – I		
Unit 1	**Maintenance Concepts:** Origin and development of Total Productive Maintenance (TPM) ,Objectives and functions, Reliability Centered Maintenance (RCM), maintainability prediction, availability and system effectiveness, maintenance costs, maintenance organization.	**7**
Unit 2	**Maintenance Models:** Minimal repair, maintenance types, Preventive maintenance methodology, balancing Preventing Maintenance (PM) and breakdown maintenance, PM schedules: deviations on both sides of target values, PM schedules: functional characteristics, replacement models.	**7**
Unit 3	**Total Productive Maintenance-1:** Zero breakdowns, Zero Defects and TPM, maximizing equipment effectiveness, autonomous maintenance program, Eight pillars of TPM, TPM small group activities	**6**
Section – II		
Unit 4	**Total Productive Maintenance-2:** TPM organization, management decision, educational campaign creation of organizations, establishment of basic policies and goals, formation of master plan, TPM implementation.	**6**
Unit 5	**Maintenance Logistics:** Human factors in maintenance, maintenance manuals, maintenance staffing methods, queuing applications, simulation, spare parts management, maintenance planning and scheduling and interpretation (analysis)	**7**
Unit 6	**Online Monitoring:** Condition Monitoring Techniques, Vibration Monitoring, Signature Analysis, Wear Debris Monitoring, Maintenance Management Information System, Expert systems, Corrosion Monitoring and Control.	**7**

Mapping of POs & COs:

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

References:	
Text Books	
1	Mishra, R. C., Pathak, K., "Maintenance Engineering and Management", 2nd Edition, Prentice – Hall of India.
2	Steven Borris, "Total Productive Maintenance", McGraw-Hill.
3	Terry Wireman, "Total Productive Maintenance", 2nd Edition, Industrial Press, 2004.
4	Tina Kanti Agustiady, Elizabeth A. Cudney, "Total Productive Maintenance: Strategies and Implementation Guide", Productivity Press, 2015.
5	Kern Peng, "Equipment Management in the Post-Maintenance Era: A New Alternative to Total Productive Maintenance (TPM)", Productivity Press, 2012.
Reference Books	
1	David J. Sumanth, "Total Productivity Management (TPmgt): A Systematic and Quantitative Approach to Compete in Quality, Price and Time", Productivity Press, 1997.
2	Fumio Gotoh, Masaji Tajiri, "Autonomous maintenance in Seven Steps: Implementing TPM on the ShopFloor", Productivity Press, 1999.
3	Seiichi Nakajima, "Total Productive Maintenance", Productivity Press, 11th edition, 1988
Video Link	
1	https://www.youtube.com/watch?v=WzKV4h2pl0w
2	https://www.youtube.com/watch?v=rcrF7zV0qOQ
3	https://onlinecourses.swayam2.ac.in/imb22_mg01/preview

PCC-ME8043- Introduction to Drone Technology

Lectures	**:**	3 Hrs/Week	**Evaluation Scheme**		
Credit	**:**	3	**ISE**	**:**	40 Marks
Tutorials	**:**		**ESE**	**:**	60 Marks

Course Objectives: The objective of the course is to

1. Introduce the basic concepts of unmanned aerial vehicles.
2. Make students familiarize with the design aspects of UAV.
3. Impart knowledge on the hardware components and their application in the UAV systems.
4. Infer about the communication and control detail of UAV.
5. Introduce the basic operational futures of UAV systems.

Course Outcomes:

COs	**At the end of successful completion of the course, the student will be able to**	**Blooms Taxonomy**
CO1	Understand the preliminary design requirements for an unmanned aerial vehicle.	Understand
CO2	Identify different hardware for UAV	Remember/Understand
CO3	Design a simple model of UAV system.	Create
CO4	Design micro aerial vehicle systems by considering practical limitations	Create
CO5	Integrate various systems of unmanned aerial vehicle	Apply
CO6	Perform system testing for unmanned aerial vehicles	Analyze/Evaluate

Description:

In today's world more focus is on the development of unmaned aerial vehicles due to advancements in the technology and wide Application.

Prerequisites:	1	Fluid Mechanics
	2	Analysis of Mechanical Elements
	3	Material science and Meterology
	4	Design of Machine Elements

Section – I		
Unit 1	**INTRODUCTION TO UAV** History of UAV –classification – Introduction to Unmanned Aircraft Systems--models and prototypes – System Composition-applications	**08**
Unit 2	**THE DESIGN OF UAV SYSTEMS** Introduction to Design and Selection of the System- Aerodynamics and Airframe Configurations-Characteristics of Aircraft Types- Design Standards and Regulatory Aspects-UK,USA and Europe-Design for Stealth--control surfaces-specifications.	**08**
Unit 3	**AVIONICS HARDWARE** Autopilot – AGL-pressure sensors-servos-accelerometer –gyros-actuators-power supply-processor, integration, installation, configuration, and testing	**08**

Unit 1	**COMMUNICATION PAYLOADS AND CONTROLS** Payloads-Telemetry-tracking-Aerial photography-controls-PID feedback-radio control frequency range –modems-memory system-simulation-ground test-analysis-trouble shooting.	**08**
Unit 2	**THE DEVELOPMENT OF UAV SYSTEMS** Waypoints navigation-ground control software- System Ground Testing-System In-flight Testing-Future Prospects and Challenges-Case Studies – Mini and Micro UAVs.	**08**

Mapping of POs & COs:

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

References:

	Text Books
1	Paul G Fahlstrom, Thomas J Gleason, "Introduction to UAV Systems", UAV Systems, Inc,1998
2	Reg Austin "Unmanned Aircraft Systems UAV design, development and deployment", Wiley,2010.
	Reference Books
1	Dr. Armand J. Chaput, "Design of Unmanned Air Vehicle Systems", Lockheed Martin Aeronautics Company, 2001
2	Kimon P. Valavanis, "Advances in Unmanned Aerial Vehicles: State of the Art and the Road toAutonomy", Springer, 2007
3	Robert C. Nelson, Flight Stability and Automatic Control, McGraw-Hill, Inc, 1998.
	Video Link
1	https://www.youtube.com/playlist?list=PLFW6lRTa1g83B1HdU2mece6QLeBrtspL7.

ME801T- MECHATRONICS LAB

Practicals : 2 hrs/ week
Credits : 1

Examination Scheme
ISA : 25 Marks
POE : 25

Course Objectives: The objective of the course is to
1. To learn how to apply the principles of Mechatronics and automation for the development of system. 2. To prepare Mechanical Engineering students for advanced graduate studies in Mechatronics, Robotics & Control system designs.

Course Outcomes:

Cos	**At the end of successful completion of the course, the student will be able to**	**Blooms Taxonomy**
CO1	Understand and identify mechatronics system and its basic components and signal conditioning process	Understand Remember
CO2	Design a mechatronic system with sensors, transducers, microprocessor or microcontroller.	Design Create
CO3	Understand and identify PLC and its input, output devices , PLC wiring diagram and their basic sketches	Understand
CO4	Design and develop PLC and its programming for problem under consideration Or any industrial applications.	Create

Prerequisites:		
	1:	Basics of Electrical wiring
	2:	Basics of Electronics
	3:	Instrumentation and Automation

Practicals:

Sr. No.	Practical Topic	Hrs.	Bloom's Taxonomy
1	Study of sensors (minimum four)	2	Understand
2	Assignment on signal conditioning	2	Knowledge
3	Assignment on Microprocessor and Microcontroller.	2	Knowledge
4	Fabrication of Simple Mechatronics working project by a group of 4/5 students using hardware and suitable software.	2	Create
5	PLC programming on Industrial Applications based on Timers, Counters, internal relays (Minimum 4applications)	2	Apply Create
6	Assignment on HMI and SCADA	2	Understand
7	Industrial visit to study Mechatronics system application & submission of visit report.	2	Analysis Evaluate

Mapping of POs & COs:

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

References:	
Text Books	
1	Mechatronics – Nitaigour P. Mahalik Mahalik, ISBN 1259082318, 9781259082313 Publisher Tata McGraw-Hill Education
2	Microprocessor Architecture, Programming, and Applications with the 8085, by Ramesh Gaonkar (Author) Publisher : Penram International Publishing (1 December 2000) ISBN-10 : 8187972092
3	Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering by W. Bolton (Author), Publisher : Pearson Education; 4th edition (1 January 2010) ISBN-10 : 8131732533
Reference Books	
1	Introduction to Mechatronics (Oxford Higher Education) by Dr K. K. Appukuttan Publisher : Oxford University Press (2 August 2007), ISBN-10 : 0195687817
2	Programmable Logic Controllers: Principles and Applications, by John W. Webb, Ronald A. Reis, Publisher : Prentice Hall India Learning Private Limited; 5th edition (25 March 2002), ISBN-10 : 013041672X
3	SCADA: Supervisory Control and Data Acquisition, by Stuart A Boyer, International Society of Automation; 4th edition (15 February 2016)
4	Programmable Logic Controllers: Programming Methods and Applications by John R. Hackworth (Author), Frederick D. Hackworth Jr. (Author), Publisher : PHI; Har/Com edition (11 April 2003) ISBN-10 : 0130607185
5	Human Machine Interaction by Dhananjay R. Kalbande, Prashant Kanade, Sridari Iye Publisher: Wiley's India
Video Link	
1	**https://nptel.ac.in/courses/112107298 (For Mechatronics)**
2	**https://nptel.ac.in/courses/112103174 (For PLC)**

PCC-ME-802T NOISE AND VIBRATION LAB

Tutorials : 2 Hr/Week
Credit : 1

Evaluation Scheme
ISA : 25 Marks
POE : 25 Marks

Course Objectives: The objective of the course is to

1. Introduce students the concepts, principles and framework of Vibrations
2. Understand vibration analysis techniques for different types of vibrations.
3. Acquaint with the principles of vibration measuring instruments.
4. Create awareness about principles of sound level measurement and noise..

Course Outcomes:

COs	At the end of successful completion of the course, the student will be able to	Blooms Taxonomy
CO1	Understand the concept of Equivalent stiffness of spring combination & natural frequency for different types of vibrations.	Remember /Apply
CO2	Analyze logarithmic decrement for single DOF damped system	Analyze
CO3	Determine natural Frequency of different types of torsional vibrations.	Apply
CO4	Demonstrate the various types vibration exciters as well as different types of vibration and noise measuring instruments.	Understand

Description:

Most of failures are takes place due to mechanical vibrations and life of the machine and vibration are closely related. Therefore knowledge of Noise and vibrations is essential for Mechanical Engineering students.

Prerequisites:	1	Analysis of Mechanical Element
	2	Theory of Machines-II

Practicals:

Sr. No.	Practical Topic	Hrs.	Bloom's Taxonomy
1	Experiment on equivalent spring mass system	2	Remember
2	Experiment on study of forced vibration characteristics	2	Apply
3	Determination of logarithmic decrement for single DOF damped system	2	Analyze
4	Experiment on torsional vibration of two rotors without damping	2	Apply
5	Experiment on torsional vibration of three rotors without damping		Apply
6	Demonstration of different types of vibration exciters	2	Understand
7	Measurement of vibration parameters using vibration measuring instruments	2	Understand
8	Measurement of Noise by using noise measuring instruments.	2	Understand

Mapping of POs & COs:

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

References:

Text Books:	
1	Mechanical Vibrations", Singiresu S. Rao, Pearson Education, ISBM–81-297-0179-0-(2004).
2	Mechanical Vibrations", G. K. Grover, Published by Nemchandand Brothers, Roorkee.
3	Mechanical Vibrations", G. K. Grover, Published by Nemchandand Brothers, Roorkee.
4	Theory of Vibrations with Applications, W. Thomson, Pearson Education, 2nd Edition.
5	Mechanical Vibration", Dr. Debabrata Nag, Wiley India Pvt. Ltd, ISBN 978-81-265-3090-8.
Reference Books:	
1	MechanicalVibration,AustinChurch,WielyEastern.2ndEdition
2	Mechanical Vibrations", J. P. DenHartog, Tata McGrawhill Book Company Inc., 4thEdition.
3	Vibrations and Noise for Engineers, Kewal Pujara Dhanpat Rai and Sons, (1992)
4	Mechanical vibration", William J Palm III Wiley India Pvt. Ltd., ISBN 978-81-265-3168-4,1stEdition

PCC-ME808T-Engineering Economics and Costing

Course Objectives: The objective of the course is to	
1	Know basics of Engineering Economics
2	understand the concepts of the time value of money
3	Understand and apply cost concepts
4	Understand cost statements/records of the product and its effect on decision making

Course Outcomes:		
COs	**At the end of successful completion of the course, the student will be able to**	**Blooms Taxonomy**
CO1	Understand the basics of Economics and its application in the field of engineering	Remember/ Apply
CO2	Develop an awareness and understanding time value of money and techniques for evaluation of engineering project	Remember/Develop
CO3	Equip students with the skills required to understand cost statements/records of the product and its effect on decision making	Remember
CO4	Understand and apply Depreciation and break even concept	Remember

Description: Engineering Economics and Costing course consist of Economics and its application in the field of engineering, time value of money, cost statements/records of the product, Depreciation and break even concept.

Prerequisites:	1	Mathematics
	2	Industrial Engineering
	3	Industrial Management and operation Research

Sr. No.	Practical Topic	Hrs.	Bloom's Taxonomy
1.	Introduction to Estimation Costing , Engineering Economics and its application in the field of engineering	2	Understand
2.	Presentation on Depreciation and break even Concept	2	Understand Evaluate
3.	Presentation on time value of money and techniques	2	Understand
4.	Exercise cost statements/records of the product and its effect on decision making	2	Evaluate
5.	Difference between Estimating and costing	2	Remember
6.	Presentation on Cost and revenue concepts	2	Evaluate
7.	Exercises on Costing Methods.	2	Analysis
8.	Cost control on indirect materials and tools	2	Remember/ Analysis

Mapping of POs & COs:

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

References:

Text Books

1. Riggs, Bedworth and Randhwa, "Engineering Economics", McGraw Hill Education
2. D.M. Mithani, Principles of Economics. Himalaya Publishing House

Reference Books

1. Sasmita Mishra, "Engineering Economics & Costing ", PHI
2. Sullivan and Wicks, " Engineering Economy", Pearson
3. R.Paneer Seelvan, " Engineering Economics", PHI
4. Gupta, " Managerial Economics", TMH
5. Lal and Srivastav, " Cost Accounting", TMH

Video Link
1
2
3

PW-ME805T PROJECT WORK PHASE-II

Practicals: 2 hrs. /week
Credits: 3
ISA: 100 Marks

Tutorials: NA
Total Credits: 3
POE: 100 Marks

Course Objectives: The objective of the course is to

1. Embed the skill in a group of students to work independently on a topic/ problem/ experimentation selected by them and encourage them to think independently on their own to bring out the conclusion under the given circumstances of the curriculum period in the budget provided with the guidance of the faculty.

2. Encourage creative thinking processes to help them to get confidence by planning and carrying out the work plan of the project and to successfully complete the same, through observations, discussions and decision making process.

Course Outcomes:

COs	At the end of successful completion of the course the student will be able to	Bloom's Taxonomy
CO1	Think creatively on real life engineering problems.	Knowledge, Understand,
CO2	Engineering knowledge to deduce proper solutions to real life engineering problems.	Knowledge, Understand, Application
CO3	Work in a team and acquire collaborative skills to achieve common goals.	Knowledge, Understand, Application
CO4	Learn independently, reflect on their learning and take appropriate actions to improve it.	Knowledge, Understand, Application, Synthesis
CO5	Communicate effectively and present ideas clearly with specific audiences in written and oral forms.	Knowledge, Understand, Application, Synthesis
CO6	Plan for activities in order to complete the task in predefined time.	Knowledge, Understand, Application, Create

Description:

The project work phase I can be a design project / experimental project and or computer simulation project or any of the topics related with Mechanical engineering stream. The project phase I work is allotted in groups on different topics. The students' groups are required to undertake the project Phase-I during the seventh semester and the same is continued in the eighth semester (Phase-II). Project Phase-I consists of reviews of the work carried earlier and the submission of a preliminary report. Report should highlight scope, objectives, methodology, approach and tools to be used like software and others, outline of project and expected results and outcome along with timeframe. The project phase I work is to be extended for project phase II at B. Tech. (Mech.) Sem. VIII with the same group working under guidance of the same Faculty member assigned for project phase I.

Prerequisites:	1:	Fundamentals of Mechanical Engineering
	2:	Report writing and Presentations Skills
	3:	Basic Communication skills

Project Work Phase II Load

A batch of maximum three groups of four to five students per group, shall work under one Faculty member of the department. The group of one student is strictly not allowed. Same groups of Seventh Semester shall work under the same faculty member of the department

Project Work Phase II Definition

Project work phase-II is a continuation of project phase-I started in the seventh semester. Before The end of the eighth semester, there will be two reviews, one at start of the eighth semester and other towards the end. In the first review, progress of the project work done is to be assessed. In the second review, the complete assessment (quality, quantum and authenticity) of the thesis is to be evaluated. Both the reviews should be conducted by guide and Evaluation committee. This would be a pre-qualifying exercise for the students for getting approval for the submission of the thesis. The final evaluation of the project will be external evaluation.

Project Phase II Term Work

The term work under projects submitted by students shall include

1. Work Diary: Work Diary maintained by group and countersigned by the guide weekly. The contents of the work diary shall reflect the efforts taken by project group for

a. Brief report preferably on journals/ research or conference papers/ books or literature surveyed to select and bring up the project.

b. Brief report of feasibility studies carried to implement the conclusion.

c. Rough Sketches/ Design Calculations/ Testing reports/ Experimentation results.

Project Report

Project report should be of 50 to 60 pages (typed on A4 size sheets). For standardization of the project reports the following format should be strictly followed.

1. Page Size: TrimmedA4
2. Top Margin: 1.00Inch
3. Bottom Margin: 1.32Inches
4. Left Margin: 1.5Inches
5. Right Margin: 1.0Inch
6. Para Text: Times New Roman 12 Point.Font
7. Line Spacing: 1.5 Lines
8. Page Numbers: Right Aligned at Footer. Font 12 Point Times New Roman
9. Headings: Times New Roman, 14 Point Boldface
10. Certificate: All students should attach a standard format of Certificate as described by the department. Certificate should be awarded to the batch and not to individual student. Certificate should have signatures of Guide, Head of Department and Principal/Director
11. Index ofReport:

i) TitleSheet

ii) Certificate
iii) Acknowledgement
iv) Table ofContents.
v) List ofFigures
vi) List of Tables

1. Introduction
2. Literature Survey/Theory
3. Design/ Fabrication/ Production/ Actual work carried out for the same and Experimentation.
4. ObservationResults
5. Discussion on Result and Conclusion

12. References: References should have the following format For Books: “Title of Book”, Authors, Publisher, Edition For Papers: “Title of Paper, Authors, Journal/Conference Details, Year
13. The Project report shall be signed by the each student in the group, approved by the guide and endorsed by the Head of theDepartment
14. Presentation: The group has to make a presentation in front of the faculty of department at the end of semester.

Important Notes:

1. Each Project group should continue maintaining a diary for project and should write (a) Book/s referred (b) Company/ies visited (c) Person/s contacted (d) Computer work done (e) Papers referred (f) Creative thinking.
2. The Diary along with Project Work Phase I Report shall be assessed at the time of oral examination
3. One copy of the report should be submitted to Institute/ Department, one copy to Guide and one copy should remain with each student of the project group.

In-Semester Assessment (ISA):

Department will constitute an Evaluation Committee to review the project phase I work on. The evaluation committee consists of faculty members of which are internal guide and another expert in the specified area of the project. The completion of work, the submission of the report and assessment should be done at the end of Part-II (Eighth semester).

Mark Distribution:

Concept – 25 Marks, Work Done – 25 Marks, Presentation – 25 Marks, Report – 25 Marks

Practical Oral Examination (POE):

Oral examination shall be conducted with presentation of the project phase I.
The distribution of marks shall be

40 marks for contribution of the student in the project work
40 marks shall be awarded for achieving the objectives of the project set forth.
20 marks for Question/ Answer

*The external examiner shall be preferably an Industrial expert from the same field.

Mapping of POs & COs:

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO 3
CO1	2	2	2	3	--	3	--	--	--	3	2	--	1	1	1
CO2	3	3	3	--	3	1	2	2	1	2	2	2	1	1	1
CO3	--	--	--	--	--	--	--	2	3	2	3	2	--	--	--
CO4	3	--	--	3	3	--	2	--	2	3	2	3	3	3	3
CO5	--	--	--	--	2	--	--	--	--	3	--	--	--	--	--
CO6	--	--	--	--	--	--	--	3	--	--	3	--	2	2	2

ME807 –AUDIT COURSE-VIII

Lectures	**:**	--	**Evaluation Scheme**		
Credit	**:**	Non-Credit	**ISE**	**:**	--
Tutorials	**:**	--	**ESE**	**:**	--
			Audit Point	**:**	02

Course Objectives:

The paper presentation makes much more interesting talk and it can help to develop the students' confidence. In addition, being published in reputable journals increases the visibility and credibility of students/researchers and promotes career opportunities.

Students have to submit certificate of paper presented or published to the department.

Course Particulars :

Paper presentation / Publication on Project.

Title of the Course: INDUSTRIAL INTERNSHIP Course Code:ME810 PCC	P	CH	Credit
	8-10 weeks	--	5
Evaluation Scheme	ISA	75	
	POE	75	

Course Pre-Requisite:
Domain knowledge of Mechanical Engineering

Course Description:

Under Internship, every student will undergo minimum 8 week and maximum 10 weeks training in an Industry. Each student will study the working of different departments of industry with implemented manufacturing technologies. Similarly student will identify a technical problem from selected industry and try to find out a feasible solution of the same. Student has to prepare and submit its report to the institute.

The Internship Pattern Course is designed to provide students with hands-on experience in a professional work environment related to their field of study. Students will have the opportunity to apply theoretical knowledge gained in the classroom to real-world scenarios and gain practical skills. Through internships, students will develop industry-specific competencies, enhance their professional network, and gain a deeper understanding of their chosen field.

Course Objectives:

1. Apply theoretical knowledge gained in the classroom to practical work situations.
2. Implement ideas/real time industrial problem/ current application.
3. Evaluate better solution for selected problem using state of the art topics in a broad area of his/her specialization.
4. Internship helps students to build confidence in handling and finding feasible solution of areal time industrial problem.

Course Outcomes:

CO1. Understand the functioning of company in terms of inputs transformation process and outputs crops and services.

CO2. Learn to adjust with the company culture, work norms, code of conduct.

CO3. Understand and follow the safety norms, code of conduct

CO4. Learn to observe, analyze and document the details as per industry practices.

CO5. Understand the processes, systems and procedures and to relate to the theoretical concepts-studies.

CO6. Write and present the report of industrial training

Duration: 8 to 12Weeks Details:

8 to 12 weeks of work at industry site. Supervised by an expert at the industry and Mentor of the Institute.

Term Work

- Students on joining Training at the concerned Industry / Organization, submit the Joining Report/Letters / Email.
- Before starting the internship, students are often required to submit a proposal outlining the objectives, scope, and expected outcomes of their internship to the mentor.
- Students undergo industrial training at the concerned Industry / Organization of required time period.
- Students will submit training report after completion of internship along with Training Certificate to be obtained from industry.
- Collect the Internship Completion Letter given by authorized industry and Mentor.
- Assess the work based on progress report (signed by industry expert).
- Mode of Evaluation: Internship Report, Presentation and Project Review.

Criteria of selection of students

The students who want to opt for industry internship which are required to fulfill the criteria specified.

1. Cgpi of students up to semester VI should be ≥ 7.00 (with no backlog)
2. Ready to move to the place where industry assignment is allotted.
3. The entire cost of the internship will be borne by the students (lodging, boarding,travelling and any other cost).

4. The students have to go through selection process of the company.
5. Maximum number of students will be decided based on the policy guidelines prepared from time to time.
6. Once the student is allotted the company (after final selection process) cannot be changed and it is binding on the student to complete the assignment in that company.

Criteria for listing the companies

1. It should be a medium or large scale industry having the functional departments and facilities to design develop and manufacture the products or offer services and potential to recruit engineers after training.
2. Company should provide minimum 2-3 internship assignments and projects and extend facilities to students the learning as well as access to data and information and guidance to complete the assign project.
3. Should be able to keep record of attendance and provide a mentor to monitor the project and help the students to sort out problem issues.

Internship execution procedure

The Internship Cell in association with Training and Placement Cell will arrange internship for students in industries/organization before the start of seventh semester. The following general procedure shall be adopted for execution of internship:

- **Step 1:** Request Letter/ Email from the Internship Cell of the department should go to industry to allot various slots of 8 to 10 weeks. Students request letter/profile/ interest areas may be submitted to industries for their willingness for providing the training.
- **Step 2:** Industry will confirm the training slots and the number of seats allocated for internships via Confirmation Letter/ Email. In case the students arrange the

internship themselves the confirmation letter will be submitted by the students in the Internship Cell. In this case, internship must be approved from Internship Cell. Based on the number of slots agreed to by the Industry, the Internship Cell will allocate the students to the industry. In addition, the internship slots may be conveyed through Telephonic or Written Communication (by Fax, Email, etc.) by the Internship Cell.

- **Step 3:** Students on joining Training at the concerned Industry / Organization, submit the Joining Report/Letters / Email.
- **Step 4:** Students undergo industrial training at the concerned Industry / Organization.
- **Step 5:** Students will submit training report after completion of internship along with Training Certificate to be obtained from industry.
- **Step 6:** List of students who have completed their internship successfully will be prepared by the Internship Cell.

Guidelines for the students

- All the students need to go for internship for minimum of 8 to 12 weeks.
- Students can take mini projects, assignments, case studies by discussing it with concerned authority from industry and can work on it during internship.
- All students should compulsorily follow the rules and regulations as laid by industry.
- Every student should take prior permissions from concerned industrial authority if they want to use any drawings, code or any other document or report from industry.
- Student should follow all ethical practices and SOP of industry.
- Students must take necessary health and safety precautions as laid by the industry.
- Student should contact his/her Faculty Mentor/Supervisor from college on weekly basis to communicate the progress.
- Each student must prepare internship report in consultation with the Faculty Mentor/Supervisor and submit it to a departmental internship coordinator.

Internship monitoring

Each student is assigned a faculty mentor by the institute who monitors the progress of both the internship and project and helps the student to sort-out in issues/problems arising. The faculty is scheduled to make three visits during the internship.

1.	At the beginning of the program	First week of the program
2.	Mid of the program (to review program)	After 4 Weeks
3.	At the end of internship	For evaluation

Note: Apart from these three scheduled visits, faculty on request of students/company will visit in case of any issue related to the internship project.

Evaluation of internship:

The industrial training of the students will be evaluated in following two stages:

1. Evaluation by Industry

   The industry will evaluate the students based on the Punctuality, eagerness to learn, Maintenance of Daily Diary and skill test in addition to any remarks.

2. Evaluation through seminar presentation/viva-voce at the Institute

   The student must give a seminar based on his training report, before an expert committee constituted by the concerned department as per norms of the institute. The evaluation is based on the following criteria: Quality of content presented, proper planning for presentation, Effectiveness of presentation, Depth of knowledge and skills, Attendance record, daily diary, departmental reports shall also be analyzed along with the Internship Report.

The assessment of the internship will be done jointly by the industry and faculty assigned to the students. The tentative scheme of the assessment will be

1.	Punctuality behavior and following code of conduct (to be assessed by company personal)	20%
2.	Initiative, observation and interest in learning new things (faculty in charge)	20%
3.	Familiarization with specific Department/shop/function assigned to the student (to be assessed by company personal)	10%
4.	Final evaluation based on presentation of work, internship report (Jointly by the company personnel and examiner appointed by Institute and faculty guide)	50%

Student should score minimum 50% marks in the assessment of Internship presentation. It is mandatory for successful completion of internship.

Different Document Formats for Industrial Internship

Different Formats for documents are available on the department web page of Institute Website

Annexure
I. Student internship program application format
II. Format for request letter from institute to internship provider
III. Student Daily Diary (Log) Recording Format
IV. Supervisor Evaluation of Intern Format
V. Student Feedback on Internship Format
VI. Evaluation of Internship by Institute Format

ME811 PCC–INDUSTRIAL ENGINEERING LAB

Practical : 2 Hr/Week
Credit : 1

Evaluation Scheme
ISA : 50 Marks
POE : NA

Course Objectives: The objective of the course is to

1.To introduce students the concepts, principles and framework of Industrial Engineering and various productivity enhancement techniques.
2. To understand Method study and time study techniques.
3. To acquaint the students with tools and technique of material handling.
4. To acquaint the students the concept of value analysis, job evaluation and merit rating.

Course Outcomes:

COs	At the end of successful completion of the course, the student will be able to	Blooms Taxonomy
CO1	Understand the tools and techniques to improve productivity	Knowledge
CO2	Manage and implement different concepts involved in method study and understanding of work content in different situations.	Apply
CO3	Study principles of motion economy	Analyze
CO4	Measure and estimate standard time for job.	Evaluate
CO5	Understand different types of plant layouts.	Understand
CO6	Interpret job evaluation and merit rating.	Create

Description:

In order to sustain in today's competitive world and to satisfy customers every industry is adopting cost reduction techniques to enhance the productivity.

Prerequisites:	1	Industrial Management and Operation Research

Practicals:

Sr. No.	Practical Topic	Hrs.	Bloom's Taxonomy
1	Problems on productivity.	2	Knowledge
2	Case study on method study.	2	Understand Analyze
3	Two handed process chart.	2	Understand Analyze
4	Stop watch time study for an operation.	2	Apply
5	Plant site location analysis.	2	Apply Analysis
6	Case study on Value analysis concept.	2	Evaluate

Mapping of POs & COs:

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

References:

Text Books:	
1	M. Telsang, "Industrial Engineering and Production Management", S. Chand Publication.
2	O.P. Khanna, "Work Study" Dhanpat Rai Publi. New Delhi.
3	M Mahajan, Industrial Engineering and Production Management, DhanpatRai and Co.
4	Banga and Sharma, Industrial Organization & Engineering Economics, Khanna publication.
5	Introduction to Work Study, ILO, Geneva and Oxford and IBH Publi. Co. Pvt.Ltd.

Reference Books:	
1	R.M. Barnes, "Motion and time study design and measurement of work" John Willey & Sons Inc. 7th Edi.
2	H.B. Maynard and others, "Industrial Engg. Handbook" IV th Edi. McGraw Hill Publi.
3	J.AdamEE,RJEbert"Production and Operation Management",Prentice Hall Englewood Cliff N.
4	David Sumanth, "Productivity Engg. And Management", Tata McGraw Hill, New Delhi.

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Academic Dean
T.K.I.E.T., Warananagar

Dean, Academic
Tatyasaheb Kore Institute of Engg.
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