GOVERNMENT COLLEGE OF ENGINEERING AMRAVATI

DEPARTMENT OF MECHANICAL ENGINEERING

PROPOSED CURRICULUM

For

B. TECH. FINAL YEAR (MECHANICAL)

Finalised after APEC meeting

(2022 - 2023)

PROGRAM OBJECTIVES

I. To prepare students for successful careers in industry/ higher studies /R&D institutions that meet global needs.

II. To provide students with solid foundation in basic science and basic engineering required to solve and analyze mechanical engineering problems.

III. To develop ability among students to solve industrial, environmental, Techno-social problems with latest and appropriate mechanical engineering techniques and tools available

IV. To inculcate professional skill, ethical responsibility, team work and leadership qualities in students.

V. To promote awareness of entrepreneurship, self-education, lifelong learning and to develop sense of social responsibility.

PROGRAM OUTCOMES

I. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

II. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

III. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

IV. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

V. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

VI. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

VII. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

VIII. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

IX. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

X. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

XI. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

XII. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES

1. Identify Mechanical Engineering related real life issues/ problems in industries, society and provide feasible solution

2. Apply the knowledge of the basic streams of Mechanical Engineering viz. thermal, design and production system to design mechanical system and product development

3. Plan and implement the activities in the small, medium and large enterprises as a part of team or as an individual

GOVERNMENT COLLEGE OF ENGINEERING, AMRAVATI
MECHANICAL ENGINEERING DEPARTMENT
SCHEME FOR III & IV Semester B. Tech. Mechanical Engineering

Category	Course Code	Name of the Course	Teaching Scheme (Hrs./week)				Evaluation scheme						Credits
							Theory			Practical			
			L	T	P	Total	MSE	TA	ESE	ICA	ESE	Total	
	Semester – III												
BSC	SHU321A *SHU322A	Differential Equations and Probability *Integral Calculus and Probability	3	-	-	3	30	10	60	-	-	100	3
PCC	MEU321	Thermodynamics	4	-	-	4	30	10	60	-	-	100	4
PCC	MEU322	Manufacturing Processes	4	-	-	4	30	10	60	-	-	100	4
PCC	MEU323	Materials Engineering	4	-	-	4	30	10	60	-	-	100	4
ESC	MEU324	Machine Drawing	3	-	-	3	30	10	60	-	-	100	3
MC	SHU323	Introduction to Constitution of India	1	-	-	1	-	20	30	-	-	50	0
LC	MEU325	Materials Engineering Lab	-	-	2	2	-	-	-	25	25	50	1
LC	MEU326	Machine Drawing Lab	-	-	2	2	-	-	-	25	25	50	1
			19	**-**	**4**	**23**	**150**	**70**	**330**	**50**	**50**	**650**	**20**
	Semester – IV												
BSC	SHU425	Human value and ethics	1	-	-	1		20	30	-	-	50	0
PCC	MEU421	Applied Thermodynamics-I	4	-	-	4	30	10	60	-	-	100	4
PCC	MEU422	Fluid Mechanics	4	-	-	4	30	10	60	-	-	100	4
PCC	MEU423	Manufacturing Technology	4	-	-	4	30	10	60	-	-	100	4
PCC	CEU430	Strength of Material	4	-	-	4	30	10	60	-	-	100	4
MC	SHU422	Environmental Studies	1	-	-	1	-	20	30	-	-	50	0
LC	MEU424	Fluid Mechanics Lab	-	-	2	2	-	-	-	25	25	50	1
LC	CEU431	Strength of Material Lab	-	-	2	2	-	-	-	25	25	50	1
			18		**4**	**22**	**120**	**80**	**300**	**50**	**50**	**600**	**18**

L – Theory lecture, T – Tutorial; P – lab work: Numbers under teaching scheme indicated contact clock hours
BSC- Basic Science; PCC – Program Core Course; ESC- Engineering Science; MC – Mandatory Course; LC- Lab Course
MSE- Mid Semester examination**; TA-** Teacher Assessment**; ICA** – Internal Continuous Assessment; **ESE** – End Semester Examination

***For the students directly admitted to second year (Lateral entry)**

GOVERNMENT COLLEGE OF ENGINEERING, AMRAVATI

MECHANICAL ENGINEERING DEPARTMENT

SCHEME FOR V & VI Semester B. Tech. Mechanical Engineering

Category	Course Code	Name of the Course	Teaching Scheme (Hrs./week)				Evaluation scheme						Credits
							Theory			Practical			
			L	T	P	Total	MSE	TA	ESE	ICA	ESE	Total	
	Semester – V												
PCC	MEU 521	Heat Transfer	4	-	-	4	30	10	60	-	-	100	4
PCC	MEU522	Machine Design –I	4	-	-	4	30	10	60	-	-	100	4
PCC	MEU523	Applied Thermodynamics-II	4	-	-	4	30	10	60	-	-	100	4
PCC	MEU524	Theory of Machines	4	-	-	4	30	10	60	-	-	100	4
PCC	MEU525	Turbo machines	4	-	-	4	30	10	60	-	-	100	4
MC	SHU522	Essence of Indian Traditional Knowledge	-	-	-	-	-	-	30	-	-	30	0
LC	MEU526	Thermal Lab-I	-	-	2	2	-	-	-	25	25	50	1
LC	MEU527	Theory of Machines Lab	-	-	2	2	-	-	-	25	25	50	1
PCC	MEU528	Seminar	-	-	2	2	-	-	-	50	-	50	1
			20		**6**	**26**	**150**	**50**	**330**	**100**	**50**	**680**	**23**
	Semester – VI												
PCC	MEU621	Instrumentation & Control	4	-	-	4	30	10	60	-	-	100	4
PCC	MEU622	New and Renewable Energy Sources	4	-	-	4	30	10	60	-	-	100	4
PCC	MEU623	Machine Design-II	4	-	-	4	30	10	60	-	-	100	4
PEC	MEU624	Program Elective-I	3	-	-	3	30	10	60	-	-	100	3
PEC	MEU625	Program Elective-II	3	-	-	3	30	10	60	-	-	100	3
OEC	MEU633	Open Elective-I	3	-	-	3	30	10	60	-	-	100	3
LC	MEU627	Design Lab	-	-	2	2	-	-	-	25	25	50	1
PROJECT	MEU628	Minor Project	-	-	6	6	-	-	-	50	50	100	3
			20		**8**	**29**	**180**	**60**	**360**	**75**	**75**	**750**	**25**

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MSE- Mid Semester examination**; TA-** Teacher Assessment**; ICA** – Internal Continuous Assessment; **ESE** – End Semester Examination

GOVERNMENT COLLEGE OF ENGINEERING, AMRAVATI
MECHANICAL ENGINEERING DEPARTMENT
SCHEME FOR VII & VIII Sem. B. Tech. Mechanical Engineering

Category	Course Code	Name of the Course	Teaching Scheme (Hrs./week)				Evaluation scheme						CreditS
							Theory			Practical		Total	
			L	T	P	Total	MSE	TA	ESE	ICA	ESE		
	Semester – VII												
PCC	MEU 721	Automation in Manufacturing	4	-	-	4	30	10	60	-	-	100	4
PCC	MEU 722	Gas Dynamics and Jet Propulsion	3	-	-	3	30	10	60	-	-	100	3
PEC	MEU 723	Program Elective-III	3	-	-	3	30	10	60	-	-	100	3
PEC	MEU724	Program Elective-IV	3	-	-	3	30	10	60	-	-	100	3
PEC	MEU 725	Program Elective-V	3	-	-	3	30	10	60	-	-	100	3
OEC	MEU 733	Open Elective-II	3	-	-	3	30	10	60	-	-	100	3
LC	MEU727	Manufacturing Lab	-	-	2	2	-	-	-	25	25	50	1
LC	MEU 728	Thermal Lab-II	-	-	2	2	-	-	-	25	25	50	1
			19	**-**	**4**	**23**	**180**	**60**	**360**	**50**	**50**	**700**	**21**
	Semester – VIII												
PEC	MEU 821	*Program Elective-VI	3	-	-	3	30	10	60	-	-	100	3
PROJECT	MEU 822	Project and Seminar / Industry Internship Project	-	-	24	24	-	-	-	200	200	400	12
			3	**-**	**24**	**27**	**30**	**10**	**60**	**200**	**200**	**500**	**15**

***Students going for Industrial Project/Thesis will complete above course through online platform such as MOOCs. , NPTL etc or by self-study mode and will directly appear for ESE only. (Total internal marks (MSE+TA) will be awarded proportional to ESE marks secure)**

L – Theory lecture, T – Tutorial; P – lab work: Numbers under teaching scheme indicated contact clock hours
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Program Elective Courses

MEU 624Elective-I		MEU 625Elective- II	
Sr. No.	Professional Courses	Sr. No.	Professional Courses
A	Internal Combustion Engines	A	Computation Fluid Dynamics
B	Mechatronic Systems	B	Total Quality Management
C	Mechanical Vibration	C	Industrial Robotics
D	Fracture Mechanics and Non-destructive Testing	D	Hydraulics and Pneumatics
E	Industrial Management	E	Operations Research Technique

MEU 723 Elective-III		MEU 724Elective- IV		MEU 725 Elective-V		MEU 821 Elective-VI	
Sr. No.	Professional Courses	Sr. No.	Professional Courses	Sr. No.	Professional Courses	Sr. No.	Professional Courses
A	Refrigeration and Air Conditioning	A	Power Plant Engineering	A	Automobile Engineering	A	Micro-scale Heat Transfer
B	Composite Materials	B	Production Planning and Cost Estimation	B	Machine Tool design	B	Micro and Nano Manufacturing
C	Finite Element Analysis	C	Computer Aided Design	C	Stress Analysis	C	Product Design and development
D	Computer Integrated Manufacturing	D	Energy Conservation and Management	D	Cryogenic	D	Supply Chain Management

Open Elective Courses

Sr. No.	MEU 633 Open Elective-I	Sr. No.	MEU 733 Open Elective- II
A	Thermal & Fluid Engineering	A	Alternative Sources of Energy
B	Operations Research	B	Nanotechnology and Surface Engineering
C	Industrial Management and Quality Control	C	Lean Manufacturing

Government College of Engineering, Amravati
Equivalence of Courses in Old Scheme with New Scheme
B. Tech : Mechanical Engineering
Year : Second Year (Semester – III & IV)

Sr. No.	Course in old scheme			Course in new Scheme		
	Course Code	**Course name**	**No. of Credits**	**Course Code**	**Course name**	**No. of Credits**
1.	MEU301	Material Science and Engineering	03	MEU323	Materials Engineering	4
2.	SHU301	General Proficiency – II	02	**No equivalence**		
3.	MEU302	Engineering Thermodynamics	04	MEU321	Thermodynamics	4
4.	SHU302	Engineering Mathematics –III	03	SHU321A *SHU322A	Differential Equations and Probability *Integral Calculus and Probability	4
5.	CEU303	Strength of Materials	04	CEU425	Strength of Material	4
6.	MEU303	Material Science and Engineering Lab.	01	MEU325	Materials Engineering Lab	1
7.	MEU307	Strength of Materials Lab.	01	CEU431	Strength of Material Lab	1
8.	EEU311	Electric Drives and Control	04	**No equivalence**		
9.	EEU312	Electric Drives and Control Lab.	01	**No equivalence**		
10.	MEU401	Fluid Mechanics	04	MEU422	Fluid Mechanics	4
11.	MEU402	Kinematics of Machines	04	No equivalence		
12.	MEU403	Thermal Engineering & Energy Conversion	4	MEU421	Applied Thermodynamics-I	4
13.	MEU404	Manufacturing Processes	04	MEU322	Manufacturing Processes	4
14.	MEU405	Machine Drawing	02	MEU324	Machine Drawing	3
15.	MEU406	Fluid Mechanics Lab	01	MEU424	Fluid Mechanics Lab	1
16.	MEU407	Kinematics of Machines Lab	01	**No equivalence**		
17.	MEU408	Manufacturing Processes Lab	01	**No equivalence**		
18.	MEU409	Computer Aided Drafting Lab	02	MEU326	Machine Drawing Lab	1
19.	**No equivalence**			MEU423	Manufacturing Technology	4
20.	**No equivalence**			SHU425	Human value and ethics	0
21.	**No equivalence**			SHU422	Environmental Science	0
22.	**No equivalence**			SHU323	Introduction to Constitution of India	0

Government College of Engineering, Amravati
Equivalence of Courses in Old Scheme with New Scheme
B. Tech: Mechanical Engineering
Year: Third Year (Semester – V & VI)

	Course in old scheme			Course in new Scheme		
Sr. No	**Course Code**	**Course name**	**No. of Credits**	**Course Code**	**Course name**	**No. of Credits**
1.	MEU501	Machine Design – I	3	MEU522	Machine Design –I	4
2.	MEU502	Dynamics of Machines	3	MEU524	Theory of Machines	4
3.	MEU503	Machining Processes	3			
4.	MEU504	Metrology and Measurement system	4			
5.	MEU505	Hydraulic Machines	3	MEU525	Turbo machines	4
6.	MEU506	Machine Design-I Lab.	1	MEU627	Design Lab	1
7.	MEU507	Dynamics of Machines Lab.	1	MEU527	Theory of Machines Lab	1
8.	MEU508	Machining Processes Lab.	1			
9.	MEU509	Metrology & Measurement System Lab.	1			
10.	MEU510	Hydraulic Machine Lab	1	MEU526	Thermal Lab-I	1
11.	MEU511	Self-study –I	2	MEU528	Seminar	1
12.	MEU601	Operation Research Management	3	MEU 633E	Operations Research Technique	3
13.	MEU602	Machine Design-II	3	MEU623	Machine Design-II	4
14.	MEU603	Heat Transfer	3	MEU521	Heat Transfer	4
15.	MEU604	Control Systems Engineering	3	MEU621	Instrumentation & Control	4
16.	MEU605	Industrial Management and Quality Control	3	MEU 633B	Industrial Management and Quality Control	3
17.	MEU606	Computational Lab.	1		-	
18.	MEU607	Machine Design – II Lab.	1	MEU627	Design Lab	1
19.	MEU608	Heat Transfer Lab.	1	MEU526	Thermal Lab-I	1
20.	MEU609	Control Systems Engineering Lab.	1		-	
21.	MEU610	Minor Project	2	MEU628	Minor Project	3

22.	MEU611	Self Study-II	2		-	
23.	MEU612	Industrial Lecture – I	-		-	
24.		-		MEU523	Applied Thermodynamics-II	4
25.				MEU622	New and Renewable Energy Sources	4
26.		-		SHU522	Essence of Indian Traditional Knowledge	0
27.		-		MEU624	Program Elective-I	3
28.		-		MEU625	Program Elective-II	3
29.		-		MEU633	Open Elective-I	3

Government College of Engineering, Amravati

Equivalence of Courses in Old Scheme with New Scheme

B. Tech: Mechanical Engineering

Year: Final Year (Semester – VII & VIII)

Course in old scheme				**Course in new Scheme**		
Sr. No	**Course Code**	**Course name**	**No. of Credits**	**Course Code**	**Course name**	**No. of Credits**
1	MEU701	Refrigeration and Air Conditioning	3	MEU 721	Automation in Manufacturing	4
2	MEU702	Computer Aided Design	3	MEU 722	Gas Dynamics and Jet Propulsion	3
3	MEU703	Elective-I	3	MEU 723	Program Elective-III	3
4	MEU704	Institute Level Elective	3	MEU724	Program Elective-IV	3
5	MEU705	Refrigeration and Air Conditioning Lab	1	MEU 725	Program Elective-V	3
6	MEU706	Computer Aided Design Lab.	1	MEU 733	Open Elective-II	3
7	MEU707	Elective-I Lab.	1	MEU727	Manufacturing Lab	1
8	MEU708	Project Stage-I	2	MEU 728	Thermal Lab-II	1
9	MEU709	Seminar	1			
10	MEU710	Industrial Training / Visit	2			
11	MEU711	Industrial Lecture - II	1			
12	MEU712	Self Study -III	2			
1	MEU801	Internal Combustion Engines	3	MEU 821	*Program Elective-VI	3
2	MEU802	Mechatronics	3	MEU 822	Project and Seminar / Industry Internship Project	12
3	MEU803	Elective-II	3			
4	MEU804	Elective-III	3			

Course in old scheme				Course in new Scheme		
5	MEU805	Internal Combustion Engines Lab.	1			
6	MEU806	Mechatronics Lab.	1			
7	MEU807	Elective-III Lab.	1			
8	MEU808	Project	6			
9	MEU809	Self Study- IV	2			

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MEU721 AUTOMATION IN MANUFACTURING

Teaching Scheme: 04 L Total: 04 Credits: 04
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE Total Marks: 100
Duration of ESE: 2hrs. 30 min.

Course objective:

I. To impart the concept of automation in manufacturing systems.
II. To inculcate the knowledge of Group Technology and automation.
III. To acquire the fundamental concepts of hydraulic systems, actuators their design and control devices, sequence and their operation.
IV. To induce the knowledge of rapid prototyping Technology and automated assembly system

Course contents:

Introduction: Definition, concepts of automation, Automation in manufacturing System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations. Introduction to automated material handling and storage – ASRS, AGV.

Types of Automation - Automation strategies, Group Technology & Coding Methods, Flexible Manufacturing System – Types, Advantages, Limitations. Computer Integrated Manufacturing and Computer Aided Process Planning.

Rapid Prototyping: Introduction to Rapid Prototyping, classification of RP Processes, working principle, models &specification process, application, advantages & disadvantages, Stereo Lithography Apparatus (SLA), Laminated Object Manufacturing,(LOM), 3D Printing, Fused Deposition Modelling (FDM). Rapid Tooling and STL format.

Hydraulic Fluid power Automation : Advantages of hydraulic fluid power automation, operational principles and uses of hydraulic power system, functioning of hydraulic components such as pumps, filters, control devices, linear and rotary actuators, hydraulic control for industrial application, design and development of hydraulic circuits for simple application areas involving selection of hydraulic components for specific applications, electro hydraulic principles and components used in electro-hydraulic, industrial applications based on electro hydraulic, proportional valves and activation technology ,industrial applications with proportional valves.

Pneumatic Systems: Operational principles and application, air compressors, Pneumatic cylinders and air motors, Pneumatic valves, functions of different pneumatic components and selection, construction of pneumatic controls and circuit diagrams for conveying, feeding, clamping, indexing, cutting and non-cutting operations. Programmable Logic Controller: Introduction, Micro PLC, Programming a PLC, Logic Functions, Input & Output Modules, PLC Processors, PLC Instructions

Automated assembly System: Design for Automated Assembly, Types of Automated Assembly Systems, Part Feeding Devices, Analysis of Multi-station Assembly Machines, Analysis of a Single Station Assembly Machine. Automated Inspection and Testing: Automated Inspection Principles and Methods, Sensor Technologies for Automated Inspection, Coordinate Measuring Machines, Other Contact Inspection Methods, Machine Vision, Other optical Inspection Methods.

Text books:

1. Mikell P Groover, “Automation, Production System and Computer Integrated Manufacturing”, Prentice Hall Publications, ISBN 81-203-0618-X, 2014
2. Robot and Manufacturing Automation, C. Ray Asfahl ,Amazon,
3. Assembly Automation and Product Design, Geoffrey Boothroyd,
4. Industrial hydraulic control, Peter Rohner, Wiley

Reference books:

1. Automatic Assembly. Boothroyd , C. Poli, L. Murch, Marcel Dekker Inc.
2. Mechanization by pneumatic control, Werner Deport and Kurt Stool, Vol. I and II.
3. Introduction to Manufacturing Technology, Date P. P., Principles and Practices, Jayco Publishers, Mumbai

Course Outcomes: Upon completion of this course the student will be able to:

MEU721.1 Understand the concept of Automaton and apply them in the integration of various manufacturing processes.

MEU721.2 Implement the various classification and types of automation strategies.

MEU721.3 Apply the Knowledge acquired in the fundamental concepts of hydraulic automation, their design and control devices, sequence and their operation through computer control.

MEU721.4 Analyse various automated flow lines, Explain assembly systems and line balancing methods and automatic assembly.

MEU721.5 Apply the Knowledge acquired in rapid prototyping and programmable logic controllers.

CO – PO –PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU721.1	3	2	2	2	0	1	0	0	0	0	0	2	1	2	0
MEU721.2	2	1	3	3	0	2	0	0	0	0	0	1	0	0	1
MEU721.3	2	2	2	2	0	0	0	0	0	0	0	1	0	1	0
MEU721.4	3	2	3	2	0	2	0	0	0	0	0	1	1	0	0
MEU721.5	2	2	2	2	0	0	0	0	0	0	0	0	0	1	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

MEU722 GAS DYNAMICS AND JET PROPULSION

Teaching Scheme: 03 L Total: 03 Credits: 03
Evaluation Scheme: 30 MSE +10 TA+ 60 ESE Total Marks: 100
Duration of ESE: 2hrs. 30min

Course objective:

I. To identify the basic distinction between Compressible and incompressible flow
II. To understand the occurrence of shock wave and its effect
III. To get some basic knowledge of Jet Propulsion and Rocket Propulsion

Course contents:

Basic concepts and isentropic flows: Energy and momentum equations of compressible fluid flows – Stagnation states, Mach waves and Mach cone – Effect of Mach number on compressibility – Isentropic flow through variable ducts – Nozzle and Diffusers

Flow through ducts: Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties.

Normal and Oblique Shocks: Governing equations – Variation of flow parameters across the normal and oblique shocks – Prandtl – Meyer relations – Applications.

Jet propulsion: Theory of jet propulsion – Thrust equation – Thrust power and propulsive efficiency – Operating principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines.

Space propulsion: Types of rocket engines – Propellants-feeding systems – Ignition and combustion – Theory of rocket propulsion – Performance study – Staging – Terminal and characteristic velocity – Applications – space flights.

Text Books:

1. Modern Compressible flow, Anderson, J.D,3rd edition, McGraw Hill, 2010
2. Fundamentals of Compressible Flow, Yahya, S.M, New Age International (P) Limited, New Delhi, 2003.
3. Gas Dynamics, Radhakisnan E, Prentice Hall of India publication Pvt.Ltd

Reference Books:

1. Gas Turbine Theory, Cohen. H., G.E.C. Rogers and Saravanamutto, Longman Group Ltd.2015
2. Gas Turbines, Ganesan. V, Tata McGraw Hill Publishing Co, New Delhi, 2015.
3. Dynamics and Thermodynamics of Compressible fluid Flow, Shapiro. A. H John, Wiley, New York, 2014.
4. Rocket Propulsion Element, Sutton GP, John Wiley Publisher, 2016

Course outcome:

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

MEU722.1. Apply the concept of compressible flows in variable of ducts

MEU722.2. Apply the concept of compressible flows in constant area of ducts

MEU722.3. Examine the effect of expansion and compression waves in compressible flow

MEU722.4. Use the concept of gas dynamics in Jet Propulsion

MEU722.5. Apply the concept of gas dynamics in space Propulsion

CO – PO –PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU722.1	3	2	2	3	0	0	0	0	0	0	0	0	3	3	0
MEU722.2	3	2	2	3	0	0	2	0	0	0	0	0	3	3	0
MEU722.3	3	3	2	3	0	0	0	0	0	0	0	0	3	3	0
MEU722.4	3	2	3	3	0	0	2	0	0	0	0	0	3	3	0
MEU722.5	3	3	3	2	0	0	2	0	0	0	0	0	3	2	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

MEU723 (A) REFRIGERATION AND AIR CONDITIONING

Teaching Scheme: 03 L+ 00T Total: 03 **Credits: 03**
Evaluation Scheme: 30 MSE +10 TA+ 60 ESE **Total Marks: 100**
Duration of ESE: 2hrs.30min

Course Objectives:

I. To appraise multi pressure vapor compression refrigeration systems
II. To learn aspects of vapor absorption refrigeration systems
III. To acquaint with applied psychometrics
IV. To familiarize with various air conditioning systems
V. To make heating load calculations in an air-conditioning system

Course contents:

Introduction: History, methods and applications of refrigeration; Types and applications of air conditioning systems; current status and future trends; air cycle refrigeration systems

Vapour compression refrigeration (VCR) systems: Analysis of simple VCR system; Use of *p-h* and *T-s* charts; Effect of operating conditions such as condenser and evaporator Pressure, superheating and sub-cooling; Actual VCR system

Refrigerants: Classification, desirable properties and designation of refrigerants; merits and demerits of commonly used refrigerants. Ozone depletion and global warming issues.

Multi pressure vapour compression systems: classification; compound compression systems, multi-evaporator systems, individual and multiple expansion valves

Vapour absorption systems: Simple vapour absorption cycle; practical absorption systems, comparison of vapour compression and absorption cycles

Refrigeration system components and controls: Brief description of compressors, condensers, evaporators, defrosting methods, expansion devices, accessories and refrigeration controls

Psychrometry of air conditioning processes: Properties of moist air; Psychrometric chart, Psychrometric processes, Psychrometric processes related to air conditioning

Air conditioning systems: Unitary system, window type and split type air conditioning; Central system: direct expansion system, all water and all air systems; winter, summer and year round air conditioning

Heating and cooling load calculations: Basic considerations, heat gain/losses, sensible and latent, heating load estimates, sensible heat factor, bypass factor, apparatus dew point.

Text Books:

1. Refrigeration and air conditioning, Ahmadul Ameen, Prentice Hall of India, New Delhi, 2006.
2. Refrigeration and air conditioning, C P Arora, Tata McGraw-Hill, 2nd edition, 2003.

Reference Books:

1. Refrigeration and air conditioning, W.F. Stoecker, J.W. Jones, McGraw-Hill, 1982.
2. Refrigeration and Air Conditioning, M. Prasad, New Age, 1985.

3. The ASHRAE Handbooks with CDs, 2005-2008.
4. Refrigeration and Air Conditioning Technology, 4th edition, J.A. Tomczyk, W.C. Whitman, and W.M. Johnson, Delmar S. Africa, 2000.

Course Outcomes:

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

MEU723A.1 Identify methods for performance improvement of vapour compression systems.

MEU723A.2 Analyse and suggest the multi pressure vapour compression refrigeration Systems.

MEU723A.3 Utilize vapour absorption refrigeration systems

MEU723A.4 Analyse air-conditioning processes using the principles of psychrometry.

MEU723A.5 Evaluate heating load to design an air-conditioning system.

CO – PO –PSO Mapping:

Course Outcomes	**Program Outcomes**														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU723A.1	3	3	3	2	0	0	0	0	0	0	0	2	3	2	0
MEU723A.2	3	3	3	3	0	0	0	0	0	0	0	2	3	3	0
MEU723A.3	3	3	3	2	0	0	0	0	0	0	0	2	3	3	0
MEU723A.4	3	3	3	3	0	0	0	0	0	0	0	2	3	2	0
MEU723A.5	3	3	3	3	0	0	0	0	0	0	0	2	3	2	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

MEU723 (B) COMPOSITE MATERIALS

Teaching Scheme: 03 L   Total = 03   **Credit: 03**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE   **Total Marks: 100**
Duration of ESE: 2 hrs. 30 min.

Course Objectives:

I. To name the main classification of composite materials and identify its characteristics
II. To know properties, applications of composite materials
III. To understand the mechanical behavior of composite materials
IV. To get an overview of the methods of manufacturing composite materials

Course contents:

Definition and applications of composite materials, fibers- glass, carbon, ceramic and aramid Fibers;

Matrices- polymer, graphite, ceramic and metal matrices; characteristics of fibers and matrices

Lamina-assumptions, macroscopic viewpoint, generalized Hooke's law, reduction of homogeneous orthotropic lamina, isotropic limit case, orthotropic stiffness matrix, commercial material properties, rule of mixtures, transformation matrix, and transformed stiffness

Manufacturing of composite materials, bag moulding, compression moulding, pultrusion, filament welding, other manufacturing processes

Basic assumptions of laminated anisotropic plates, symmetric laminates, angle ply laminates, cross ply laminates, laminate structural moduli, and evaluation of lamina properties

Determination of lamina stresses, maximum stress and strain criteria, von-Mises Yield criterion for isotropic materials, generalized Hill's criterion for anisotropic materials, Tsai-Hill's criterion for composites, prediction of laminate failure, thermal analysis of composite Laminates

Analysis of laminated plates, equilibrium equations of motion, energy formulation, static Bending analysis, buckling analysis, free vibrations, natural frequencies

Text Books:

1. Gibson R.F., Principles of Composite Material Mechanics, second edition, McGraw Hill,1994
2. Hyer M.W., Stress Analysis of Fiber- Reinforced Composite Materials, McGraw Hill,1998

Reference Books:

1. Materials Science and Engineering, An introduction. W. D. Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007
2. Composite Materials, K.K. Chawla, Springer, 2019
3. Composite Materials Science and Applications, Deborah D.L. Chung, Springer, 2010
4. Composite Materials Design and Applications, Daniel Gay, Suong V. Hoa, and Stephen W. Tasi, CRC Press, 2002.

Course Outcomes:

On completion of the course the students will be able to:

MEU723B.1 Differentiate between structure, property and applications of variety of composites

MEU723B.2 Analyze stress-strain relationship in composites

MEU723B.3 Suggest suitable composite material for the desired application

MEU723B.4 Determine suitable method of manufacture of composites

MEU723B.5 Predict failure of laminate

CO-PO-PSO Mapping:

Course Outcomes	**Program Outcomes**														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU723B.1	3	2	3	0	0	0	0	0	0	0	0	0	3	3	0
MEU723B.2	3	3	3	0	0	0	0	0	0	0	0	0	3	3	0
MEU723B.3	3	3	3	0	0	0	0	0	0	0	0	0	3	3	0
MEU723B.4	3	3	3	0	0	0	0	0	0	0	0	0	3	3	0
MEU723B.5	3	3	3	0	0	0	0	0	0	0	0	0	3	3	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

MEU723 (C) FINITE ELEMENT ANALYSIS

Teaching Scheme: 03 L + 00 T   Total: 03   Credits: 03
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE   Total Marks: 100
Duration of ESE: 02.30 Hrs.

Course Objectives:

I. To develop a practical approach to Finite Element Method (FEM) as tool to solve engineering problems.
II. To introduce the FEM and its applications to common problems in engineering, especially structural and thermal areas
III. To develop the proficiency in various transmission systems.

Course Contents:

Introduction: Basic concept, Historical background, engineering applications, general description, comparison with other methods, Need for weighted – integral forms, relevant mathematical concepts and formulae, displacement transformation matrix, stiffness matrix, weak formulation of boundary value problems, virational methods, Rayleigh –Ritz method and weighted residual approach

Finite Element Techniques: Model boundary value problem, finite element discretization, element shapes, sizes, and node locations, interpolation functions, shape functions, derivation of element equations, connectivity, boundary conditions, principal of potential energy, FEM solution, post-processing, Compatibility and completeness requirements, convergence criteria, higher order and iso-parametric elements, natural coordinates,

Applications to solid and structural mechanics problems: External and internal equilibrium equations, one-dimensional stress-strain relations, plane stress and strain problems, strain displacement relations, boundary conditions compatibility equations, analysis of trusses, frames and solids of revolution, computer programs.

Application to heat transfer problem: Vibrational approach, Galerkin approach, one-dimensional and two-dimensional steady state problems for conduction, convection and radiation

Application to fluid mechanics problems: In viscid incompressible flow, potential function and stream function formulation, incompressible viscous flow, stream function, velocity - pressure and stream function - vorticity formulation, solution of incompressible and compressible fluid film lubrication problems

Text Books:

1. An Introduction to Finite Element Method, J.N. Reddy, Tata McGraw Hill, New Delhi, 2nd Edition, 2005
2. Finite Element Analysis, P. Seshu, Prentice Hall India, New Delhi, First Edition, 2006

Reference Books:

1. Introduction to Finite Element Method, C S Desai, J F Abel, CBS Publishers, 2nd Edition, 2005
2. The Finite Element Method in Engineering, S. S. Rao, Elsevier India, Fourth Edition 2008

Course Outcomes:

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

MEU723C.1 Synthesize information and ideas for use in the evaluation process.

MEU723C.2 Develop governing equations of mechanical systems using domain knowledge and mathematical principles and apply principles of variation and integral forms of solution to formulate finite element problem.

MEU723C.3 Analyze and build FEA model for complex engineering problems.

MEU723C.4 Perceive the fundamental theory of the finite elements.

MEU723C.5 Develop skills to model the behavior of structures under mechanical and thermo-mechanical loads

Course Articulation Matrix

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU723C.1	3	1	3	0	0	0	0	0	0	0	0	0	3	2	0
MEU723C.2	2	3	2	3	0	0	0	0	0	0	0	0	1	3	0
MEU723C.3	2	2	3	3	0	0	0	0	0	0	0	0	2	2	0
MEU723C.4	2	2	3	2	0	0	0	0	0	0	0	0	2	3	0
MEU723C.5	2	2	3	2	0	0	0	0	0	0	0	0	1	2	0

0-no correlation 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

MEU723 (D) COMPUTER INTEGRATED MANUFACTURING

Teaching Scheme: 03 L **Total: 03** **Credits: 03**

Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**

Duration of ESE: 2hrs.30 min.

Course objective:

I. To impart the concept of computer integrated manufacturing and its implications
II. To inculcate the knowledge of robotic technology, kinematic analysis, Material Handling System and its applications.
III. Prepare the students to gain insight on Flexible Manufacturing System, Implementation considerations, manufacturing system components.
IV. To induce the knowledge of computer aided manufacturing and process planning,

Course Contents:

Introduction to C.I.M : Introduction, Types of data, Types of interfaces, Computer network structures, computerized production management systems, Inventory management, MRP, Operation scheduling, Process monitoring, Computer aided quality control, Testing/ Inspection methods.

Flexible Manufacturing System: Introduction, Components of FMS, Group Technology, Part classification and families, Composite part, Types of FMS layouts, Advantages of FMS.

Robotics: Robot configurations, Drives for robots, Sensors used in robotics, Programming technique, Programming languages, Applications, Latest development in Robotics.

Material Handling and Storage: Introduction handling and storage-ASRS, AGV.

Computer Aided Manufacturing :Numerical Control, Elements of a NC system, Steps in NC based manufacturing, Point to point, straight line and contouring control, Manual and Computer Assisted Part Programming, NC and APT programming, Adaptive control, Distributed Numerical Control.

Computer Aided Process Planning: Introduction, Retrieval and Generative CAPP systems, generation of Machining Data.

Text Books:

1. Systems Approach to Computer Integrated Design and Manufacturing", Nanua Singh, John Wiley & Sons,
2. Automation, Production Systems and Computer Integrated Manufacturing", Groover M.P, Prentice-Hall of India Pvt. Ltd., New Delhi, 2014
3. Group Technology in Engineering Industry", Burbidge, J.L. Mechanical Engineering pub. London
4. Ibrahim Zeid, "CAD/CAM Theory and Practice", Tata McGraw Hill Publication

Reference books:

1. Handbook of Flexible Manufacturing Systems” Jha N.K, Academic Press Inc., 1991.
2. G.T Planning and Operation, in The automated factory - HandBook: Technology and Management” Askin, R.G. and Vakharia, A.J, Cleland, D.I. and Bidananda, B (Eds), TAB Books, NY, 1991.
3. Cellular Manufacturing Systems” Irani S.A, Hand Book
4. Planning, design and analysis of cellular manufacturing systems” Kamrani, A.K, Parsaei, H.R and Liles, D.H. (Eds), ,Elsevier, 1995.
5. Principles of Process Planning”, A logical approach, Gideon Halevi and Roland D. Weill Chapman & Hall, 1995.

Course Outcomes: After completion of course, the students will be able to:

MEU723D.1 understand the concept of CIM and apply them in the integration of various Manufacturing processes.

MEU723D.2 Enlist features on which the parts are classified in part families for group Technology

MEU723D.3 Apply the Knowledge based scheduling, Hierarchy of computer control, Supervisory computer Manufacturing data systems, data flow and CAD/CAM.

MEU723D.4 Develop NC part program for the given component and robotic tasks.

MEU723D.5 Enlist various components of a typical FMS system, Robotics and CIM

CO-PO-PSO Mappings:

Course Outcomes	**Program Outcomes**														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU723D.1	1	0	0	1	0	1	0	0	0	0	0	0	1	2	0
MEU723D.2	2	2		1	3	2	0	0	0	0	0	1	0	0	1
MEU723D.3	2	2	2	1	2	1	0	0	0	0	0	0	0	1	0
MEU723D.4	2	3	3	1	0	3	0	0	0	0	0	0	1	0	
MEU723D.5	2	0	0	1	3	0	0	0	0		0	1	0	0	2

0 - no correlation 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

MEU724 (A) POWER PLANT ENGINEERING

Teaching Scheme: 03L+0T   Total: 03   Credits: 03
Evaluation Scheme: 30MSE+10TA+60ESE   Total Marks: 100
Duration ESE: 2hrs. 30min

Course Objectives:

I. To study different sources of energy and their economics and environmental impact
II. To understand the systems, performance of different power plants.
III. To explore the technology of renewable and new energy sources
IV. To outline waste disposal options for coal and nuclear power plants

Course Contents:

Energy, economic and environmental issues: different sources of energy , comparative study energy requirement , energy security, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.
Coal based thermal power plants: Rankine cycle , layout of modern coal power plant, super critical boilers, FBC boilers, Steam turbines, Steam condensers, subsystems of thermal power plants, fuel and ash handling, draught system, performance of boiler ,feed water treatment, binary cycles and cogeneration systems
Gas turbine and combined cycle power plants: Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants, Integrated Gasifier based Combined Cycle (IGCC) systems.
Nuclear energy conversion: Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants.
Non-conventional power plant: Hydroelectric power plants, classification, typical layout and components, Wind, Tidal, solar PV and Solar thermal,

Text Books:

1. Power Plant Engineering, Nag P.K., 4th Edition, McGraw Hill Education, July2017
2. Power Plant Engineering, Domkundwar and Arora Domkundwar, 8th edition Dhanpat Rai & Co. (P) Limited,1 January 2016
3. A Textbook of Power Plant Engineering, R.K. Rajput , 5th edition Laxmi Publications,1 January 2016

Reference Books:

1. Power Plant Technology, M. M. El-Wakil, Indian Edition, McGraw Hill Education, 1 July 2017.
2. Standard Handbook of Power plant Engineering Thomas Elliott, Kao Chen, Robert Swanekamp , 2nd Edition, McGraw Hill, 1998

3. Steam Turbine Theory And Practice, Kearton W.J., 7th edition,CBS Publishers & Distributors Pvt. Ltd., January 2004
4. A Textbook of Power Plant Engineering, R.K. Rajput, Fifth edition, Laxmi Publications

Course Outcomes: At the end of the course, the students will be able to:

MEU724 A.1 Explain the different energy sources, their economics and environmental impact

MEU724 A.2 Identify technologies of coal based thermal power plant, Gas Turbine, combined Cycle power plant, nuclear power plant, hydroelectric power plant and power Plant of renewable sources

MEU724 A.3 Estimate the performance of above power plants

MEU724 A.4 Design different systems of above power plants

MEU724 A.5 Compare the above pants on the basis of economics. Energy security, Environmental impact

CO-PO-PSO Mappings:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU724A.1	2	1	2	1	2	3	2	1	3	3	2	2	3	3	3
MEU724A.2	2	1	1	3	2	0	2	1	3	3	2	2	3	3	2
MEU724A.3	2	2	3	3	2	3	2	1	2	3	2	2	1	3	3
MEU724A.4	2	1	3	3	2	3	0	1	3	3	2	2	3	3	3
MEU724A.5	2	1	3	3	2	3	1	1	1	3	2	2	3	3	3

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3- Strongly Correlated

MEU724 (B) PRODUCTION PLANNING AND COST ESTIMATION

Teaching Scheme: 03 L **Total: 03** **Credits: 03**

Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**

Duration of ESE: 2hrs.30 min.

Course objective:

I To impart the concept of its implications of production planning in manufacturing systems.

II To inculcate the knowledge of forecasting, facility layout, operation planning

III Acquire the fundamental concepts of product development, their design and costing.

IV To induce the knowledge of inventory control, cost estimation in manufacturing system

Course contents:

Product Development and Design: Introduction**,** Functions of PPC, types of production, production consumption cycle, coordination of production decisions. Product Design and Company Policy, Product Analysis: Marketing Aspect, Product Characteristics, Economic Analysis, production Aspect.

Forecasting and Facility Layout: Introduction, Time Series Methods, Casual Methods, Forecast Errors. Facility Layout: Introduction, Flow Systems, Types of Layout: Product, Process, Group Layout, Computerized Layout Planning

Production and Operation Planning: Aggregate Planning, Strategies and techniques for Aggregate Planning, Production Planning in Mass Production Systems and Assembly Line Balancing, Sequencing problems such as 1 machine n jobs, 2 machines n jobs & its extension, m machines 2 jobs, scheduling jobs with random arrivals

Inventory Control: Inventory and its purpose, the relevant costs, selective inventory analysis (ABC analysis), Classical Inventory Model, EOQ with quantity discounts, EOQ for multiple items with constraints on resources, Safety Stock, determining safety stock when usage and lead time vary, Fixed Order Period Inventory Control System

Cost Estimating: Definition, purpose and functions of estimation, role of estimator, constituents of estimates, estimating procedures. Machine hour rate: Definition, constituents, direct cost, indirect cost, steps for estimation of machine hour rate for conventional machines, CNC lathe and machining centre. Labor Cost – Direct and indirect labor, Workmen classification, Definition of wages, Methods of remuneration.

Estimation of Weight and Material Cost: Process of breaking down product drawing in to simpler elements or shapes, estimating the volume, weight and cost.

Text books:

1. A. Elsayed and T. O. Boucher, “Analysis and Control of Production Systems”, Prentice Hall, 1985
2. D. Bedworth and J. E Bailey, “Integrated Production Control: System management, Analysis and Design”, John Wiley, 1983.
3. J. R. King, “Production Planning and Control”, Pergamon Press, Oxford, 1975.

Reference books:

1. P. F. Bestwick and K. Lockyer, “Quantitative Production Management”, Pitman Publications, 1982.
2. C. Hax and D. Candea, “Production and Inventory Management”, Prentice-Hall, 1984.
3. M.Y. Khan, P. K. Jain, “Theory & Problems of Management & Cost Accounting” TMH
4. N. K. Prasad, “Principles & Practice of Cost Accounting” Book Syndicate Pvt. Ltd.
5. J.S. Charaya & G. S. Narang, “A Text Book of Estimating and Costing Mechanical” Satya Prakashan
6. Bhattacharya A. K., “Principles and Practice of Cost Accounting”, Prentice Hall India

Course Outcomes: Upon completion of this course the student will be able to:

MEU724B.1 Able to understand the concept of production and operation planning and apply them in various manufacturing processes.

MEU724B.2 Ability to implement the various classification and types of production planning Strategies.

MEU724B.3 Ability to apply the Knowledge acquired in the fundamental concepts of product development, their design

MEU724B.4 Analyse inventory control, costs and their estimation.

MEU724B.5 Ability to apply the Knowledge acquired in forecasting and facility layout.

CO-PO-PSO Mappings:

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO 5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU724B.1	3	2	2	2	0	1	0	0	0	0	0	2	1	2	
MEU724B.2	2	1	3	3	0	2	0	0	0	0	0	1	0	0	1
MEU724B.3	2	2	2	2	0	0	0	0	0	0	0	1	0	1	0
MEU724B.4	3	2	3	2	0	2	0	0	0	0	0	1	1	0	0
MEU724B.5	2	2	2	2	0	0	0	0	0	0	0		0	1	0

0 - Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

MEU724 (C) COMPUTER AIDED DESIGN

Teaching Scheme: 03 L + 00 T   Total: 03   Credits: 03
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE   Total Marks: 100
Duration of ESE: 02hrs.30 min

Course Objectives:

I. To learn about engineering design through the use of computer aided design (CAD) software and hardware
II. To learn about graphical user interface, graphics systems and standards, different geometric modeling techniques like wire frame modeling, solid modeling etc.
III. To learn the fundamental concepts of the theory of the finite element method and to develop the skills needed to apply Finite Element Methods to Problems in Mechanical Engineering
IV. To enable the students to formulate the design 1D and 2D Problems into FEA.

Course Contents:

Fundamentals of CAD/CAM: Definition of CAD, implementation CAD, Design Process, Manufacturing Process, Application of computers for design, Benefits of CAD/CAM

Computer Graphics Software: Display Devices, Network Topologies, Ground rules for Graphics Software, The Software Configuration of a Graphics System, and Functions of a Graphics System, Constructing the Geometry, Transformation, Database Structure and Contents.

Automated Drafting: Configuration of typical drafting packages, layers, entities, editing, display commands, hatching, dimensioning, Text plotting, Script files, DXF and IGES files, blocks, Parametric programming, Customization of drafting packages and graphic standards.

Wire Frame, Surface and Solid Modeling: Modeling of curves and surfaces, cubic splines, Bezier splines Schemes for representing solid objects, Construction, Solid geometry and boundary representation, Feature of solid modeling packages

Finite Element Methods: Introduction, Importance, and Applications of FEA, Fundamental concepts, Discrimination, Numbering, Stress strain equilibrium, Stress –Strain relationship, Boundary and support conditions, and general steps of finite element method.

1D/2D Problems: Coordinate and Linear Shape Functions, The potential energy approach, The Galerkin approach, The global stiffness matrix, Boundary conditions , Penalty and Elimination Methods, Quadratic Shape Functions, Constant Strain Triangle CST, Isoperimetric representations, Development of Truss equations, Introduction to FEA packages.

Application of CAD: Application of CAD in 3D Printing and Reverse Engineering

Text Books:

1. Computer Aided Design and Manufacturing , Groover M.P., Prentice-Hall of India , 10th Edition ,2018
2. CAD/CAM Theory and Practice, Zeid Ibrahim, Tata McGraw Hill, 8th edition, 2019.

3. An Introduction to the Finite element Methods, Reddy, J.N., Tata McGraw Hill, 6rd Edition, 2019

Reference Books:

1. Automation Production Systems and Computer Integrated Manufacturing, Groover M. P., Prentice-Hall of India, 4th Edition, 2018.
2. CNC Machines, Pabla B.S., New Age International Publications, 1st Edition, Reprint 2019.
3. CAD/CAM Principals and Applications, Rao P.N. Tata McGraw Hill, 2018.

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

MEU724C.1	Illustrate the fundamentals of computer aided design, role of computer in design process
MEU724C.2	Describe technique of transformation of geometric entities using transformation matrix
MEU724C.3	Describe the technique of representation of geometric entities including points, lines, and parametric curves, surfaces and solid
MEU724C.4	Able to obtain an understanding of the fundamental theory of the FEA method
MEU724C.5	Demonstrate the understanding of FEA to solve real life 2D and 3D problem

CO-PO-PSO Mappings:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU724 C.1	2	3	2	0	2	0	0	0	0	0	0	0	3	2	0
MEU724C.2	2	0	2	3	2	0	0	0	0	0	0	0	2	3	0
MEU724C.3	2	0	3	0	2	0	0	0	0	0	0	0	0	3	0
MEU724C.4	2	0	2	3	0	0	0	0	0	0	0	0	0	3	0
MEU724C.5	2	0	2	3	3	0	0	0	0	0	0	0	0	3	0

0 - Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

MEU724 (D) ENERGY CONSERVATION AND MANAGEMENT

Teaching Scheme: 03L+ 0T Total: 03 Credits: 03
Evaluation Scheme: 30 MSE+10TA+60ESE Total Marks: 100
Duration of ESE: 2hrs. 30min

Course Objectives:

I. To introduce the concepts, techniques, design and applications of energy conservation and auditing.
II. To understand the methods of energy auditing in electrical systems in this course
III. To enable students to understand and implement the energy conservation in thermal , mechanical system
IV. To identify the problems, analyze the data and choose the relevant methods to apply.
V. To give solutions to the problems in field of energy conservation.

Course contents:

Introduction: energy & power scenario of world, National Energy consumption data, and environmental aspects associated with energy utilization; Energy Auditing- need, types, methodology and barriers, role of energy managers, instruments of energy auditing.
Energy Conservation in electrical systems: Components of electric billing, HT and LT supply, transformers, cable sizing; Concept of capacitors, power factor improvement, harmonics; Electric motors- motor efficiency, computation, energy efficient motors; Illumination- Lux, Lumens, types of lighting, efficacy, LED lighting and scope of energy conservation in lighting.
Energy Conservation in Thermal systems: Boilers, Furnaces and Thermic Fluid heaters-efficiency computation and energy conservation measures; Steam distribution and usage, steam traps, condensate recovery, flash steam utilization; Insulation & Refractoriness.
Energy conservation in major utilities: pumps, fans, blowers, compressed air systems, Refrigeration& Air Conditioning systems, Cooling Towers, DG sets.
Energy Economics: discount period, payback period, internal rate of return, net present value; Life Cycle costing- ESCO concept.

Text Books:

1. Energy Manager Training Manual (4 Volumes) available at www.energymanagertraining.com, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004

Reference Books:

1. Industrial energy management and utilization, Witte, L C, Schmidt, P S, and Brown, D R., United States: N. p., 1988. Web
2. Design and Management for Energy Conservation, Callaghn P.W., Pergamon Press, Oxford, 1981
3. The Efficient Use of Energy, Dryden. I.G.C., Butterworths, London, 1982
4. Energy Management Hand book, Turner. W.C., Wiley, New York, 1982

5. Energy Management ,Murphy W.R.; G.A. McKay, Butterworths, London, 1987

Course Outcomes:

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

MEU724 D. 1 To use the instruments of energy auditing

MEU724 D. 2 To audit the energy consumption of different industries

MEU724 D. 3 To suggest the strategy for its conservation of energy

MEU724 D. 4 To offer energy services, usually design, retrofitting and implementation of Energy efficiency projects

MEU724 D. 5 To implement the strategy of conservation of energy and to evolve new Solution

CO-PO-PSO Mappings:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU724D.1	2	1	2	1	2	3	2	1	3	3	2	2	3	3	3
MEU724D.2	2	1	1	3	2	2	2	1	3	3	2	1	3	3	2
MEU724D.3	2	2	3	3	2	3	2	1	1	3	2	2	1	3	3
MEU724D.4	2	1	3	3	2	3	1	1	3	3	2	2	3	3	3
MEU724D.5	2	1	3	3	2	3	1	1	2	2	2	2	3	3	3

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

MEU725 (A) AUTOMOBILE ENGINEERING

Teaching Scheme: 03 L + 00T **Total: 03** **Credits: 03**
Evaluation Scheme: 30 MSE +10 TA+ 60 ESE **Total Marks: 100**
Duration of ESE: 2hrs.30min

Course Objectives:

I. Introduction to engineering analysis of the automobile and its sub-systems.
II. Application of engineering principles to automotive design.
III. Familiarization with modeling and analysis methods.
IV. Familiarization with the automotive industry and its terminology

Course contents:

Engine, Engine Part and Mounting: Introduction, History, Classification of automobiles, Major components of Automobile and its functions, Chassis Types, Subsystems of automobile. Functions and locations, Power for propulsion, Vertical and horizontal engine acceleration, Merits and demerits, Hill climbing, Engine parts-types, Construction and functions.

Fuel System, Multiple Cylinder Engine & Cooling system: Types of Inlet manifold, Fuel pumps, fuel injectors for diesel engine, fuel filters, fuel gauges, Air filters, Basic principles & working of MPFI and CRDI, Auto emission and its control General considerations, Engine balance, Vibration, Firing order, Road performance curves, Engine maintenance and troubleshooting , Electronic engine Management, turbo chargers (WGT, VGT), engine emission control by 3-way catalytic converter system, Emission norms (Euro & BS). Types of cooling system, Anti-freeze mixtures, Troubles and remedies of cooling system, heating and air conditioning

Electrical Setup & Ignition System: Battery Capacity, Standard capacity rating, Battery life, battery testing, recharging of battery, starter motor drive - Bendix drive, Over running clutch drive, Solenoid switch Battery: construction, Types, Rating, Battery coil and magneto ignition system, Ignition timing and its effect on engine performance, Ignition advance mechanisms, Electronic ignition system, intelligent ignition system in two and four wheelers.

Transmission System: Clutch, Construction, Operation, Types, Requirements, Maintenance and troubleshooting, Gear Boxes, Sliding mesh, Constant mesh and synchromesh gear box, Double synchromesh type, over drives, Automatic transmission system, , CVT, Four wheel drive, Torque tube drive, Differential, Propeller shaft and universal joint rear axle assembly, steering and front axle, Function, Types of steering, Linkages, Steering gears, Steering gear ratio, Power steering

Wheels and Tyres, Brakes, Suspension System:: Alignment, Balancing, Camber, Castor, King pin inclination, Toe-in & Toe-out effects, Types of tyres, Mechanical, hydraulic brakes, disc brakes, Air brakes, and Vacuum brakes, Fault finding and maintenance of brakes, antiskid brake control system, Introduction**,** Need of suspension, Types, Maintenance and Trouble shooting.

Alternative energy sources, natural gas, LPG, biodiesel, bio-ethanol, gasohol and hydrogen fuels in automobiles, modifications needed, performance, combustion & emission characteristics of alternative fuels in SI and CI engines, Electric and Hybrid vehicles, application of Fuel Cells

Text books:

1. Automobile Engineering Kirpal Singh, 7 th ed., Standard Publishers, New Delhi, 1997.
2. Automobile Engineering Jain K.K. and Asthana R.B., Tata McGraw Hill, New Delhi, 2002.
3. Advanced Engine Technology Heisler H., SAE International Publ., USA, 1998.

Reference Books:

1. Automotive Mechanics, Joseph Heitner, 2nd Edition, CBS Publisher, New Delhi, 2004
2. Automobile Engineering, G. B. S. Narang, 2nd Edition, Khanna Publication, New Delhi, 2006

Course Outcomes: After completion of course, student will be able to:

MEU725A.1 Describe the vehicle construction, chassis, lubrication system and cooling system in automobile, 3-way catalytic converter.

MEU725A.2 Describe the principle and working of Carburetors, CRDI, MPFI, electronic fuel injection system and Ignition system.

MEU725A.3 Differentiate between clutch, gear box, rear axle drives, fluid flywheel, and torque converter.

MEU725A.4 Identify the wheels, tyres, steering gear box, suspension system-telescopic, and leaf spring

MEU725A.5 Appraise the recent trends in alternate fuels and automobile safety system

CO – PO –PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU 725A.1	3	2	3	0	2	3	2	1	3	3	2	2	3	3	3
MEU 725A.2	3	2	3	3	2	0	2	1	3	3	2	0	3	3	0
MEU 725A.3	0	2	3	3	2	3	2	1	0	3	2	2	0	3	3
MEU 725A.4	3	0	3	3	2	3	0	1	3	3	2	2	3	3	3
MEU 725A.5	3	2	3	3	2	3	2	1	3	3	0	2	3	0	3

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

MEU725 (B) MACHINE TOOL DESIGN

Teaching Scheme: 03 L **Total: 03** **Credits: 03**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2 hrs. 30 min

Course Objectives:

I Impart the critical knowledge of various machine internal parts.
II Illustrate the concept of dynamics of machining by varying parameters.
III Interpret different concepts of automation of machine parts.

Course contents:

Introduction: General requirements of Machine Tool Design, Kinematics of machine tool, Various driving systems used in machine tools, Mechanical, Electrical, Hydraulic, stepless regulation of speeds

Regulation of Speed and Feed Rates: Basic design consideration in the design of variable speed range in the machine tools, Layout of speed in geometric, logarithmic and arithmetic progression, Design of speed and feed boxes and their classification, Gear box design

Machine Tool Structure (bed, column, cross-rail): Functions and their requirements, design criterion for machine tool structure, design procedure, factors affecting stiffness of machine tool structure and their profile

Machine Tool Spindles: Functions of spindle, Materials and requirements for spindles, Design of spindles, Effect of Machine Tool Compliance on Machine Accuracy, Bearings for spindles

Machine Tool Guide-ways and Slide-ways: Design based on force of beds, slide ways, carriage, tables of Lathes, shapes of guide-ways and slide-ways of Milling machines, Materials, Methods of adjusting clearance in guide-ways.

Vibrations of Machine Tools: Effects of vibration on machine tool on cutting controls, work piece, tool life. Sources of vibrations, Types of vibrations (forced, chatter, stickup vibrations) and its minimization, Shock absorbers

Control systems in Machine Tools: Functions, Requirements and classification, control systems for speeds and feeds, various motions etc., Manual and automatic control systems**.**

Machine Tools Testing: Static and Dynamic rigidity, Methods of increasing rigidity of structure, Procedure for assessing dynamic stability, Dynamic characteristics, Stability analysis, Static and dynamic testing of machines as per Schlesinger's test and Tobias stability.

Text Books:

1. Machine Tool Design and Numerical Control, N. K Mehta, Tata McGraw Hill, Third Edition, 2012
2. Design of Machine Tools, D. K. Pal and S. K. Basu, Oxford-IBH, Fifth Edition, 2008

Reference Books:

1. Machine Tool Design Handbook, Central Machine Tool Institute, Bangalore, Tata McGraw Hill
2. Principles of Machine Tools, A. Bhattacharya and G. C. Sen, New Central Book Agency,

Calcutta, 3rd Edition,
3. Numerical Control and Computer Aided Manufacturing, T. Kundra, P.N. Rao, N. K. Tiwari, Tata McGraw Hill, 3rd Edition

Course Outcomes: After completion of course, students will be able to:

MEU725B.1 Demonstrate knowledge of standard machine tool elements and moving parts.

MEU725B.2 Articulate the concepts of dimensional measurement and explain its importance.

MEU725B.3 Interpret tool design methods and punch and die manufacturing techniques.

MEU725B.4 Explain effects of vibration on machine tool and cutting controls.

MEU725B.5 Analyze stability of machine tool and static/ dynamic testing of machines.

CO – PO – PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU725B.1	2	1	1	2	1	0	0	0	2	1	0	1	2	2	2
MEU725B.2	2	1	1	2	1	0	0	0	2	1	0	1	2	2	2
MEU725B.3	2	1	1	2	1	0	0	0	2	1	0	1	2	2	2
MEU725B.4	2	1	1	2	1	0	0	0	2	1	0	1	2	2	2
MEU725B.5	2	1	1	2	1	0	0	0	2	1	0	1	2	2	2

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

MEU725 (C) STRESS ANALYSIS

Teaching Scheme: 03L + 00T Total: 03 Credits: 03
Evaluation Scheme: 30 MSE + 10TA + 60 ESE Total Marks: 100
Duration of ESE: 2hrs.30min

Course Objectives:

I. To develop the foundations of stress and strain.
II. To describe displacement field, Hooke's constitutive law.
III. Analyzing stress problems through the application of the basic laws and equation.
IV. To understand the failure theories to solve practical problems.

Course contents:

Analysis of Stress: Introduction to tensor analysis, stress tensors, Cauchy's stress principle, Principal Stresses in three dimensions, Equilibrium equations, octahedral stresses, and Mohr's stress circle.

Analysis of Strain: Analysis of strain: Strain tensors, Strain transformation, Principal strains, Octahedral strains, Mohr Circle for strain, Equations of compatibility.

Stress -Strain Relations: Generalized Hooke's Law, Transformation of compatibility condition from strain components to stress components, Strain energy in an elastic body, St. Venant's principle, Uniqueness theorem.

Two dimensional Problems in Cartesian coordinate system: Plane stress and plane strain problems, Stress function, Stress function for plane stress and plain strain cases, Solution of two-dimensional problems with different, loading conditions by the use of polynomials.

Two Dimensional Problems in Polar Coordinate System: Strain-displacement relations, Compatibility equation, Stress-strain relations, Stress function and biharmonic equation, Antisymmetric problems, Effect of circular holes on stress distribution in plates.

Torsion of Prismatic Bars: General solution of the torsion problem, Torsion of circular and elliptic cross sections.

Experimental stress Analysis: Introduction to Photo elasticity, Moir, Holography, Speckle Methods etc.

Strain Gauge Technique: Strain measurement by resistance gauges, types of strain gauges, Equipment for indicating and recording strains transducer and its application.

Text Books:

1. "Applied Elasticity", T. G. Sitharam and L. Govindraju, Interline Publishers, Bangalore.
2. Theory of Elasticity (Third Ed.). Timoshenko, Stephen P.; James Norman Goodier (1970). Tata McGraw-Hill India Edition.
3. Failure of materials in mechanical design: analysis, prediction, prevention. Collins, Jack A. John Wiley & Sons

Reference Books:

1. "Foundations of Solid Mechanics". Y. C. Fung, Prentice- Hall Publishers.
2. "Foundations of Solid Mechanics", Arthur P. Boresi, Richard J. Schmidt, Wiley (2003).
3. Fatigue Design Handbook, Advances in Engineering Vol -4(SAE).

4. Experimental Stress Analysis: A Text Book for Engineering Students. Singh, Sadhu. Khanna publishers.
5. "Experimental stress analysis". Dally, James W., and William F. Riley.

Course Outcomes:

On completion of the course, the student will be able to:

MEU725C.1 Apply knowledge of failure theories appropriately to solve problems of practical interest with a variety of loading situations.

MEU725C.2 Analyze and calculate stress/strain distributions for 2D problems of elasticity using stress function approach

MEU725C.3 Describe stress strain measurement through experimental technique, and stress-strain relation of composite materials.

MEU725C.4 Describe various equipment required to perform the experimental stress-strain analysis.

MEU725C.5 Describe the displacement field, Hooke’s constitutive law.

CO – PO –PSO Mapping:

Course Outcomes	**Program Outcomes**														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU725C.1	3		2	2	0	0	0	2	0	0	1	3	1	1	0
MEU725C.2	3	2	2	2	0	0	0	2	0	0	1	3	0	0	0
MEU725C.3	3	2		2	0	0	0	2	0	0	1	3	1	0	
MEU725C.4	3	2	2	2	0	0	0	2	0	0	1	3	0	1	0
MEU725C.5	3		2	2	0	0	0	2	0	0	1	3	0	1	0

0- Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 – Strongly Correlated

MEU725 (D) CRYOGENICS

Teaching Scheme: 03 L+ 00T **Total: 03** **Credits: 03**
Evaluation Scheme: 30 MSE +10 TA+ 60 ESE **Total Marks: 100**
Duration of ESE: 2hrs.30min

Course Objectives:

I. To recognize the evolution of low temperature science
II. To get overview on the properties of materials at low temperature
III. To study various gas liquefaction systems
IV. To learn aspects of cryogenic storage and transfer
V. To acquaint with the applications of cryogenics

Course contents:

Introduction: Historical development, low temperature properties of engineering materials, mechanical properties, thermal properties, electric and magnetic properties. Cryogenic fluids and their properties, Overview of applications.

Liquefaction systems: Ideal system, Joule Thomson expansion, adiabatic expansion, Linde Hampson Cycle, Claude & Cascaded System, Magnetic Cooling, Stirling Cycle, Cryo Coolers.

Gas liquefaction systems: Introduction, Production of low temperatures, General Liquefaction systems, Liquefaction systems for Neon, Hydrogen and Helium, Critical components of Liquefaction systems.

Cryogenic Refrigeration systems: Ideal Refrigeration systems, Refrigeration using liquids and gases as refrigerant, Refrigerators using solids as working media.

Cryogenic fluid storage and transfer systems: Cryogenic Storage vessels and Transportation, Thermal insulation and their performance at cryogenic temperatures, Super Insulations, Vacuum insulation, Powder insulation, Cryogenic fluid transfer systems.

Applications of Cryogenics: Broad applications in space, Food Processing, super conductivity, Electrical Power, Biology, Medicine, Electronics and Cutting Tool Industry.

Text Books:

1. Cryogenic Systems, Randal F.Barron, McGraw Hill, 1986.
2. Fundamentals of Cryogenic Engineering, Mamata Mukhopadhyay, PHI, 2010.
3. Cryogenic Engineering, Revised and Expanded, Thomas Flynn, CRC, 2004.

Reference Books:

1. Cryogenic Technology and Applications, A. R. Jha, Butterworth-Heinemann, 2005.
2. Cryogenic Engineering, Fifty Years of Progress, Klaus D. Timmerhaus and Richard P. Reed, Springer, 2007.
3. Handbook of Cryogenic Engineering, Editor – J.G. Weisend II, Taylor and Francis, 199

Course Outcomes:

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

MEU725D.1 Identify effect of cryogenic treatment on properties of materials.

MEU725D.2 Illustrate concepts of liquefaction of gases.
MEU725D.3 Explain principles of cryogenic systems.
MEU725D.4 Summarize ultra-low temperature systems and their applications.
MEU725D.5 Illustrate aspects of cryogenic fluid storage.

CO – PO –PSO Mapping

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU725D.1	3	2	2	0	0	0	0	0	0	0	0	0	3	2	0
MEU725D.2	3	3	3	2	0	0	0	0	0	0	0	0	3	3	0
MEU725D.3	3	3	3	2	0	0	0	0	0	0	0	0	3	3	0
MEU725D.4	3	2	3	0	0	0	0	0	0	0	0	0	3	2	0
MEU725D.5	3	2	2	0	0	0	0	0	0	0	0	0	3	2	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

MEU733 (A) ALTERNATIVE SOURCES OF ENERGY

Teaching Scheme: 03L + 00T Total: 03 Credits: 03
Evaluation Scheme: 30 MSE+10TA+60 ESE Total Marks: 100
Duration of ESE: 2hrs.30min

Course Objectives:

I. To provide students an overview of global energy resources.
II. To introduce students to Wind Energy, Tidal and Ocean Energy, Geothermal Energy and Magneto Hydrodynamics, Nuclear Energy, solar energy and biomass Energy
III. To expose students to future energy systems and energy use scenarios with a focus on promoting the use of renewable energy resources and technologies.

Course contents:

Principles of solar radiation:
Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extra-terrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

Solar energy collection: Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

Solar energy storage and applications: Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating, cooling techniques, solar distillation and drying, photovoltaic energy conversion.

Wind Energy: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria.

Bio-Mass: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, IC Engines operation on Bio-mass and their economic aspects.

Geothermal Energy: Resources, types of wells, methods of harnessing the energy, potential in India.

Ocean Energy: Ocean Thermal Energy Conversion, Principles utilization, setting of Ocean Thermal Energy Conversion plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.

Direct Energy Conversion: Need for direct energy conversion, Carnot cycle and its limitations, principles of direct energy conversion. Thermo-electric generators, see-beck, Peltier and Joule-Thomson effects, Figure of merit, materials, applications, MHD generators, principles, dissociation and ionization, hall effect, magnetic flux, MHD accelerator, MHD Engine, power generation systems, electron gas dynamic conversion, economic aspects. Fuel cell principle, Faraday’s law, thermodynamic aspects, selection of fuels and operating conditions.

Text Books:

1. "Renewable Energy Technologies", Chetansing h Solanki, Prentice Hall of India, 2008.
2. Fundamentals of Renewable Energy Resources, G. N.Tiwari and M. K. Ghosal, Narosa Publishing House, 2007
3. Solar Energy, Sukhatme, 3rd Edition, Tata McGraw-Hill Education, 2008

Reference books:

1. Renewable Energy Resources, John Twidell & Anthony D. Weir, 2nd Edition, Taylor & Francis, 2006
2. Thermal Energy, Mahesh Rathore, Tata McGraw-Hill Education, 2010
3. Principles of Solar Energy, D. Yogi Goswami, Frank Krieth & John F Kreider, 2nd Edition, Taylor & Francis, 2000
4. Non-Conventional Energy, Ashok V Desai, Wiley Eastern Ltd. New Delhi, 2003
5. Non-Conventional Energy Systems, K. Mittal, Wheeler Publishing, 1997
6. Renewable Energy Technologies, R. Ramesh, K. Uday Kumar, M. Anandakrishnan, Narosa Publishing House, 1997
7. Non-Conventional Energy Sources, G.D. Rai, 4th Edition, Khanna publishers, 2009

Course Outcomes:

On completion of the course, the student will be able to:

MEU726A.1 Identify renewable energy sources and their utilization.

MEU726A.2 understand the basic concepts of solar radiation and analyze the working of solar PV and thermal systems.

MEU726A.3 Understand principles of energy conversion from alternate sources including Wind, geothermal, ocean, biomass, biogas and hydrogen.

MEU726A.4 Understand the concepts and applications of fuel cells, thermoelectric convertor and MHD generator.

MEU726A.5 Identify methods of energy storage for specific applications

CO – PO – PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU726A.1	1	2	3	0	2	3	3	3	2	2	2	1	2	1	1
MEU726A.2	3	2	2	2	3	2	2	2	3	1	0	2	3	2	2
MEU726A.3	1	3	2	2	2	3	1	3	2	2	2	1	2	1	2
MEU726A.4	2	0	2	2	1	2	3	3	3	1	0	1	1	3	0
MEU726A.5	0	1	3	3	1	3	3	1	1	1	2	2	2	1	1

0- Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 – Strongly Correlated

MEU733 (B) NANOTECHNOLOGY AND SURFACE ENGINEERING

Teaching Scheme: 03 L **Total: 03** **Credits: 03**
Evaluation Scheme: 30 MSE +10 TA+ 60 ESE **Total Marks: 100**
Duration of ESE: 2hrs.30min

Course Objectives:

I. To understand the concept of nanotechnology and nanoscience in the industries and in consumer products.
II. To develop essential knowledge of the surface engineering and surface modification along with its various technologies in demand.
III. To understand standard methods for surface modification.

Course contents:

Basic Elements of Nano-science and Nanotechnology: Engineering scale of nanotechnology, different classes of nano-materials, Advantages and limitations of nanomaterials, Properties of some important nanomaterials such as carbon nanotubes, nano clay, metal nanowires,.

Carbon Nanotubes (CNTs): Structure and Properties of CNTs, Classification of CNTs, Synthesis methods, purification and functionalization of CNTs.

Tools to characterize Nanomaterials: X-Ray Diffraction (XRD), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Scanning Probe Microscopy, Atomic Force Microscopy, UV/Visible Spectroscopy.

Engineering applications of Nanotechnology- Composites, coating, packaging, automobile tires, electrical/ electronics, optical, magnetic, solar cells, computer chips, display, sensors, actuators, fuel cells, and bio-medical fields, medicine/dentistry/artificial/implants, Cosmetics and Consumer Goods, Nano Sensor, Water Treatment and the Environment, Paints, Food and Agriculture Industry

Surface Engineering: Introduction to surface engineering, Scope of surface engineering for different engineering materials, Surface Preparation methods such as Chemical, Electrochemical, Mechanical: Sand Blasting, Shot peening, Shot blasting, Hydro-blasting, Vapor Phase Degreasing etc., Coatings: Classification, Properties and applications of Various Coatings.

Different methods for surface modifications: Surface modification by use of directed energy beams, Plasma, Sputtering & Ion Implantation. Surface modification by Friction stir processing. Surface composites.

Text Books:

1. Textbook of Nanoscience and Nanotechnology, B.S. Muty, P. Shankar, Baldev Raj, B.B Rath and James Murday, University Press, 2016
2. Nanostructures and Nanomaterials: Synthesis, Properties and Applications by G. Cao, Imperial College Press, 2004.
3. Surface Preparation and Finishes for Metal, James A. Murphy, McGraw-Hill, New York 1971

Reference Books:

1. Introduction to Nanotechnology by Charles P. Poole Jr and. Frank J. Owens, Wiley-Inter science, 2003.
2. Nanoscale Science and technology by Robert Kelsall (editor), Ian W. Hamley (co-editor), Mark Geoghegan (co-editor) ,2005
3. The Chemistry of Nanomaterials: Synthesis, Properties and Applications by C. N. R. Rao, A. Muller, A. K. Cheetham, WILEY-VCH Verlag GmbH & Co. K GaA, Weinheim, 2004
4. Nanoscale Materials in Chemistry Edited by Kenneth J. Klabunde, John Wiley & Sons, Inc., 2009
5. Surface Engineering Hand Book, edited by Keith Austin, London : Kogan Page, 1998

Course Outcomes:

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

MEU726B.1 Understand the basic concepts of Nanoscience and Nanotechnology.

MEU726B.2 Explain carbon nanotubes and their synthesis.

MEU726B.3 Use to characterize nanomaterials tools & methods in the domain of engineering.

MEU726B.4 Apply of nanotechnology in modern engineering and industrial domain.

MEU726B.5 Comprehend the basics of Surface Engineering and understand the importance & role of surface modifications to achieve several technological properties.

CO – PO –PSO Mapping:

Course Outcomes	**Program Outcomes**														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU726B.1	0	0	2	3	3	3	3	1	3	3	2	3	2	2	3
MEU726B.2	0	2	2	2	2	1	2	1	3	3	2	3	2	2	3
MEU726B.3	0	2	2	3	2	3	2	1	3	2	2	2	3	2	3
MEU726B.4	1	1	3	3	2	3	3	1	2	2	2	2	3	2	3
MEU726B.5	1	1	3	3	2	3	2	1	3	3	1	2	2	1	2

0 - Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

MEU 733 (C) LEAN MANUFACTURING

Teaching Scheme: 03 L **Total: 03** **Credits: 03**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **TOTAL MARKS: 100**
Duration of ESE: 2 hrs. 30 min

Course Objectives:

I Impart the knowledge of basic lean manufacturing and it applications.
II Illustrate different concepts and elements of lean manufacturing
III Interpret different approaches for lean manufacturing implementation
IV Introduce lean manufacturing assessment.

Course contents:

Introduction to lean manufacturing: history, Need, Benefits, Limitations and Applications of lean Manufacturing
Concepts in lean manufacturing: Overview of the Toyota Production System (TPS), Concept of value in lean, concept of waste in lean, Eight sources of waste their causes and remedies.
Elements of lean manufacturing: Primary tools of lean manufacturing such as 5S, Value Stream Mapping, Tool Productive Maintenance and work cell
Secondary tool of lean manufacturing: Just in time Single minute exchange of die, design of manufacturing and assembly, poke yoke, Kanban system, Visual management, Lean Vs Push Manufacturing.
Implementation of lean Manufacturing: Different approaches for lean manufacturing implementation, important factors in lean implementation, barriers and limitations in lean implementations.
Lean Manufacturing assessment: introduction to Lean audits, Employee involvement in the change process improvement of working culture by lean Manufacturing.

Text books:

1. Lean thinking , James Womack and Daniel Jones, Free press
2. The Toyota Way of Field book, Jeffery Liker and David Meier, McGraw-Hill
3. The Kaizen Blitz by Laraia, Moody and Hall , Weily

Reference books:

1. Lean production Simplified , Pascal Dennies , Productivity Press

Course Outcomes: After completion of course, student will be able to

MEU726C.1 Explain the concept, history and application of lean manufacturing.
MEU726C.2 Interpret different elements of lean manufacturing.
MEU726C.3 Interpret different tools of lean manufacturing.
MEU726C.4 Implement lean manufacturing in real life situation.
MEU726C.5 Perform lean manufacturing assessment

CO – PO – PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU726C.1	2	1	1	2	1	0	0	0	2	1	0	1	2	2	2
MEU726C.2	2	1	1	2	1	0	0	0	2	1	0	1	2	2	2
MEU726C.3	2	1	1	2	1	0	0	0	2	1	0	1	2	2	2
MEU726C.4	2	1	1	2	1	0	0	0	2	1	0	1	2	2	2
MEU726C.5	2	1	1	2	1	0	0	0	2	1	0	1	2	2	2

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

MEU727 MANUFACTURING LAB

Teaching Scheme: 02 P **Total: 02** **Credit: 01**
Evaluation Scheme: ICA 25 + ESE 25 **Total Marks: 50**
Duration of ESE: 3 hrs.

Course Objectives:

I To understand the making of pattern using pattern making tools for sand casting
II To demonstrate the preparation of two box green sand mould and to understand the construction /working principle of metal melting furnace CUPOLA
III Practice of making a composite job with the help of Electric Arc welding and Gas welding.
IV Plan the one job on lathe covering taper turning and threading and one composite job on shaper, milling, drilling, grinding machine.

List of Experiments:

1. **Pattern Making Shop:** Study of different types of patterns and pattern making tools, one job on preparation of a pattern.
2. **Foundry Shop:** Study of any two furnaces, Study of foundry tools, Demonstration of casting Sand preparation and testing. One job on preparation of green sand mould.
3. **Welding Shop:** Preparation of a composite job with the help of Electric Arc Welding and Gas welding.
4. **Machine Shop:** To prepare one job on lathe covering taper turning and threading and one composite job on shaper, milling, drilling, grinding machine.

Note:

ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A&B

ESE: The end semester Exam for practical shall be based on performance in one of the experiments and may be followed by sample questions

Course Outcomes: After completion of course, student will be able to:

MEU727.1 Demonstrate a pattern using pattern making tools for sand casting
MEU727.2 Construct the two box green sand mould and interpret the working of Cupola
MEU727.3 Prepare a composite job with the help of Electric Arc Welding and Gas Welding.
MEU727.4 Illustrate a job on lathe covering taper turning and threading and one Composite job on shaper, milling, drilling, grinding machine.
MEU727.5 Interpret necessity, principle, advantages, disadvantage, limitations, applications of Machining Processes

CO – PO – PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU727.1	2	1	1	2	1	0	0	0	2	1	0	1	2	2	2
MEU727.2	2	1	1	2	1	0	0	0	2	1	0	1	2	2	2
MEU727.3	2	1	1	2	1	0	0	0	2	1	0	1	2	2	2
MEU727.4	2	1	1	2	1	0	0	0	2	1	0	1	2	2	2
MEU727.5	2	1	1	2	1	0	0	0	2	1	0	1	2	2	2

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

MEU728 THERMAL LAB – II

Teaching Scheme: 02 P Total: 02 **Credit: 01**
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks: 50**

Course Objectives:

I. To understand the performance of IC Engines
II. To find calorific values of solid and liquid fuels
III. To study the performance of steam generator-turbine
IV. To find coefficient of performance of refrigeration system.

Minimum Eight Experiments (five to be selected by course teacher and three performance experiments by the student) to be performed to achieve course outcomes

List of Experiments:

The following is a representative list of practical/exercises. The instructor may choose experiments to fulfill the course outcomes.

1. Constant speed performance test on a single-cylinder CI engine.
2. Heat balance test on a single-cylinder CI engine.
3. Motoring and retardation tests on a single-cylinder CI engine.
4. Morse test on a 4-cylinder SI engine.
5. Constant speed performance test on a dual fuel engine.
6. Constant speed performance test on a VCR engine by varying compression ratio, fuel injection pressure and start of injection.
7. Performance test on reciprocating air compressor
8. Constant speed performance test on a centrifugal blower.
9. Performance evaluation of a PV cell array in series and parallel modes using solar simulator.
10. Performance evaluation of solar flat plate collector in natural and forced circulation modes.
11. Performance evaluation of DMFC and PEM fuel cells.
12. Study of Boilers.
13. Junker's Calorimeter: Determination of the calorific value of the given gas sample.
14. Bomb Calorimeter: Determination of the calorific value of the given sample of liquid/solid fuel.
15. Smoke meter and Exhaust gas analyzer: Measurement of smoke density and composition of the engine exhaust of a CI Engine during a constant speed performance test.
16. Determination of COP of a refrigeration system
17. Experiments on Psychometric processes

ICA – The Internal Continuous Assessment shall be based on practical record and knowledge or skills acquired. The performance shall be assessed experiment wise by using continuous assessment format, A & B.

ESE- The End Semester Exam for Practical shall be based on performance in one of the experiments and may be followed by sample questions.

Course Outcomes:

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

MEU728.1. Evaluate the performance of IC Engines and draw heat balance sheet.

MEU728.2. Investigate the performance of reciprocating air compressor

MEU728.3. Analyze the performance PV cell array, solar flat plate collector.

MEU728.4. Find the COP of refrigeration system

MEU728.5. Determine of the calorific value of the given liquid/solid/gas fuel.

CO – PO – PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU728.1	3	2	3	2	2	3	2	1	3	3	2	2	3	3	3
MEU728.2	3	2	3	3	2	2	2	1	3	3	2	1	3	3	2
MEU728.3	2	2	2	3	2	3	2	1	2	3	2	2	2	3	3
MEU728.4	3	3	3	3	2	3	1	2	3	3	2	2	3	3	3
MEU728.5	3	2	3	3	2	3	2	2	3	3	2	2	3	3	3

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

MEU 821 (A) MICRO-SCALE HEAT TRANSFER

Teaching Scheme: 03 L+ 00T Total: 03 Credits: 03
Evaluation Scheme: 30 MSE +10 TA+ 60 ESE Total Marks: 100
Duration of ESE: 2hrs.30min

Course Objectives:

I. To recognize basic concept of micro-scale systems
II. To study the analytical aspects of micro-scale conduction, convection and radiation
III. To acquaint with heat transfer using Nano-particles and applications

Course contents:

Micro-scale systems: overview of macro-scale thermo-fluid sciences, science and technology background of micro-scale systems, basics of kinetic theory and statistical mechanics, thermodynamic relations, Boltzmann transport equations.
Micro-scale heat conduction, hyperbolic heat conduction equation, basics of electron and phonon transport, thermal conductivity models.
Micro-scale convection, Knudsen number and flow regimes, continuum approach, slip models, heat transfer in Poiseuille micro-flows, single phase convection in mini and micro channels using liquids and gases, boiling and condensation in mini and micro channels.
Micro-scale radiative heat transfer, Maxwell's relations, Plank's law, radiative properties for micro-scale regime.
Introduction to Nano-scale heat transfer, basic theory of heat transfer enhancement using nanoparticles, selected applications of micro-scale and Nano-scale heat transfer.

Text Books:

1. Transport Phenomena in Microfluidic Systems, P.K. Panigrahi, Wiley, 2015.
2. Statistical Thermodynamics and Microscale Thermophysics, V.P. Carey, Cambridge Univ. Press, 1999.
3. Heat Transfer and Fluid Flow in Minichannels and Microchannel, 2nd ed., S. Kandlikar, S. Garimella, D. Li, S. Colin, and M.King, Butterworth-Heinemann, 2014.
4. Microscale and Nanoscale Heat Transfer: Fundamentals and Engineering Applications, C.B. Sobhanand G.P. Peterson, CRC Press, 2008.

Reference Books:

1. Nano/Micro scale Heat Transfer, Z.M. Zhang, McGraw-Hill, 2007.
2. Microscale and Nanoscale Heat Transfer, S. Volz (Ed.), Springer, 2007.
3. Introduction to Microfluidics, P. Tabeling, Oxford University Press, 2005.
4. Microflows & Nanoflows: Fundamental and Simulation, G. Karniadakis, A. Beskok and N. Aluru, Springer, 2005.

Course Outcomes:

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

MEU821A.1 Identify scaling laws for heat transfer and flow phenomenon.

MEU821.A2 Analyse systems with micro-scale heat conduction.

MEU821A.3 Analyse micro-scale convection and channel flows

MEU821A.4 Illustrate the concepts of micro-scale radiative heat transfer.

MEU821A.5 Illustrate applications of micro-scale and nano-scale heat transfer.

CO – PO –PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU821A.1	3	3	3	2	0	0	0	0	0	0	0	0	3	3	0
MEU821A.2	3	3	3	2	2	0	0	0	0	0	0	0	3	3	0
MEU821A.3	3	3	3	2	2	0	0	0	0	0	0	0	3	3	0
MEU821A.4	3	3	2	1	1	0	0	0	0	0	0	0	3	2	0
MEU821A.5	3	2	2	0	0	0	0	0	0	0	0	0	3	2	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

MEU 821 (B) – MICRO AND NANO MANUFACTURING

Teaching Scheme: 03 L+ 00T **Total: 03** **Credits: 03**
Evaluation Scheme: 30 MSE +10 TA+ 60 ESE **Total Marks: 100**
Duration of ESE: 2hrs.30min

Course Objectives:

I. Understand the basics of micro and nano machining logistics and supply chain management
II. To give awareness of different techniques used in micro and nano machining.
III. To give in-depth idea of the conventional techniques used in micro machining-manufacturing.
IV. To introduce Non-conventional micro & nano manufacturing and finishing approaches
V. To introduce Micro and Nanofabrication Techniques and other processing routes in Micro and nano machining/manufacturing.

Course contents:

Introduction: Introduction, Basic elements of molecular dynamics modelling, Design and requirements for state of the art MD cutting process simulations, Capabilities of MD for nanoscale material removal process analysis, Advances and recent developments in material removal process simulation, Summary.

Ductile Mode Cutting of Brittle Materials The mechanism of ductile mode cutting of brittle materials, The chip formation in cutting of brittle materials, Machined surfaces in relation to chip formation mode Diamond Tools in Micromachining Diamond technology, Preparation of substrate, Modified HFCVD process.

Conventional Processes: Micro-turning, Micro-drilling and Micro-milling Introduction, Micro-turning, Micro-drilling, Micro-milling, Product quality in micromachining Micro-grinding and Ultra precision Processes Introduction, Micro and nano grinding, Nano grinding tools

Micro and Nano Finishing Processes Need for Nano finishing, Magnetic abrasive Finishing, Magnetorheological Finish, Elastic Emission Finishing, Magnetic Float Polishing, Ion Beam finishing.

Micro Joining Challenges, Micro Resistance welding, Ultrasonic welding, Micro TIG, Applications.

Applications of Nano and Micromachining in Industry Typical machining methods, Applications in optical manufacturing, Semiconductor and electronics related applications.

Text books:

1. J. Paulo Davim, Mark J. Jackson Nano and Micro machining, John Wiley & Sons, 2013
2. Kapil Gupta, Micro and Precision Manufacturing, Springer, 2017

Reference Books:

1. J. Paulo Davim, Mark J. Jackson Nano and Micro machining, John Wiley & Sons, 2013
2. Yi Qin, Micro-manufacturing Engineering and Technology, William Andrew, 2015

Course Outcomes: After completion of course, student will be able to:

MEU 821B.1 Differentiate about the different techniques used in micro and Nano manufacturing

MEU 821B.2 Describe the principle and working of various Nano machining processes.

MEU 821B.3 Differentiate between micro and Nano processes in machining.

MEU 821B.4 Understand micro and nano fabrication techniques

MEU 821B.5 Appraise the recent trends in nano machining and joining processes and the metrology

CO – PO –PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU 821B.1	3	2	3	0	2	3	2	1	3	3	2	2	3	3	3
MEU 821B.2	3	2	3	3	2	0	2	1	3	3	2	0	3	3	0
MEU 821B.3	0	2	3	3	2	3	2	1	0	3	2	2	0	3	3
MEU 821B.4	3	0	3	3	2	3	0	1	3	3	2	2	3	3	3
MEU 821B.5	3	2	3	3	2	3	2	1	3	3	0	2	3	0	3

0 - Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

MEU821 (C) PRODUCT DESIGN AND DEVELOPMENT

Teaching Scheme: 03L + 00T **Total: 03** **Credits: 03**
Evaluation Scheme: 30 MSE+10TA+60 ESE **Total Marks: 100**
Duration of ESE: 2hrs.30min

Course Objectives:

I. Introduction to the engineering design and structured design methods.
II. To understand basic concepts of product design, product features and its architecture.
III. To gain basic knowledge in the common features a product has and how to incorporate them suitably in product.
IV. To identify the use of CAD software to create 3D solid models.
V. To understand the principles to execute a design from concept to finished product.

Course contents:

Design Fundamentals:

The importance of engineering design, types of design, the design process, relevance of product life cycle issues in design, designing to codes and standards- societal considerations in engineering design, generic product development process, various phases of product development-planning for products, establishing markets, market segments- relevance of market research

Customer oriented design & Societal Considerations:

Identification of customer needs, customer requirements, Quality Function Deployment Product Design Specifications, Human Factors in Design, Ergonomics and Aesthetics. Societal consideration, Contracts, Product liability, Protecting intellectual property, Legal and ethical domains, Codes of ethics, Ethical conflicts, Environment responsible design-future trends in interaction of engineering with society

Material selection processing and Design:

Material Selection Process, Economics – Cost Vs. Performance, Weighted property Index, Value Analysis, Role of Processing in Design, Classification of Manufacturing Process, Design for Manufacture, Design for Assembly, Designing for castings, Forging, Metal Forming, Machining and Welding, Residual Stresses, Fatigue, Fracture and Failure.

Design Methods:

Creativity and problem solving, creative thinking methods, generating design concepts, systematic methods for designing, functional decomposition, physical decomposition, functional representation, morphological methods-TRIZ- axiomatic design. Decision making theory, utility theory, decision trees, concept evaluation methods.

Industrial Design concepts:

Human factors design, user friendly design, design for serviceability, design for environment, prototyping and testing, cost evaluation, categories of cost, overhead costs, activity-based costing, methods of developing cost estimates, manufacturing cost, value analysis in costing.

Text Books:

1. Product Design, Kevin Otto and Kristin wood, 2nd edition, Pearson Education Inc.

2. Product design and development, K.T. Ulrich and S.D. Eppinger, Tata McGraw Hill, 2015
3. Product Development, Chitale & Gupta, 4thedition,Tata McGraw Hill,2016

Reference books:

1. Product design & process Engineering by Niebel & deeper, McGraw hill
2. Value Management by Heller, Addison Wasley
3. Value Engineering A how to Manual S.S. Iyer, New age International Publishers
4. Value Engineering: A Systematic Approach by Arthur E. Mudge – McGraw Hill
5. New Product Development Tim jones. Butterworth Heinmann, Oxford

Course Outcomes:

On completion of the course, the student will be able to:

MEU821C.1 Describe an engineering design and development process.

MEU821C.2 Create 3D solid models of mechanical components using CAD software.

MEU821C.3 Demonstrate individual skill using selected manufacturing techniques.

MEU821C.4 Employ engineering, scientific, and mathematical principles to execute a design from concept to finished product.

MEU821C.5 Describe the design method with creative thinking.

CO – PO –PSO Mapping:

Course Outcomes	**Program Outcomes**														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU821C.1	3	0	2	2	0	0	0	2	1	0	1	3	1	1	0
MEU821C.2	3	2	2	2	0	0	0	2	1	0	1	3	0	0	0
MEU821C.3	3	2		2	0	0	0	2	1	0	1	3	1	0	0
MEU821C.4	3	2	2	2	0	0	0	2	1	0	1	3	0	1	0
MEU821C.5	3		2	2	0	0	0	2	1	0	1	3	0	1	0

0- Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 – Strongly Correlated

MEU 821 (D) SUPPLY CHAIN MANAGEMENT

Teaching Scheme: 03 L   Total: 03   Credit: 03
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE   Total Marks: 100
Duration of ESE: 2 hrs. 30 min.

Course Objectives: The objectives of this course are to:

I. Understand the basics of logistics and supply chain management
II. Know supply chain management and their interrelationships within individual companies and across the supply chain
III. Evaluate supply chain
IV. Use tools and techniques in implementing supply chain management
V. Introduce about planning and scheduling of resources.

Course Contents:

Introduction: Definitions of SCM, Basic steps of SCM, SCM and Logistics, Components of Supply Chain (SC), Mapping SC.

Planning demand, Inventory and Supply: Demand forecasting- Meaning, objectives, types, qualitative and quantitative methods. Managing supply chain cycle inventory, Uncertainty in the supply chain, managing inventory for short life – cycle products.

Resource Planning and |Scheduling: Introduction to operation planning, Enterprise resource planning, Material requirement planning, scheduling service and manufacturing processes.

Supply Chain Performance Measurement: Benchmarking, Performance dimensions and measures, Supply Chain Operation Reference (SCOR) model, Performance measurement and control.

Supply Chain Risk Management: Introduction, supply chain vulnerability, meaning of risk, categories of risk, model of risk management, success factors in risk management process, approach to mitigate risk.

Sustainability Practices: Corporate social responsibility, supply chain responsibility, competitive sustainability, Green procurement, Green manufacturing, Green marketing, Regulatory compliance (Multi-model transport of goods Act, Free Trade and Warehousing Zones Act, GST) Ethical practices in procurement, manufacturing and marketing.

Textbooks:

1. Supply Chain Logistic Management, Bowersox, Closs and Cooper, McGraw Hill, 5th Edition.
2. Essential of Supply Chain Management, Michael H. Hugos, John Wiley and sons, 3rd Edition
3. Logistics and Supply Chain Management, Martin Christopher, Prentice Hall, 4th edition.

Reference Books:

1. Designing and Managing the Supply Chain, David Levi and Philip Kaminsky, McGraw Hill, 3rd edition.
2. Purchasing and Supply Chain Management, Monczka, Handfield, Giunipero, Patterson, Cengage learning (7th edition).

Course Outcomes: After completion of course, students will be able to:

MEU821D.1 Explain the importance, benefits, and applications of SCM.
MEU821D.2 Apply quantitative methods for forecasting demand of resources in industry.
MEU821D.3 Plan and schedule the enterprise resources.
MEU821D.4 Measure the performance of supply chain.
MEU821D.5 Understand the legal aspect of supply chain performance.

CO – PO –PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU821D.1	0	0	0	0	0	0	0	0	0	3	0	2	0	0	0
MEU821D.2	0	0	3	0	3	0	0	0	0	0	0	0	3	3	3
MEU821D.3	0	0	3	0	3	0	2	0	0	0	0	0	3	3	3
MEU821D.4	0	0	3	0	3	0	0	0	0	0	0	0	3	3	3
MEU821D.5	0	0	0	0	0	3	0	2	0	0	0	0	0	0	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 – Strongly Correlated

MEU 822 PROJECT AND SEMINAR / INDUSTRY INTERNSHIP PROJECT

Teaching Scheme: 24 P + 00 T **Total: 24** **Credits: 12**
Evaluation Scheme: 200 ICA + 200 ESE **Total Marks: 400**
Duration of ESE: 02.30 Hrs.

Course Objectives:

I. To collect information on novel and latest development in core and allied area of the subject.
II. To encourage the process of independent thinking and working together in a group.
III. To implement innovative ideas for social benefit.
IV. To develop the ability to describe, interpret and analyze technical issues.
V. To improve the ability of presentation skill and communication techniques.

Course Contents:

PROJECT AND SEMINAR

Student shall select a topic for Project as per guidelines of the institute in the field of Mechanical Engineering.

1. Topics shall be registered within a 15 days after beginning of VIII Semester and shall be approved by the concerned guide and Program Head.
2. Students should know the functional and technical details of selected topic after carrying out the conceptual study.
3. Students should complete implementation of ideas given in synopsis, so that project work should be completed before end of semester.
4. Students shall submit the final project report in proper format as per guidelines given on the college website
5. For uniform and continuous evaluation, evaluation committee for each group shall be formed by Program Head in which guide must be a member. Internal marks should be awarded by committee at the end of semester based on continuous evaluation.
6. Final examination of project shall include demonstration, presentation of complete work and oral examination based on the project work.

INDUSTRY INTERNSHIP PROJECT

1. The aim of Industry Internship Project is to closely work with industry to apply theoretical knowledge in a real-world context providing real industrial project enabling learning focused on the application knowledge. This gives a student an opportunity to make their first traces in the industrial reality and start building a personal network, an important prerequisite for a successful industry career.
2. The purpose of the INDUSTRY INTERNSHIP PROJECT to solve real industrial problems by following established engineering methods, working in teams, and effectively communicating with various stakeholders.
3. The students can work in group decided by the department as per availability of Faculty. The individual students can also undertake the Industry Institute Project subject to availability of Industry Mentor/Guide. Students/Group select the industry which is ready

to provide INDUSTRY INTERNSHIP PROJECT through oral/written communication. Once selected the student group has to visit the industry/stay as per need. The institute will not provide any assistance in Travel and Stay. The student/ Group need to submit acceptance letter from Industry regarding allowing the student/groups for INDUSTRY INTERNSHIP PROJECT stating the Project name or research area.

4. Each group has an Industry Project Guide and Institute Project Guide. The meeting with Project guide is once within week/two week at Institute. These meetings typically include assistance in finding solutions recent problems in the projects, technical support on applied software packages, and support with writing the final report. The project groups do multiple company visits where they meet the industrial contacts to formulate the problem, collect data and information, and gain necessary experiences from the industry.
5. Furthermore, INDUSTRY INTERNSHIP PROJECT includes seminars aiming to give the students experience of communicating to a larger audience, working in teams, etc. The Project monitoring will be done by Institute Guide to know whether learning objective is achieved or not.
6. The INDUSTRY INTERNSHIP PROJECT undergone individual student/ Group will have to submit following documents on the successful completion of Industry Institute Project
    1. Authenticated attendance record from Industry internship project mentor/supervisor/Guide
    2. Industry internship project signed by Industry Mentor/Guide
    3. Industry internship project Completion Letter by Industry Mentor/ Guide
    4. Project evaluation report signed by Industry Mentor/ Guide

Note:

ICA: The Internal Continuous Assessment shall be based on the active participation of the students in the Project work and knowledge / skill acquired. Oral examination shall be conducted on the Project report, by the panel of examiners consisting of Project Guide, Course Coordinator and Expert appointed by Program Head.

ESE: The End Semester Examination for Project shall consist of Demonstration if any, presentation and oral examinations based on the project report.

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

MEU822.1 Identify and compare technical and practical issues related to the area of course specialization.

MEU822.2 Outline interpreted bibliography of research demonstrating scholarly skills. Prepare a well-organized report employing elements of technical writing and critical thinking.

MEU822.3 Demonstrate the ability to describe, interpret and analyze technical issues. Apply principles of ethics and standards, skill of presentation and communication techniques.

MEU822.4 Work in a group to develop the leadership/interpersonal skills for finishing task within timeframe.

MEU822.5 Identify the critical issues in Industry and try to give the effective solution.

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU822.1	3	1	3	0	0	0	0	0	3	0	2	0	3	2	1
MEU822.2	2	3	2	3	0	0	0	0	2	0	3	0	1	3	0
MEU822.3	2	2	3	2	0	0	0	0	2	0	2	0	2	2	2
MEU822.4	2	2	3	2	0	0	0	0	2	0	2	0	2	3	3
MEU822.5	2	2	3	0	0	0	0	0	2	0	3	0	1	2	3

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 – Strongly Correlated

DEPARTMENT OF MECHANICALENGINEERING

B. TECH. (MECHANICAL) CURRICULUM

<u>2019-20</u> Batch - onwards

GOVT. COLLEGE OF ENGINEERING, AMRAVATI

PROGRAM OBJECTIVES

I. To prepare students for successful careers in industry/ higher studies /R&D institutions that meet global needs.

II. To provide students with solid foundation in basic science and basic engineering required to solve and analyze mechanical engineering problems.

III. To develop ability among students to solve industrial, environmental, Techno-social problems with latest and appropriate mechanical engineering techniques and tools available

IV. To inculcate professional skill, ethical responsibility, team work and leadership qualities in students.

V. To promote awareness of entrepreneurship, self-education, lifelong learning and to develop sense of social responsibility.

PROGRAM OUTCOMES

I. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

II. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

III. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

IV. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

V. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

VI. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

VII. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

VIII. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

IX. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

X. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

XI. **Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.**

XII. **Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.**

PROGRAM SPECIFIC OUTCOMES

1. **Identify Mechanical Engineering related real life issues/ problems in industries, society and provide feasible solution**

2. **Apply the knowledge of the basic streams of Mechanical Engineering viz. thermal, design and production system to design mechanical system and product development**

3. **Plan and implement the activities in the small, medium and large enterprises as a part of team or as an individual**

Semester I

Teaching Scheme							Evaluation Scheme						
Category	Course Code	Course Title	Theory	Tutorial	Practical		Theory			Practical		Total	Credits
			Hrs/week	Hrs/week	Hrs/week	Total	MSE	TA	ESE	ICA	ESE		
MC	SHU100	Induction Program	Two weeks mandatory audit course										0
BSC	SHU121	Physics	3	1	---	4	30	10	60	---	---	100	4
BSC	SHU122	Calculus and Linear Algebra	3	1	---	4	30	10	60	---	---	100	4
ESC	EEU121	Basic Electrical Engineering	3	---	---	3	30	10	60	---	---	100	3
ESC	CEU121	Engineering Mechanics	3	---	---	3	30	10	60	---	---	100	3
HSMC	SHU123	English	2	---	---	2	---	---	60	---	---	60	2
BSC/LC	SHU124	Physics Lab	---	---	2	2	---	---	---	50	---	50	1
ESC/LC	EEU122	Basic Electrical Engg Lab	---	---	2	2	---	---	---	50	---	50	1
ESC/LC	CEU122	Engineering Mechanics Lab	---	---	2	2	---	---	---	50	---	50	1
HSMC/LC	SHU125	English Lab	---	---	2	2	---	---	---	50	---	50	1
ESC/LC	MEU121	Workshop Practice I	---	---	2	2	---	---	---	50	---	50	1
		Total	14	2	10	26	120	40	300	250	0	710	21

Semester II

Teaching Scheme							Evaluation Scheme						
Category	Course Code	Course Title	Theory	Tutorial	Practical		Theory			Practical		Total	Credits
			Hrs/week	Hrs/week	Hrs/week	Total	MSE	TA	ESE	ICA	ESE		
BSC	SHU221	Chemistry	4	--	---	4	30	10	60	---	---	100	4
BSC	SHU222	Integral calculus and differential equations	3	1	---	4	30	10	60	---	---	100	4
ESC	CSU221	Programming for Problem solving	3	---	---	3	30	10	60	---	---	100	3
ESC	MEU221	Engineering Graphics	2	---	---	2	30	10	60	---	---	100	2
ESC	MEU222/ ETU221	Basic Mechanical Engineering/ Basic Electronics Engineering	2	---	---	2	30	10	60	---	---	100	2
BSC/LC	SHU223	Chemistry Lab	---	---	2	2	---	---	---	50	---	50	1
ESC/LC	CSU222	Programming for Problem solving Lab	---	---	4	4	---	---	---	50	---	50	2
ESC/LC	MEU223	Engineering Graphics Lab	---	---	4	4	---	---	---	50	---	50	2
ESC/LC	MEU224	Workshop Practice II	---	---	2	2	---	---	---	50	---	50	1
		Total	14	1	12	27	150	50	300	200	0	700	21

TA: Teacher Assessment **MSE: Mid Semester Examination** **ESE: End Semester Examination** **ICA: Internal Continuous Assessment**

MSE Duration: 1.30 Hrs all courses

Important Note:

MEU222 for only Electrical, Electronics & TC, Computer Science, Information Technology and Instrumentation Engineering branch
ETU221 for only Civil and Mechanical Engineering branch

In Semester I, the students of Civil, Mechanical, Electrical & Instrumentation Engineering shall be offered group A courses, and that of Electronics & TC, Computer Science and Information Technology shall be offered group B courses. In Semester II, vice versa.

In addition following courses are offered
SHU122 and MEU121 for all students in Semester I. SHU222 and MEU224 for all students in Semester II.
MEU222 shall be offered in Semester I for Electronics & TC, Computer Science, Information Technology branch. And it shall be offered in Semester II for Electrical and Instrumentation Engineering branch
ETU221 shall be offered in Semester II for Civil and Mechanical Engineering branch.

There should be direct correspondence of group A and group B courses.

Sr. No.	Group A Courses		Group B Courses	
	Course Code	Title of Course	Course Code	Title of Course
1	SHU121	Physics	SHU221	Chemistry
2	EEU121	Basic Electrical Engineering	CSU221	Programming for Problem solving
3	CEU121	Engineering Mechanics	MEU221	Engineering Graphics
4	SHU123	English	SHU223	Chemistry Lab
5	SHU124	Physics Lab	CSU222	Programming for Problem solving Lab
6	EEU122	Basic Electrical Engineering Lab	MEU223	Engineering Graphics Lab
7	CEU122	Engineering Mechanics Lab		

8	SHU125	English Lab		

Category of Course	Definition	Credits
BSC	Basic Science Courses	18
ESC	Engineering Science Courses	21
HSMC	Humanities and Social Sciences including Mgt.Courses	3
	Total Credits	42

Semester III

Teaching Scheme							Evaluation Scheme						
Category	Course Code	Course Title	Theory	Tutorial	Practical		Theory			Practical		Total	Credits
			Hrs/week	Hrs/week	Hrs/week	Total	MSE	TA	ESE	ICA	ESE		
BSC	SHU321A *SHU322A	Differential Equations and Probability *Integral Calculus and Probability	3	-	-	3	30	10	60	-	-	100	3
PCC	MEU321	Thermodynamics	4	-	-	4	30	10	60	-	-	100	4
PCC	MEU322	Manufacturing Processes	4	-	-	4	30	10	60	-	-	100	4
PCC	MEU323	Materials Engineering	4	-	-	4	30	10	60	-	-	100	4
ESC	MEU324	Machine Drawing	3	-	-	3	30	10	60	-	-	100	3
MC	SHU323	Introduction to Constitution of India	1	-	-	1	-	20	30	-	-	50	0
LC	MEU325	Materials Engineering Lab	-	-	2	2	-	-	-	25	25	50	1
LC	MEU326	Machine Drawing Lab	-	-	2	2	-	-	-	25	25	50	1
		Total	**19**	-	**4**	**23**	**150**	**70**	**330**	**50**	**50**	**650**	**20**

Semester IV

Teaching Scheme							Evaluation Scheme						
Category	Course Code	Course Title	Theory	Tutorial	Practical		Theory			Practical		Total	Credits
			Hrs/week	Hrs/week	Hrs/week	Total	MSE	TA	ESE	ICA	ESE		
BSC	SHU425	Human value and ethics	1	-	-	1		20	30	-	-	50	0
PCC	MEU421	Applied Thermodynamics-I	4	-	-	4	30	10	60	-	-	100	4
PCC	MEU422	Fluid Mechanics	4	-	-	4	30	10	60	-	-	100	4
PCC	MEU423	Manufacturing Technology	4	-	-	4	30	10	60	-	-	100	4
PCC	CEU430	Strength of Material	4	-	-	4	30	10	60	-	-	100	4
MC	SHU422	Environmental Studies	1	-	-	1	-	20	30	-	-	50	0
LC	MEU424	Fluid Mechanics Lab	-	-	2	2	-	-	-	25	25	50	1
LC	CEU431	Strength of Material Lab	-	-	2	2	-	-	-	25	25	50	1
		Total	**18**		**4**	**22**	**120**	**80**	**300**	**50**	**50**	**600**	**18**

L – Theory lecture, T – Tutorial; P – lab work: Numbers under teaching scheme indicated contact clock hours
BSC- Basic Science; PCC – Program Core Course; ESC- Engineering Science; MC – Mandatory Course; LC- Lab Course
MSE- Mid Semester examination; **TA-** Teacher Assessment; **ICA** – Internal Continuous Assessment; **ESE** – End Semester Examination

*For the students directly admitted to second year (Lateral entry)

Semester V

Teaching Scheme							Evaluation Scheme						
Category	Course Code	Course Title	Theory	Tutorial	Practical		Theory			Practical		Total	Credits
			Hrs/week	Hrs/week	Hrs/week	Total	MSE	TA	ESE	ICA	ESE		
PCC	MEU 521	Heat Transfer	4	-	-	4	30	10	60	-	-	100	4
PCC	MEU522	Machine Design –I	4	-	-	4	30	10	60	-	-	100	4
PCC	MEU523	Applied Thermodynamics-II	4	-	-	4	30	10	60	-	-	100	4
PCC	MEU524	Theory of Machines	4	-	-	4	30	10	60	-	-	100	4
PCC	MEU525	Turbo machines	4	-	-	4	30	10	60	-	-	100	4
LC	MEU526	Thermal Lab-I	-	-	2	2	-	-	-	25	25	50	1
LC	MEU527	Theory of Machines Lab	-	-	2	2	-	-	-	25	25	50	1
PCC	MEU528	Seminar	-	-	2	2	-	-	-	50	-	50	1
		Total	**20**		**6**	**26**	**150**	**50**	**330**	**100**	**50**	**680**	**23**

Semester VI

Teaching Scheme							Evaluation Scheme						
Category	Course Code	Course Title	Theory	Tutorial	Practical		Theory			Practical		Total	Credits
			Hrs/week	Hrs/week	Hrs/week	Total	MSE	TA	ESE	ICA	ESE		
PCC	MEU621	Instrumentation & Control	4	-	-	4	30	10	60	-	-	100	4
PCC	MEU622	New and Renewable Energy Sources	4	-	-	4	30	10	60	-	-	100	4
PCC	MEU623	Machine Design-II	4	-	-	4	30	10	60	-	-	100	4
PEC	MEU624	Program Elective-I	3	-	-	3	30	10	60	-	-	100	3
PEC	MEU625	Program Elective-II	3	-	-	3	30	10	60	-	-	100	3
OEC	MEU626	Open Elective-I	3	-	-	3	30	10	60	-	-	100	3
LC	MEU627	Design Lab	-	-	2	2	-	-	-	25	25	50	1
PROJECT	MEU628	Minor Project	-	-	6	6	-	-	-	50	50	100	3
		Total	**20**		**8**	**29**	**180**	**60**	**360**	**75**	**75**	**750**	**25**

L – Theory lecture, T – Tutorial; P – lab work: Numbers under teaching scheme indicated contact clock hours
BSC- Basic Science; PCC – Program Core Course; ESC- Engineering Science; MC – Mandatory Course; LC- Lab Course
MSE- Mid Semester examination; **TA-** Teacher Assessment; **ICA** – Internal Continuous Assessment; **ESE** – End Semester Examination

Semester VII

Teaching Scheme							Evaluation Scheme						
Category	Course Code	Course Title	Theory	Tutorial	Practical		Theory			Practical		Total	Credits
			Hrs/week	Hrs/week	Hrs/week	Total	MSE	TA	ESE	ICA	ESE		
PCC	MEU 721	Automation in Manufacturing	4	-	-	4	30	10	60	-	-	100	4
PCC	MEU 722	Gas Dynamics and Jet Propulsion	3	-	-	3	30	10	60	-	-	100	3
PEC	MEU 723	Program Elective-III	3	-	-	3	30	10	60	-	-	100	3
PEC	MEU724	Program Elective-IV	3	-	-	3	30	10	60	-	-	100	3
PEC	MEU 725	Program Elective-V	3	-	-	3	30	10	60	-	-	100	3
OEC	MEU 726	Open Elective-II	3	-	-	3	30	10	60	-	-	100	3
LC	MEU727	Manufacturing Lab	-	-	2	2	-	-	-	25	25	50	1
LC	MEU 728	Thermal Lab-II	-	-	2	2	-	-	-	25	25	50	1
		Total	**19**	-	**4**	**23**	**180**	**60**	**360**	**50**	**50**	**700**	**21**

Semester VIII

Teaching Scheme							Evaluation Scheme						
Category	Course Code	Course Title	Theory	Tutorial	Practical		Theory			Practical		Total	Credits
			Hrs/week	Hrs/week	Hrs/week	Total	MSE	TA	ESE	ICA	ESE		
PEC	MEU 821	*Program Elective-VI	3	-	-	3	30	10	60	-	-	100	3
PROJECT	MEU 822	Project and Seminar / Industry Internship Project	-	-	24	24	-	-	-	200	200	400	12
		Total	**3**	-	**24**	**27**	**30**	**10**	**60**	**200**	**200**	**500**	**15**

***Students going for Industrial Project/Thesis will complete above course through online platform such as MOOCs. , NPTL etc or by self-study mode and will directly appear for ESE only. (Total internal marks (MSE+TA) will be awarded proportional to ESE marks secure)**

L – Theory lecture, T – Tutorial; P – lab work: Numbers under teaching scheme indicated contact clock hours
BSC- Basic Science; PCC – Program Core Course; ESC- Engineering Science; MC – Mandatory Course; LC- Lab Course
MSE- Mid Semester examination**; TA-** Teacher Assessment**; ICA** – Internal Continuous Assessment; **ESE** – End Semester Examination

Program Elective Courses:

MEU624 Program Elective-I		MEU625 Program Elective- II		MEU723 Program Elective-III	
Sr. No.	Professional Courses	Sr. No.	Professional Courses	Sr. No.	Professional Courses
A	Internal Combustion Engines	A	Computation Fluid Dynamics	A	Refrigeration and Air Conditioning
B	Mechatronic Systems	B	Total Quality Management	B	Composite Materials
C	Mechanical Vibration	C	Industrial Robotics	C	Finite Element Analysis
D	Fracture Mechanics and Non-destructive Testing	D	Hydraulics and Pneumatics	D	Computer Integrated Manufacturing
E	Industrial Management	E	Operations Research Technique		

MEU724 Program Elective- IV		MEU 725 Elective-V		MEU 821 Elective-VI	
Sr. No.	Professional Courses	Sr. No.	Professional Courses	Sr. No.	Professional Courses
A	Power Plant Engineering	A	Automobile Engineering	A	Micro-scale Heat Transfer
B	Production Planning and Cost Estimation	B	Machine Tool design	B	Micro and Nano Manufacturing
C	Computer Aided Design	C	Stress Analysis	C	Product Design and development
D	Energy Conservation and Management	D	Cryogenic	D	Supply Chain Management

Open Elective Courses:

Sr. No.	MEU 626 Open Elective-I	Sr. No.	MEU 726 Open Elective- II
A	Thermal & Fluid Engineering	A	Alternative Sources of Energy
B	Operations Research	B	Nanotechnology and Surface Engineering
C	Industrial Management and Quality Control	C	Lean Manufacturing

MEU521 HEAT TRANSFER

Teaching Scheme: 04L+ 00T Total: 04 **Credits: 04**
Evaluation Scheme: 30 MSE +10 TA+ 60 ESE **Total Marks: 100**
Duration of ESE: 2hrs.30min

Course Objectives:

I. To learn the basic concept of heat transfer mechanism
II. To understand the analysis of one dimensional steady and unsteady state heat conduction
III. To understand and analyze forced and free convective heat transfer
IV. To study the concept of radiation heat transfer.
V. To learn the thermal analysis and sizing of heat exchangers

Introduction: Application, modes of heat transfer, basic laws of heat transfer.

Conduction- thermal conductivity and thermal diffusivity, effect of temperature on thermal conductivity, General heat conduction differential equation and one dimensional steady state heat conduction through slab, cylinder & sphere-simple and composite, Combined conduction convection, overall heat transfer coefficient,One dimensional steady state conduction with internal heat generation for infinite slab, wire & cylinder,critical radius of insulation Introduction two dimensional heat transfer
Fin: Conduction through extended surfaces, analysis of a uniform C.S. fin, fin efficiency, fin effectiveness, Biot number
Unsteady state heat conduction: Introduction to unsteady state heat conduction, Newton's law of cooling, lumped heat capacity analysis, Heisler chart
Radiation: general concepts and definitions, black body & grey body concept. Laws of radiation. Concept of shape factor, emissivity factor and radiation heat transfer equation. Radiation errors in temperature measurement, radiation shield
Forced convection: boundary layer theory, hydrodynamic and thermal boundary layers, Laminar & turbulent flow over flat plate and through pipes & tubes Dimensionless number and their physical significance Reynold, Prandtl, Nusselt, Grashoff number, empirical correlations for flow over flat plate, flow over cylinder and sphere , through tubes and their applications in problem solving.
Free convection: velocity and thermal boundary layers for vertical plate, free convection over vertical cylinder and horizontal plate/cylinder. Boiling and condensation.
Heat exchanger: applications, classifications, overall heat transfer coefficient, fouling. L.M.T.D. & E.N.T.U. methods, temperature profiles, selection of heat exchangers. Introduction to working of heat pipe with and without wick

Text Books:

1. Heat Transfer, J.P. Holman, 9th edtion ,Tata McGraw Hill Publication, 2002.
2. Heat Transfer, S.P. Sukhatme, Tata McGraw Hill Publication, 1994.

Reference Books:

1. Introduction to Heat Transfer, Incropera and Dewitt, John Wiley & Sons, Inc.2011

2. Computer aided heat transfer analysis, Adams J.A. & Roger D.E, Tata McGraw Hill Publication, 1997.
3. Heat pipe theory application Springer link Publication, S. W. Chi, 1998.
4. Heats Transfer, P.K. Nag, Tata McGraw Hill Publication, 2005.
5. Heat and Mass Transfer Data Book Book, C P Kothandaraman, S Subramanyam, New Age International, 1994
6. http://nptel.iitm.ac.in

Course Outcomes:

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

MEU521.1. Illustrate the basic modes of heat transfer

MEU521.2. Compute one dimensional steady and unsteady state heat transfer

MEU521.3. Interpret and analyze forced and free convection heat transfer

MEU521.4. Apply concept of radiation heat transfer

MEU521.5. Design simple heat exchangers

CO – PO –PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU521.1	3	2	1	0	0	0	0	0	0	0	0	2	2	1	0
MEU521.2	3	2	1	0	0	0	0	0	0	0	0	2	2	1	0
MEU521.3	3	2	2	0	0	0	0	0	0	0	0	2	2	1	0
MEU521.4	3	2	1	0	0	0	0	0	0	0	0	2	2	1	0
MEU521.5	3	2	2	0	0	0	0	0	0	0	0	2	2	1	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

MEU522 MACHINE DESIGN- I

Teaching Scheme: 04 L + 00 T Total: 04 Credits: 04
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE Total Marks: 100
Duration of ESE: 03.00 Hrs.

Course Objectives:

I. To develop proficiency in fundamental concept of design
II. To develop an ability identify, formulate and design the mechanical component used in industry
III. To develop analytical & computational skills in designing basic mechanical components used for general purposes
IV. To understand the use of design data book for selection of material, strength and standard dimensions

Introduction: Steps of design, Design Principle, Design consideration for dynamic and static load, selection of materials, designation of material as per ISI, Various codes and standards.
Simple Stresses : Simple stresses, factor of safety, Hertz constant stress, thermal stresses, impact stress, torsional stress, bending in straight and curved beams and application to hooks, c-clamps, Biaxial stress, theories of failure.
Variable Stresses: Fatigue and Endurance limit, factors influencing fatigue, surface finish, stress concentration, Stress Intensity Factor, notch sensitivity, combined steady and variable stresses, Gerber Line, Sordbergs line.
Design of screw and bolted Joints: Forms and Threads, types of Fastening, standard dimensions stresses due to screwing up and external forces, stresses due to combination of screwing up and external force, bolts of uniform strength, bolted joints for eccentric loads.
Design of Riveted Joints: Method of riveting, types of rivets and fixed joints, caulking, fullering, failures, strength and efficiency of riveted joints, joints of boiler shell, eccentric loaded joint.
Welded Joints: Types of welding and joints, strength of transverse and parallel fillet welded section, axially loaded unsymmetrical welded section, eccentrically loaded joint.
Design of springs: Types of spring, stresses in helical springs, Wahl's stress factor, bulking and surge, design of compression, tension, spiral helical and flat spiral springs, Introduction of leaf spring, material and construction, nipping, design of spring.
Design of Power Screw: Types of threads, torque required to raise loads, efficiency and helix angle, overhauling and self locking of screw, acme threads, stresses in power screw.
Design of Leaver: Types and Design Procedure.
Note: - Use of Design Data Book will be permitted during the examination.

Text Books:

1. Mechanical Engineering Design, Joseph E.Shigley and Charles R.Mischke, Tata McGraw Hill Publication, 6th Edition,2005
2. Design of Machine Element, V.B.Bhandari, Tata McGraw Hill Publications, 4th Edition, 1997

Reference Books:

1. Design of Machine Element, C.S.Sharma & Kamlesh Purohit, Prentice Hall of India Publications New Delhi, 4th Edition,2003
2. Machine Design- A basic Approach , Dr S.S.Wadhwa & S.S.Jolly, Dhanpatrai and Company, 1st Edition ,2007

Design Data Book:

1. Design Data Book for Mechanical Engineers, K.Mahadevanan & K.Balaveera Reddy, CBS Publishers & Distributor Delhi, 4th Edition 2008
2. Design Data Book – B.D.Shiwalkar, Central Techno Publication Nagpur, 2nd Edition 2007

Course Outcomes:

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

MEU522.1 Illustrate basic principle of machine design

MEU522.2 Analyze the stress and strain on mechanical components; and understand, identify and quantify failure modes for mechanical parts

MEU522.3 Demonstrate and design n basic machine elements used in machine design such as bolted joint, riveted and welded joint

MEU522.4 Apply the design and development procedure for different types of springs by using Design Data Hand book

MEU522.5 Design Power screw and develop the analytical ability to check different stresses in power screw

CO – PO –PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU522.1	2	3	2	0	0	0	0	0	0	0	0	0	3	2	0
MEU522.2	2	0	2	3	0	0	0	0	0	0	0	0	2	3	0
MEU522.3	2	0	3	0	0	0	0	0	0	0	0	0	0	3	0
MEU522.4	2	0	2	3	0	0	0	0	0	0	0	0	0	3	0
MEU522.5	2	0	2	3	0	0	0	0	0	0	0	0	0	3	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

MEU523 APPLIED THERMODYNAMICS-II

Teaching Scheme: 04 L+ 00T Total: 04 | **Credits: 04**
Evaluation Scheme: 30 MSE +10 TA+ 60 ESE | **Total Marks: 100**
Duration of ESE: 2hrs.30min

Course Objectives:

I. To understand the basic fundamental in the thermal systems.
II. To analyze the basic components of thermal systems.
III. To demonstrate basics of Air Compressor and Internal Combustion Engine.
IV. To interpret the concepts of Refrigeration, Air-conditioning and Psychrometry.
V. To develop skill for the evaluation of basic performance parameters for a given thermal system.

Internal Combustion Engine: Classification of Internal Combustion Engines, Applications of Internal combustion engines, Terminology of Internal combustion engines, General description of working of 2-stroke and 4-stroke Petrol & Diesel engine, Numericals based on engine brake power, Air standard cycles and efficiencies

Refrigeration: Principle of refrigeration, Applications, Unit of refrigeration, Carnot vapour cycle and its limitations, Vapour compression Refrigeration cycle and Coefficient of Performance, Vapour absorption refrigeration systems, Numericals based on Vapour compression Refrigeration cycle

Air-conditioning: Principle of Air conditioning, classification and applications of Air conditioning system, Rating of Air conditioning system, Psychrometry, Psychrometric chart, Psychrometric processes related to Air conditioning, Adiabatic Mixing of two Air-streams. Elementary simple problems based on Psychrometric chart only

Air Compressors: Industrial Applications of compressed air, Classification, Terminology of reciprocating Air-compressor, Performance parameters, Methods of compression for improving Isothermal efficiency, Clearance volume and its effect on work done and volumetric efficiency, Multi-stage compression, Condition for minimum work in two stage compression, Inter-cooling and its effects

Text Books

1. Basic and Applied Thermodynamics, P.K. Nag, 2nd Edition, Tata Mc-Graw Hill Pub., 2010.
2. Thermal Engineering by Mahesh M Rathore, 3rd Edition, Tata Mc-Graw Hill, 2010.

Reference Books:

1. Thermodynamics-An Engineering Apporach, Y. A. Cengel and M. A. Boles, 3rd Edition, Mc Graw Hill, 1998.
2. Applied Thermodynamics, Onkar Singh, 3rd Edition, New Age International Publishing, 2009.
3. Power Plant Engineering, P.K. Nag, 3rd Edition, Tata Mc-Graw Hill Publishing, 2008.

Course Outcomes:

After completion of course, student will be able to:

MEU523.1 Analyze the basic components in the thermal systems

MEU523.2 Select the suitable performance improvement method

MEU523.3 Apply the basics of thermodynamics to evaluate required performance parameter

MEU523.4 Draw inferences from the Indoor and Outdoor conditions on psychrometric chart

MEU523.5 Classify Internal combustion engines, Air compressors & Air-conditioning systems

CO – PO –PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU523.1	3	2	2	2	0	0	0	0	1	1	0	2	1	2	1
MEU523.2.	2	3	2	2	0	0	0	0	1	1	0	2	2	2	2
MEU523.3.	3	3	2	3	0	0	0	0	1	1	0	2	1	2	1
MEU523.4.	3	3	2	3	0	0	0	0	1	1	0	2	2	2	2
MEU523.5	2	3	0	2	0	0	0	0	1	1	0	2	1	1	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

MEU524 THEORY OF MACHINES

Teaching Scheme: 04 L + 00T Total: 04 | **Credits: 04**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE | **Total Marks: 100**
Duration of ESE: 2 hrs. 30 min.

Course Objectives:

I. To classify all components of mechanisms, and determine the displacement, velocity, and acceleration at any point of the link of the mechanism and laydown the cam for specified output motions.
II. To explain the basic concepts of toothed gearing and find velocity ratio of gear trains
III. To estimate the effects of friction in machine elements
IV. To examine the forces on different machine parts by different methods.
V. To paraphrase the undesirable effects of unbalances and write the equations for motions of vibrating machine parts.

Kinematics of Mechanisms: Mechanisms – Terminology and definitions – kinematics inversions of 4 bar and slide crank chain – kinematics analysis in simple mechanisms – velocity and acceleration polygons– Analytical methods – computer approach – cams – classifications – displacement diagrams - layout of plate cam profiles – derivatives of followers motion – circular arc and tangent cams.

Gears and Gear Trains: Spur gear – law of toothed gearing – involute gearing – Interchangeable gears – Gear tooth action interference and undercutting – nonstandard teeth – gear trains – parallel axis gears trains – epicyclic gear trains – automotive transmission gear trains.

Friction in Machine Elements: Surface contacts – Sliding and Rolling friction – Friction drives – Friction in screw threads – Bearings and lubrication – Friction clutches – Belt and rope drives – Friction aspects in brakes– Friction in vehicle propulsion and braking.

Force Analysis: Applied and Constrained Forces – Free body diagrams – static Equilibrium conditions – Two, Three and four members – Static Force analysis in simple machine members – Dynamic Force Analysis – Inertia Forces and Inertia Torque – D'Alembert's principle – superposition principle – dynamic Force Analysis in simple machine members

Balancing and Vibration: Static and Dynamic balancing – Balancing of revolving and reciprocating masses – Balancing machines – free vibrations – Equations of motion – natural Frequency – Damped Vibration – bending critical speed of simple shaft – Torsional vibration – Forced vibration – harmonic Forcing – Vibration isolation.

Text Books:

1. Rattan. S.S, "Theory of Machines", McGraw-Hill Education Pvt. Ltd., 2014.
2. Thomas Bevan "THE THEORY OF MACHINES', CBS Publisher distributers Pvt.Ltd.ISBN:81-239-0874-1

Reference Books:

1. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", Oxford University Press, 2017
2. Amitabha Ghosh and Asok Kumar Mallik, "Theory of Mechanisms and Machines", Affiliated East-West Pvt. Ltd., 1988.
3. Rao.J.S. and Dukkipati.R.V. "Mechanism and Machine Theory", New Age International Pvt. Ltd., 2006.

Course Outcomes:

Upon successful completion of this course student should be able to

MEU524.1 Identify the components of mechanisms as perterminologies, predict the displacement, velocity, and acceleration of any point of link of the mechanism with help of different methods and design cam contour for specified output motions

MEU524.2 Appraise the basic concepts of toothed gearing and find the velocity ratio of gear trains

MEU524.3 Estimate the torques/forces by considering the effects of friction onmachine elements

MEU524.4 Analyze the force-motion relationship in components subjected to external forces and analyze of standard mechanisms.

MEU525.5 Evaluate the undesirable effects of unbalances and calculate the frequency of vibrating machine elements.

CO-PO-PSO Mapping:

Course Outcomes	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU524.1	3	3	3	1	1	0	0	0	0	0	0	2	3	3	0
MEU524.2	3	3	3	1	1	0	0	0	0	0	0	2	3	3	0
MEU524.3	3	3	3	1	1	1	0	0	0	0	0	2	3	3	0
MEU524.4	3	3	3	1	1	1	0	0	0	0	0	2	3	3	0
MEU524.5	3	3	3	2	2	1	0	0	0	0	0	2	3	3	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

MEU525 TURBO MACHINES

Teaching Scheme: 04 L+ 00T Total: 04 **Credits: 04**
Evaluation Scheme: 30 MSE +10 TA+ 60 ESE **Total Marks: 100**
Duration of ESE: 2hrs.30min

Course Objectives:

I. To understand the basic principles of turbomachines and its applications
II. To know the basic principles and characteristic curves of turbines and pumps
III. To estimate the performance of various types of compressors, turbines and pumps

Basic Principles of Turbomachines: Introduction, Energy transfer in turbomachines, Impulse momentum principle, Fixed and moving flat plate and curve vanes, series of vanes, exchange of energy, Euler's equation for turbo machines

Rotary Compressor: Concepts of Rotary compressors, Root blower and vane type compressors, Centrifugal compressors. Velocity diagram construction and expression for work done, introduction to slip factor, power input factor.

Gas Turbine: Theory and fundamentals of gas turbines, principles, classification, Joule's cycles, assumptions for simple gas turbines, cycle analysis, work ratio, concept of maximum and optimum pressure ratio, actual cycle, effect of operating variable on thermal efficiency. Regeneration, inter cooling, reheating, their effects on performance. Closed cycle and semi closed cycles gas turbine plant/ Applications of gas turbines.

Hydraulic Turbines: Classification of hydraulic turbines, Construction of velocity vector diagram's, head and specific work, components of energy transfer, degree of reaction. Performance analysis of Pelton turbine, Francis turbine, Kaplan turbine. Working principles, velocity triangles, work done, specific speed, efficiencies, performance curve for turbines.

Hydraulic Pumps Pump definition and classifications. Centrifugal pump classifications, working principles, velocity triangles, specific speed, efficiency and performance curves. Reciprocating pump classification, working principles, indicator diagram, work saved by air vessels and performance curves, cavitation in pumps.

Text Books:

1. Fluid mechanics and thermodynamics of turbo machinery, S. L. Dixon, 7th Edition, Butterworth-Heinemann, Pergamon Press Ltd, 2014
2. Fluid mechanics and Hydraulic machines, Dr. R. K. Bansal, 9th Edition, Laxmi Publication, Delhi, 2010
3. Gas Turbines, V. Ganesan, 3rd Edition, Tata McGraw Hill, 2010.

Reference Books:

1. Introduction to Fluid Mechanics and Fluid Machines, S.K. Som and G. Biswas, 2nd Ed Tata McGraw Hill Education Publishing Company Limited, 2007
2. Fluid Mechanics, F.M. White, 4th International Editions, McGraw-Hill, 2005
3. Fluid Mechanics, Streeter, 7th Edition, Tata McGraw Hill (SI), 2000

4. Gas Turbine Theory, H.I.H Saravanamuttoo, G.F.C. Rogers and H. Cohen, 4th Ed., Pearson, 2003.

Course Outcomes:

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

MEU525.1. Explain basic concepts of turbomachines and its components.

MEU525.2. Describe the working of turbines along their performance parameters.

MEU525.3. Discuss the operation of centrifugal pumps and centrifugal compressors.

MEU525.4. Estimate the effect of cavitation in turbines and pumps.

MEU525.5. Evaluate the performance of hydraulic and gas turbines.

CO – PO –PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU525.1	3	3	3	2	0	0	0	0	0	0	0	2	2	2	0
MEU525.2	3	3	2	3	2	0	0	0	0	0	0	2	2	2	0
MEU525.3	2	3	3	3	3	0	0	0	0	0	0	2	2	2	0
MEU525.4	2	2	2	3	2	0	0	0	0	0	0	2	2	2	0
MEU525.5	2	2	2	3	0	0	0	0	0	0	0	2	2	2	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

MEU526 THERMAL LAB – I

Teaching Scheme: 02 P **Total: 02** **Credit: 01**
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks: 50**

Course Objectives:

I. To carry out experimentation on the setups to find properties like thermal conductivity and emissivity
II. To perform test to find heat transfer coefficient in natural and forced convection
III. To test the performance of heat exchangers and heat pipe
IV. To carry out test and evaluate performance of turbo machines

Minimum Eight Experiments to be performed to achieve course outcomes.

The representative list of practicals is given below. The instructor may choose minimum **Eight** experiments as per the requirement.**(Minimum four from each group)**

List of Practicals:
(A) Heat Transfer

1. Determination of thermal conductivity of a metal bar.
2. Determination of thermal conductivity of insulating powder.
3. Determination of heat transfer through composite wall.
4. Determination of fin efficiency.
5. Verification of Stefan-Boltzmann law.
6. Determination of emissivity of grey body.
7. Determination of heat transfer coefficient for forced convection.
8. Determination of heat transfer coefficient for natural convection.
9. Test the performance of double pipe heat exchanger.
10. Test the performance of cross flow heat exchanger.
11. Determination of temperature distribution and efficiency of heat pipe.

(B) Turbo machines

1 Test the performance of reciprocating air compressor.
2. Test the performance of Pelton turbine.
3. Test the performance of Francis turbine.
4. Test the performance of Kaplan Turbine.
5. Test the performance of centrifugal pump.
6. Test the performance of reciprocating pump.
7. Test the performance of axial flow pump.
8. Test the performance of hydraulic ram.

Note:
ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats A& B.
ESE: The End Semester Examination for practical shall be based on performance in one of the experiments and may be followed by sample questions.

Course Outcomes:

Upon completion of this course students should be able to:

MEU521.1. Determine thermal conductivity of materials and surface emissivity

MEU521.2. Estimate heat transfer coefficient in natural/forced convection and compare with empirical values

MEU521.3. Analyse the performance of heat exchangers and heat pipe

MEU521.4. Test the performance of air compressor, hydraulic turbines and pumps

CO – PO – PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU526.1	3	1	0	0	0	0	0	0	2	2	0	0	2	0	1
MEU526.2	3	2	1	1	0	0	0	0	2	2	0	0	2	0	1
MEU526.3	3	2	2	1	0	0	0	0	2	2	0	0	2	1	1
MEU526.4	3	2	2	1	0	0	0	0	2	2	0	0	2	1	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

MEU527 THEORY OF MACHINES LAB

Teaching Scheme: 02 P **Total: 02** **Credit: 01**
Evaluation Scheme: 25ICA + 25 ESE **Total Marks: 50**

Course Objectives:

I. To identify different links, kinematic pairs, mechanisms, and determine the displacement, velocity, and acceleration at any point of the link of the mechanism and lay down the cam for specified output motions.
II. To find velocity ratio of gear trains.
III. To appraise working clutches, brakes, dynamometers.
IV. To determine gyroscopic couple experimentally and perform inertia force analysis for given mechanism.
V. To perform experiments on available vibration set up as per its set aim.

List of Experiments:

(Students have to perform minimum **eight** experiments, out which six will be prescribed by teacher and any other two experiments from the given list can be selected by students).

1. Study of gear parameter.
2. Identify different links, kinematic pairs, mechanisms and their working, of any machine in the workshop of Institute.
3. Estimate time ratio for forward to return stroke of Shaping Machine of workshop of Institute.
4. Determination of velocity , acceleration of a link of given mechanism by graphical method or analytical method or computer programming or software
5. Epicycle gear Train.
6. Determination of moment of inertia of flywheel and axle system.
7. Determination of mass moment of inertia of a body about its axis of symmetry.
8. Undamped free vibration of a single motor shaft system.
9. Torsional Vibration (Undamped) of single motor shaft system.
10. Dynamic analysis of given mechanism.
11. Experiment of motorized gyroscope.
12. Determination of critical speed of shaft.
13. Determine brake torque with help of any available dynamometer.
14. Study of clutches, brakes with help of different models in laboratory.
15. Design the cam profile to operate the given follower with its program

Course Outcomes:

Upon successful completion of this course student should be able to

MEU527.1 Determine the displacement, velocity, and acceleration of any point of link of the mechanism with help of different methods and propose the cam for specified output motions

MEU527.2 Conduct the experiments in the lab with all precautions.

MEU527.3 Conclude the experiments properly as per set aim of the experiment.

MEU527.4 Determine frequency of vibrations for given vibrating set up in laboratory.

MEU527.5 Handle the measuring equipments properly, Measure different parameters during experimentation and keep the equipments at its place after finish of work.

CO-PO-PSO Mappings:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU527.1	3	3	3	2	1	1	0	0	2	2	1	2	3	3	0
MEU527.2	3	3	3	0	0	3	0	2	2	2	1	2	3	3	0
MEU527.3	3	3	3	2	1	1	0	0	2	2	1	2	3	3	0
MEU527.4	3	3	3	2	0	1	0	1	2	2	1	2	3	3	0
MEU527.5	3	3	3	2	1	1	0	2	2	2	1	2	3	3	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

MEU528 SEMINAR

Teaching Scheme: 02 P	**Total: 02**	**Credits: 01**
Evaluation Scheme: 50 ICA		**TOTAL MARKS: 50**

Course Objectives:

I. To collect information on novel and latest development in core and allied area of the subject.
II. To encourage the process of independent thinking and working together in a group.
III. To implement innovative ideas for social benefit
IV. To develop the ability to describe, interpret and analyze technical issues.

1. Student shall select a topic for seminar which is not covered in curriculum.
2. Topics shall be registered within a month after beginning of V Semester and shall be approved by the concerned guide and Program Head.
3. Students should know the functional and technical details of selected topic after carrying out the conceptual study.
4. Before the end of semester, student shall deliver a seminar and submit the seminar report in following format: Introduction, Literature Survey, Concept, Functional and Technical Details Future scope, Applications, Comparison with similar topics / methods References
5. Student shall deliver a seminar based on submitted report. The presentation and oral examination on selected seminar topic shall be assessed by panel of examiners.

Note:

ICA – The Internal Continuous Assessment shall be based on the active participation of the students in the seminar topic and the knowledge acquired. The seminar shall be assessed by the examiner panel consisting of Seminar Guide, Course Coordinator Seminar and Expert appointed by Program Head.

Course Outcomes: After completion of course, student will be able to:

MEU528.1. Prepare a well-organized report employing elements of technical writing and critical thinking.
MEU528.2. Demonstrate the ability to describe, interpret and analyze technical issues.
MEU528.3. Apply principles of ethics and standards, skill of presentation and communication techniques.
MEU528.4. Work in a group to develop the leadership/interpersonal skills for finishing task within timeframe.

CO – PO – PSO Mapping:

CO	PO/ PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU528.1.	0	0	0	0	2	0	0	1	2	3	0	0	0	0	1
MEU528.2.	0	2	0	0	2	0	0	1	2	3	2	0	2	1	1
MEU528.3.	0	0	0	0	2	0	0	3	2	3	0	0	2	0	1
MEU528.4.	0	0	0	0	2	0	0	3	2	3	2	0	2	0	2

0-Not Correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

MEU621 INSTRUMENTATION & CONTROL

Teaching Scheme: 04 L+00T **Total: 04** **Credits: 04**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2 hrs. 30 min

Course Objectives:

I. To make the students familiarize various representations of systems.
II. To learn about various sensors used for measurement of mechanical quantities
III. To learn about system stability and control
IV. To provide an overview of the features associated with Industrial type PID controller.
V. To make students understand the various PID tuning methods.

Measurement systems and performance – accuracy, range, resolution, error sources. Temperature measurement system: RTD, Thermistor, thermocouple, their ranges, applications. Flow measurement systems: classification of flow meters, differential pressure and variable area flow meters, Calibration and selection of Flow meters.

Instrumentation system elements – sensors for common engineering measurements; Signal processing and conditioning, correction elements- actuators: pneumatic, hydraulic, electric, Static & dynamic Characteristics of instruments, errors

Control system: Open loop and Closed loop – Feedback control system characteristics – First principle modelling: Mechanical, Electrical and Hydraulic systems – Transfer function representations: Block diagram and Signal flow graph.

Control Actions-ON OFF control, self-regulating & non regulating control, Characteristic of ON-OFF, Proportional, Single speed floating, Integral and Derivative controllers – P+I, P+D and P+I+D control modes – Practical forms of PID Controller –PID Implementation, PID Controller Tuning: - PID Controller Tuning: Z-N and Cohen-Coon methods, Continuous cycling method and Damped oscillation method, Feedback & Feed forward control

Frequency Domain Analysis

Models, transfer function and system response, Bode plot, Polar plot and Nyquist plot, Construction, Interpretation and stability analysis – Frequency domain specifications - Introduction to closed loop Frequency Response.

Text Books:

1. Instrumentation and control systems by W. Bolton, 2nd edition, Newnes, 2007
2. Modern Control Engineering by Katsuhiko Ogata 4th Edition, Prentice Hall Publication, 2002
3. Thomas G. Beckwith, Roy D. Marangoni, John H. Lienhard, Mechanical Measurements (6thEdition), Pearson Education India, 2007

Reference Books:

1. Control Systems Engineering, Nise, N. S., Fifth Edition, John Willey & Sons Inc. 2015
2. Control Systems Engineering, Bhattacharya, S. K. , Fifth Edition Pearson Education 2015
3. Control Systems Engineering, Nagrath, I. J. ,Gopal, M. , Wiley Eastern, 2 nd Edition

4. Measurement Systems , Doebelin, E. O. Manik D.N., 5thEdition, McGraw-Hill Book Co. 2010
5. Process/Industrial Instruments and Controls Handbook, Gregory K. McMillan, Fifth Edition,McGraw-Hill: New York,1999.
6. "Practical PID Control" Antonio Visioli, Springer- Verlag London, 2006.
7. "Handbook of PI and PID Controller Tuning Rules", Aidan O'Dwyer, Imperial College Press, 2009.
8. "Mechanical engineers' handbook, design, instrumentation, and controls" MyerKutz, 4th Edition Hoboken, NJ : Wiley, 2015. - 1010 p.
9. Instrumentation and Control for the Chemical, Mineral and Metallurgical Processes Radhakrishnan, V. R., Allied Publishers Ltd. 1997

Course Outcomes:

Upon completion of this course, the students will be able to:

MEU621.1. Interpret the technical terms associated with control system.

MEU621.2. Acquire with the measurement of various quantities using instruments

MEU621.3. Perceive with the techniques for controlling devices automatically

MEU621.4. Come out with the solution to analyze and infer the stability of systems in time and frequency domain.

MEU621.5 Construct and interpret root locus, Bode plot, polar plot and Nyquist plot.

CO-PO-PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU621.1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
MEU621.2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
MEU621.3	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
MEU621.4	2	2	0	2	2	0	0	0	0	0	0	0	0	1	0
MEU621.5	2	2	0	0	2	0	0	0	0	0	0	0	0	2	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

MEU622 NEW AND RENEWABLE ENERGY SOURCES

Teaching Scheme: 04L+ 00T Total: 04 **Credits: 04**
Evaluation Scheme: 30 MSE +10 TA+ 60 ESE **Total Marks: 100**
Duration of ESE: 2hrs.30min

Course Objectives:

I. To study the basic concepts of solar radiation and analyze the working of solar thermal systems.
II. To learn principles of energy conversion from alternate sources including wind, geothermal, ocean, biomass, biogas and hydrogen.
III. To study the concepts and applications of fuel cells, thermoelectric convertor and MHD generator.
IV. To illustrate different methods of energy storage for specific applications

Principles of solar radiation: Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

Solar energy collection: Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors. Solar energy storage and applications: Different methods, Sensible, latent heat and stratified storage, solar ponds.

Solar Applications: solar heating, cooling techniques, solar distillation and drying, photovoltaic energy conversion.

Wind Energy: Introduction, Current status and future prospects, Basics of Wind Energy Conversion-Classification of wind turbines, Aerodynamics of wind turbines, Rotor design, performance characteristics, Betz criteria.Wind energy conversion systems

Bio-Mass: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I C Engines operation on Bio-mass and their economic aspects.

Geothermal Energy: Resources, types of wells, methods of harnessing the energy, potential in India.

Ocean Energy: Ocean Thermal Energy Conversion, Principles utilization, setting of Ocean Thermal Energy Conversion plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.

Direct Energy Conversion: Need for direct energy conversion, Carnot cycle and its limitations, principles of direct energy conversion. Thermo-electric generators, see-beck, Peltier and Joule Thomson effects, Figure of merit, materials, applications, MHD generators, principles, dissociation and ionization, hall effect, magnetic flux, MHD accelerator, MHD Engine, power generation systems, electron gas dynamic conversion, economic aspects. Fuel cell principle, Faraday's law, thermodynamic aspects, selection of fuels and operating conditions.

Text Books:

1. Fundamentals of Renewable Energy Resources, G. N.Tiwari and M. K. Ghosal, Narosa Publishing House, 2007
2. Solar Energy, Sukhatme, 3rd Edition, Tata McGraw-Hill Education, 2008
3. Non-Conventional Energy Sources, G.D. Rai, 4th Edition, Khanna publishers, 2009

Reference Books:

1. Renewable Energy Resources, John Twidel& Anthony D. Weir, 2nd Edition, Taylor & Francis, 2006
2. Principles of Solar Energy, D. Yogi Goswami, Frank Krieth & John F Kreider, 2nd Edition, Taylor & Francis, 2000
3. Solar Energy - Thermal Processes, A. Duffie and W.A. Beckman, John Wiley, 2001
4. Solar Energy fundamental & applications, H.P.Garg & J.Prakash, Tata McGraw Hill Publication

Course Outcomes:

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

MEU621.1. Identify renewable energy sources and their utilization

MEU621.2. Apply basic principles to design solar thermal and phovoltaic systems

MEU621.3. Illustrate the concept of wind energy conversion

MEU621.4. Analyse the working of energy conversion system from alternative sources

MEU621.5. Explain the concepts and applications of fuel cells, MHD generator

CO – PO –PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU622.1	1	1	1	0	0	0	2	0	0	0	0	1	2	2	0
MEU622.2	2	2	2	1	0	0	2	0	0	0	0	1	2	2	0
MEU622.3	2	2	2	1	0	0	2	0	0	0	0	1	2	2	0
MEU622.4	2	1	2	1	0	0	1	0	0	0	0	1	2	2	0
MEU622.5	1	1	1		0	0	1	0	0	0	0	1	2	2	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

MEU623 MACHINE DESIGN- II

Teaching Scheme: 04 L + 00 T Total: 004 **Credits: 04**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 03.00 Hrs.

Course Objectives:

I. To acquire the skill of design and drafting
II. To understand the standard nomenclature , force, failure, applications and design procedure of mechanical components
III. To develop the proficiency in various transmission systems.
IV. To understand the use of design data book for selection of material, strength and standard dimensions

Design of Shaft: Material, Design on the basis of strength considering shaft subjected to twisting moment only, bending moment, combined twisting and bending moment, axial load in addition to twisting and bending, Design on the basis rigidity.
Design of Key: Types, strength of keys.
Design of Coupling: Types, requirement of good couplings, design of sleeve coupling, clamp or compression coupling, rigid flange coupling, and flexible flange coupling.
Antifriction Bearing: Types of bearing, construction, designations, standard load rating by AFBMA for static and dynamic loads, life of bearings, selection of bearing, lubrication, mounting and enclosure.
Journal Bearing: Types of Lubrication, stale lubrication, Thick film lubrication, pressure distribution, minimum film thickness, relations of variable-viscosity, coefficient of friction,speed,pressure,length and diameter, bearing modulus, viscosity-Temperature chart,Sommerfield number, selection of lubricant, design procedure and numerical.
Design of flexible machine element: Flat belt types, material and construction of belt, types of drives, slip, creep, Design of V Belts and Rope drive- Construction and types, design of V belt and Rope drive. Chain Drive Classification, power, no of teeth on pockets, principal dimensions, election and design of chain. Wire Rope Design Procedure.
Design of Gears: Classification, law of gearing, forms and system of teeth, interference, beam strength of teeth, dynamic tooth load, wear tooth load, tooth failure a) Spur gear b) Helical gear : Classification face width, formative teeth number, strength of gear Design of gear c) Bevel gear : Classification, pitch angles, strength of gear, Design of gear d)Worm gear : Types, efficiency of gear, Design of gear.
Design of Clutch- Design of single plate, multiplate clutch
Design of Brake: Design of band brake and shoe brake.

Note: 1. Use of design data book will be permitted during the examination.

Text Books:

1. 1.Mechanical Engineering Design, Joseph E. Shigley and Charles R. Mischke , Tata McGraw Hill Publications, 6th edition Reprint ,2005
2. 2.Design of Machine Elements, V .B Bhandari, Tata McGraw Hill Publications, 2ndEdition 2007.

Reference Books:

1. Design Of Machine Elements, C.S Sharma & Kamlesh Purohit, Prentice Hall of India publications, New-Delhi, Eastern Economy 3rd Edition, 2003.
2. Machine Design- A Basic Approach, Dr. S.S. Wadhwa and S.S. Jolly, Dhanpat Rai and Company, Delhi , 1stt Edition 2007
3. Design data hand book for mechanical Engineers, K. Mahadevanan K. Balaveera Reddy, CBS Publishers, Delhi,4th Edition,2009
4. Design Data for Machine Element, B.D.Shiwalkar, Central Techno Publication,2nd Edition,2006

Course Outcomes:

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

MEU623.1	Apply fundamental principle of design to design components such as Shaft and Coupling
MEU623.2	Apply the standard geometry, design procedure, application and failure of ball bearing and sliding contact bearing
MEU623.3	Select and /or design belt drive and chain drive
MEU623.4	Design the appropriate gear for power transmission on the basis of given load and speed
MEU 623.5	Demonstrate understanding of various design considerations in design of brake and clutch

CO – PO –PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU623.1	3	1	3	0	0	0	0	0	0	0	0	0	3	2	0
MEU623.2	2	3	2	3	0	0	0	0	0	0	0	0	1	3	0
MEU623.3	2	2	3	2	0	0	0	0	0	0	0	0	2	2	0
MEU623.4	2	2	3	2	0	0	0	0	0	0	0	0	2	3	0
MEU623.5	2	2	3	0	0	0	0	0	0	0	0	0	1	2	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

MEU624A INTERNAL COMBUSTION ENGINES

Teaching Scheme: 03 L+ 00T Total: 03 | **Credits: 03**
Evaluation Scheme: 30 MSE +10 TA+ 60 ESE | **Total Marks: 100**
Duration of ESE: 2hrs.30min

Course Objectives:

I. To apply engineering science (thermodynamics, fluid mechanics, heat transfer) for analysis of engine operation and performance
II. To demonstrate knowledge of the engine operating characteristics and thermodynamic analysis of ideal and actual engine cycles for spark ignition and compression ignition engines
III. To compare the engine performance and combustion characteristics for conventional and alternative fuels for various types of engines
IV. To analyze the causes of exhaust emissions, influence of engine operating parameters on emissions and impact of exhaust emissions on environment and human health, exhaust after treatment technologies
V. To acquire insights about future internal combustion engine fuels and technology

Engine Types, Operation, Design and Operating Parameters: Introduction and Historical Perspective, Engine Classification, Engine Operating Cycles, Engine Components, Spark-Ignition Engine Operation – Otto Cycle, Compression Ignition Engine Operation – Diesel Cycle, Stratified Charge Engines, Engine Design and Operating Parameters

Engine Cycles and Their Analysis: Details of Two-Stroke and Four-Stroke Cycles, Air Standard Cycles, Fuel-Air cycle and Actual Cycles and Their Analysis, Assumptions and Comparison of Cycles, Thermodynamic relations for Engine Processes, Effect of Variation of Specific Heat, Dissociation and Brief Review of Other Losses, Effect of Common Engine Variables on Pressure and Temperature

Engine Fuels and Alternative Fuels: Conventional and Non-Conventional Fuels, Fossil Fuels and Their Limitations, Hydrocarbon Fuels-Gasoline, Self-ignition and Octane Rating, Diesel Fuel & Cetane Rating, Potential Alternative Fuels-Liquids and Gaseous - Properties, Advantages, Performance and Current Status of Use for Alcohols, Hydrogen, Bio-Fuels & Blends with Conventional Fuels.

Fuel Supply Systems in SI and CI Engines: Carburetors, Port Fuel Injection, Multi-Point Port Injection, Single-Point Throttle Body Injection, Direct Injection and Common Rail Injection, Fuel Injectors, Injector Nozzles and Fuel Injection Pumps

Ignition Systems for SI Engines – Conventional and Alternative Ignition Approaches, Engine Lubrication and Cooling Systems, Gas Exchange Processes- Inlet and Exhaust Processes, Supercharging and Turbocharging

Combustion in SI Engines and Combustion Chambers: Combustion in SI Engines, Stages of Combustion, Ignition Delay and Factors Affecting Ignition Delay, Normal and Abnormal Combustion, Factors Responsible for Abnormal Combustion, Knock Limited Parameters, Requirement for Combustion Chambers for SI engines, Types, Relative Advantages and Disadvantages, Applications

Combustion in CI Engines and Combustion Chambers: Stages of Combustion in CI Engines, Fuel Spray Behavior, Delay Period, and Physical Factors Affecting Delay Period, Diesel Knock, Requirements of Combustion Chamber for CI Engines, Methods of Generating Turbulence in CI Engine Combustion Chamber, Types of Combustion Chambers for CI engines

Pollutant Formation and Control: Effect of Fuel-Air/Equivalence Ratio on Engine Exhaust Emissions, Nitrogen Oxides, Carbon Monoxide, Unburned HC Emissions, Particulate Emissions, Exhaust Gas Treatment – Methods and Devices, Study of Emission Norms, BIS, EURO and US Emission Norms

Engine Operating Characteristics and Engine Performance Test: Engine Performance Parameters, Operating Variables Affecting SI and CI Engine Performance, Efficiency and Emissions, Performance Test on IC engines**,** Methods of Determination of Brake Power, Heat Balance sheet,

Advanced IC Engine Trends – Current Status, Challenges and Opportunities

Text Books:

1. Internal Combustion Engines, Ganesan V, 4th Edition, McGraw Hill Publications, New Delhi, 2017
2. A course in Internal Combustion Engines, M. L. Mathur and R. P. Sharma, D3rd Edition, Dhanpat Rai and Sons, Delhi, 1994
3. Engineering Fundamentals of the Internal Combustion Engine, Pulkrabek Willard W, 2nd Edition, Pearson India, 2015

Reference Books:

1. Internal Combustion Engines Fundamentals, John B. Heywood, 2nd Edition, McGraw-Hill, 1988.
2. Internal Combustion Engines – Applied Thermosciences, Colin R Ferguson and Allan Kirkpatrick, 3rd Edition, Wiley, New York, 2016
3. Internal Combustion Engines in Theory and Practice: Vol 1 Revised – Thermodynamics, Fluid flow, Performance, Charles Fayette Taylor, 2nd Edition Revised, Mc-Graw Hill Publications, 2018
4. Internal Combustion Engines in Theory and Practice: Vol 1 Revised – Combustion, Fuels, Materials, Design, Charles Fayette Taylor, 2nd Edition Revised, Mc-Graw Hill Publications, 2018

Course Outcomes:

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

MEU624A.1. Apply engineering science (thermodynamics, fluid mechanics, heat transfer) for analysis of engine operation and performance

MEU624A.2. Demonstrate knowledge of the engine operating characteristics and thermodynamic analysis of ideal and actual engine cycles for spark ignition and compression ignition engines

MEU624A.3. Compare the engine performance and combustion characteristics for conventional and alternative fuels for various types of engine

MEU624A.4. Analyze the causes of exhaust emissions, influence of engine operating parameters on emissions and impact of exhaust emissions on environment and human health, exhaust after treatment technologies

MEU624A.5. Acquire insights about future internal combustion engine technologies

CO – PO –PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU624A.1	3	3	3	3	2	1	1	0	0	0	0	3	3	3	0
MEU624A.2	3	3	2	2	1	0	1	0	0	0	0	2	3	3	0
MEU624A.3	2	3	2	2	2	0	0	0	0	0	0	1	2	2	0
MEU624A.4	3	3	2	2	2	2	3	1	0	0	0	3	3	3	0
MEU624A.5	2	2	2	1	1	0	2	1	0	0	0	3	2	2	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

MEU624B MECHATRONICS

Teaching Scheme: 03 L+00T **Total: 03** **Credits: ~~04~~ 03**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **TOTAL MARKS: 100**
Duration of ESE: 2 hrs. 30 min

Course Objectives:

I. To understand the fundamentals of mechanical engineering, electrical and computer engineering, software engineering and control system in synergistic framework.
II. To Evaluate the operational characteristics of sensors and transducers, drives and actuators.
III. To understand the role of various digital logic and logic controller.
IV. To create the circuit for simple practical application of mechatronics.
V. To develop the PLC program for a certain application.

Introduction: Scope and applications of Mechatronics, Measurement System with its constituent elements; Open and Closed Loop Systems; Sequential Controllers; Micro-processor Based Controllers.

Electronics for Mechanical Engineers: Introduction to Conductors, Insulators and Semiconductors, Passive components used in Electronics, Transformers, Semiconductors, Transistors, Silicon Controlled Rectifiers, Integrated Circuits, Digital Circuits.

Construction and Configuration of CNC System: Machine Structure, Slide ways, Spindle, Drive Units, Elements of Motion Transmission, Location of Transducers/Sensors/Control, Configuration, Interfacing, Monitoring, Diagnostics, Machine Data, Compensations for Machine Accuracies.

Sensors and Transducers: Sensors, Transducers, Types, Contact & Non Contact types, performance, Applications.

Drives and Actuators: Types of Motion, Kinematics chains, Cams, Gear Trains, Belt and Chain Drives, Bearings, Mechanical aspects of Motor Selection.

Electrical Actuation System: Electrical Systems, Mechanical Switches, Solid-State Switches, Solenoids, D.C. Motors, A.C. Motors, Stepper Motors.

Pneumatic & Hydraulic Actuation System: Actuation systems, Pneumatic and hydraulic systems, Directional control valves, Cylinders, Process control valves, Different control, Rotary actuators.

Digital Logic and Programmable Logic Controllers : A Review of Number Systems & Logic Gates; Boolean Algebra; Kanaugh Maps; Sequential Logic; Basic Structure of Programmable Logic Controllers; Input/ Output Processing; Programming; Timers, Internal Relays and Counters; Master & Jump Controls; Data Handling; Analogue Input/ Output; Selection of a PLC; Problems.

Micromechanics Systems: Microsensors, Microactuators; Micro-fabrication techniques LIGA Process; Lithography, etching, Micro-joining etc. Application examples; Case Studies Examples of Mechtronics Systems from Robotics Manufacturing, Machine Diagnostics, Road Vehicles and Medical Technology.

Text Books:

1. Mechatronics: An Introduction , Robert H. Bishop, Taylor and Francis Group 2017.
2. Mechatronics , M.D. Singh, J.G. Joshi, PHI 2006.
3. Mechatronics, HMT, Tata McGraw Hill, First Edition, 2008

Reference Books:

1. Mechatronics , Dan Necsulescu, Pearson.
2. Mechatronics- Integrated Mechanical Electronic System , K.P. Ramachandran, Wiley.
3. Mechatronics system Design , Devdas Shetty, Cengage Learning 2010.
4. Fundamentals of Robotics analysis and Control , J Schilling, PHI publication.
5. Feedback Control Systems, Bakshi U.A., Goyal S.C.,Technical Publications,Pune,2nd reprint 2003.

Course Outcomes:

On completion of the course, student will be able to:

MEU624B.1. Describe the mechatronics systems.

MEU624B.2. Explain the working of various transducers, drive and actuators also differentiate between them.

MEU624B.3. Design some simple mechatronics system related element to other basic contrary.

MEU624B.4. Explain the various application of mechatronics system.

MEU624B.5. Develop of PLC programming using logic gates and implementation.

CO – PO – PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU624B.1	2	2	0	0	0	0	0	0	0	0	0	0	2	1	1
MEU624B.2	2	2	0	0	0	0	0	0	0	0	0	0	2	1	0
MEU624B.3	2	2	3	1	0	0	0	0	0	0	0	0	2	1	0
MEU624B.4	2	2	0	2	0	0	0	0	0	0	0	0	2	1	0
MEU624B.5	2	2	1	1.5	0	0	0	0	0	0	0	0	2	1	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

MEU624C MECHANICAL VIBRATIONS

Teaching Scheme: 03 L+ 00T **Total : 03** **Credit: 03**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2 hrs. 30 min.

Course Objective:

I. To appraise the fundamentals of Vibration Theory.
II. To write mathematical model of mechanical vibration problems
III. To apply various techniques to solve mechanical vibration problemTo Examine
IV. To use vibration testing and measuring equipments in preventive maintenance.

Overview of the course, practical applications and research trends Harmonic and

Periodic motions, vibration terminology

Single DOF system: Vibration model, Equation of motion-Natural Frequency, Energy method, Rayleigh method Principle of virtual work, Principle of virtual Work, damping models, viscously damped free vibration Special cases: oscillatory, non-oscillatory and critically damped motions, Logarithmic decrement, Experimental determination of damping coefficient, Forced harmonic vibration, Magnification factor. Rotor unbalance, Transmissibility Vibration Isolation, Equivalent viscous damping, Sharpness of resonance.
Torsional Vibrations: Simple systems with one or two rotor masses Multi-DOF systems-transfer matrix method, Geared system, branched system
Two-DoF Free Vibrations: Generalized and Principal coordinates, derivation of equations of motion Lagrange's equation Coordinate coupling Forced Harmonic vibration
Multi-DoF System: Derivation of equations of motion, influence coefficient method, Properties of vibrating systems: flexibility and stiffness matrices, reciprocity theorem Modal analysis: undamped, damped system, Calculation of natural frequencies Rayleigh method, Stodala method, Matrix iteration method Holzer method and Dunkerley's method
Continuous systems: Vibration of strings Longitudinal and torsional vibration of rods Transverse vibration of beams: equations of motion and boundary conditions transverse vibration of beams: natural
Frequencies and mode shapes Rayleigh's energy method, Rayleigh-Ritz method, assumed modes and Galerkin's , methods
Preventive maintenance: vibration testing and measuring equipment, signal generation, signal analysis instruments, data acquisition, active and passive vibration control principle and material, damping based material selection: design consideration and specification

Text Books:

1. Rao S.S.,"Mechanical Vibrations",4e, Pearson Education Inc.,2004
2. V.P.Singh, "Mechanical vibrations",3e, DhanpatRai& Co.,2006

Reference Books:

1. G.K. Grover, "Mechanical Vibrations", Nemchand& Bros. Roorkee, 8e, 2009

2. William T Thomson & Marie Dillon Dahleh, "Theory of Vibrations with application", 5e, Pearson Education Publication, 2007
3. Tse, Morse and Hinkel, "Mechanical Vibrations", Chapman and Hall, 1991
4. DenHartog J.P., "Mechanical Vibrations", McGraw Hill, 1986

Course Outcomes:

On completion of this course students will be able to:

MEU624C.1	Synthesize mathematical models for single DoF vibration systems and Compute frequencies of them
MEU624C.2	Compute amplitude ratios, natural frequencies, and damping ratios of damped vibration systems
MEU624C.3	Select vibration isolation systems and evaluate the effect of damping on the above systems.
MEU624C.4	Analyse Two-DoF Free Vibration systems, Multi-DoF System Continuous vibration systems
MEU624C.5	Instrument and analyse mechanical vibrating system

CO-PO-PSO Mappings:

Course Outcomes	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU624C.1	3	3	3	3	1	0	0	0	0	0	0	2	3	3	0
MEU624C.2	3	3	3	3	1	0	0	0	0	0	0	2	3	3	0
MEU624C.3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	0
MEU624C.4	3	3	3	3	1	0	0	0	0	0	0	2	3	3	0
MEU624C.5	3	3	3	3	1	0	0	0	0	0	0	2	3	3	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

MEU624D FRACTURE MECHANICS AND NON DESTRUCTIVE EVALUATION

Teaching Scheme: 03 L+00T Total: 03 **Credit: 03**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2 hrs. 30 min.

Course Objectives:

I. To know the characteristics of initiation of a crack, its propagation and fracture
II. To study mechanism of fracture
III. To know damage tolerant design of the components
IV. To study various methods of non destructive evaluation of materials
V. To understand the effect of defects on mechanical performance of the materials

Introduction: Kinds of Failure, theoretical cohesive strength, defects in solids, stress concentration, notch strengthening, modes of fracture, factors affecting fracture
Linear elastic fracture mechanics: Griffith's energy balance, Surface Energy, modified Griffith's equation, Energy Release Rate, Charpy impact fracture testing, Change in Compliance Approach, Change in the Strain Energy Approach, Thin Plate vs. Thick Plate, Critical Energy Release Rate
Stress Intensity Factor: Investigations closer to the Crack Tip, Stress and Displacement Fields in Isotropic Elastic Materials, Stress Intensity Factor, Stress analysis of cracks, Westergaard's Approach: Model I (Opening Mode), Mode II (Sliding Mode), and Mode III (Tearing Mode)
An-elastic Deformation at the Crack Tip: Approximate Shape and Size of the Plastic Zone, Plastic Zone Shape for Plane Stress, Plastic Zone Shape for Plane Strain, Effective Crack Length, Crack Resistance (R curve), Crack arrest, The Irwin Plastic Zone Correction, Plastic Zone Size through the Dugdale approach, Plastic strip model, Effect of Plate Thickness
Elastic-plastic fracture mechanism: Fracture toughness determination, Definition of the J-Integral, Path Independence, Stress-Strain Relation, Experiments to Determine the Critical J-Integral, A Simplified Relation for the J-Integral, Applications to Engineering Problems, Predicting Safety or Failure, means to provide fail-safety, design philosophy, optimizing microstructure and alloy cleanliness to enhance fracture toughness
Crack Tip Opening Displacement: Relationship between *CTOD*, Kr and Gr for Small Scale Yielding, Equivalence between *CTOD* and J, Impact energy-fracture toughness correlations
Fatigue Test: Mechanism of fatigue crack nucleation and propagation, factors affecting fatigue crack growth rate, Paris Law, fatigue rate calculation, prevention of fatigue failures
Crack Detection through Non-Destructive Testing: Introduction, Examination through Human Senses, Visual Inspection, Investigation through Hearing, Detection through Smell, Other Simple Methods
Liquid Penetration Inspection: Principle, Procedure, Crack Observation
Ultrasonic Testing: Principle, Equipment, Immersion Inspection

Radiographic Imaging: Contrast through Absorption Rate, Imaging through X-rays, Imaging through Gamma Rays, Strong Points of Radiographic Imaging, Limitations of Radiographic Imaging

Magnetic Particle Inspection: Principle, Sensitivity, Hardware, Flaw Orientation, Magnetic Ink Powder, Voltage Source, Demagnetization, Strength and Limitations

Text Books:

1. Deformation And Fracture Mechanics Of Engineering Materials, R.W. Hertzberg et al, Fifth edition , John Wiley, 2020
2. Elementary Engineering Fracture Mechanics, David Broek, Springer Netherlands, 2011
3. Elements Of Fracture Mechanics, Prashant Kumar, McGraw Hill, 2014

Reference Books:

1. Fracture Mechanics, M. Jansen, J. Zuidema, R. Wanhill, Spon Press, 2004
2. Nondestructive Evaluation of Materials, ASM Handbook Vol. I and II, ASM International,2011
3. Experimental Stress analysis, James Dally and William Riley, Third Edition, McGraw Hill, 1991
4. Fracture Mechanics:- Fundamentals and Application, T.L. Anderson, Taylor and Francis, 2005

Course Outcomes:

Upon successful completion of this course student should be able to:

MEU624D.1 Illustrate the basic modes of fracture of materials.

MEU624D.2 Compute the stress at failure, the half crack size at failure, stable crack growth at crack tip

MEU624D.3 Characterize crack propagation behaviour and analyse crack growth

MEU624D.4 Apply concepts of non destructive evaluation for defect detection in materials

MEU624D.5 Design products based on theories of fracture mechanics

CO-PO-PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO 3
MEU624D.1	1	2	0	0	0	2	0	0	0	0	0	0	3	3	0
MEU624D.1	3	3	3	0	0	0	2	0	0	0	0	0	3	3	0
MEU624D.1	3	3	2	3	0	0	1	0	0	0	0	0	3	3	0
MEU624D.1	3	0	0	3	3	0	0	0	0	0	0	0	0	3	0
MEU624D.1	3	0	3	0	3	2	2	1	0	0	0	0	3	3	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

MEU624E INDUSTRIAL MANAGEMENT

Teaching Scheme: 03 L+00T **Total: 03** **Credit: 03**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2 hrs. 30 min.

Course Objectives:

I. To impart fundamental knowledge and skill sets required in the industrial management and engineering profession
II. To develop ability to apply basic knowledge of mathematics, probability and statistics, and domain knowledge of industrial management and engineering,
III. To produce graduates with the ability to adopt a system approach to design, develop, implement and innovate integrated systems
IV. To enable students to understand the interactions between engineering, business, technological and environmental spheres in the modern society.
V. To enable students to understand their role as engineers and their impact to society at large

Introduction: Definition of management, characteristics of management, functions of management - Planning, Organising, Staffing, Directing, Co-ordination, Controlling, Motivating, Communication, Decision Making, Principles of management – F.W.Taylor, Henry Fayol, Elton Mayo, Administration and management, Nature of management, levels of management, managerial skills, managerial roles, Forms of Organization- Line , Line –staff etc. Forms of ownerships – Partnership, Proprietorship, Joint stock, Co-operative society, Govt. Sector etc, concept of Globalisation

Marketing Management: Different types of market research, various marketing strategies, New product development, product life cycle, and advertising media.

Financial Management: Need for finance, Capital Structure, Fixed & working capital, Role of Securities and Exchange Board of India (SEBI), function of money market and capital Market, sources of finance. Introduction to capital budgeting, Techniques of capital budgeting. Break even analysis, financial ratios, profit and loss statements, balance sheet

Personnel Management: Functions of Personnel Management, human resources planning, recruitment and training, workers participation in management, industrial safety.

Materials Management, Estimating & Costing: Classes of materials, purchasing methods and procedure, inventory control, Stores, EOQ, ABC analysis. Objectives of estimating and costing, elements of cost,

Management Information Systems: Concept of data and information, characteristics of information, types of information, Definition of MIS, Need, Purpose and Objectives, Contemporary Approaches to MIS, Components of an information system, need to study information systems, Classification of information systems.

Quality Management: Definition of quality dimensions of product quality, Evolution of Quality, Quality costs, Customer-Orientation: Internal & External Customer concept, Seven basic quality control tools. Continuous improvement, types of quality: quality of design, conformance and performance, phases of quality management, Juran's and Demings view of quality, Quality Management Assistance Tools: Ishikawa diagram, Pareto Analysis, Pokka

Yoke (Mistake Proofing). Quality circles, TQM, Kaizen, Five S (5S), Introduction to Six Sigma Quality Management. ISO 9001:2000, Quality Management System Standard.

Text Books:

1. Essentials of Management, Koontz, Harold, 2009 Edition, McGraw Hill Education India Ltd. New Delhi.
2. Purchasing and Materials Management, Gopalkrishnan, 2010 Edition, McGraw Hill Education India Ltd. New Delhi.
3. Statistical Quality Control, E.L.Grant, R.S.Leavenworth, 6th Edition, 2005, Tata McGraw Hill Publishing Ltd, New Delhi.
4. Management Information Systems, B. Davis and Margrethe H. Olson, Mc-Graw-Hill International Editions.

Reference Books:

1. Total Quality Management, L.Suganthi, A.A.Samuel, 2nd Edition, 2005, Prentice Hall of India, New Delhi.
2. Quality Engineering Handbook, Thomas Pyzdek, Roger W. Berger, Tata McGraw Hill Publication, New Delhi.
3. Quality Handbook, J.M Juran, 4th Edition, 2005, McGraw Hill Publication, New Delhi.
4. Quality Control and TQM, P.L.Jain, 6th Edition, 2001, Tata McGraw Hill Publishing Ltd, New Delhi.
5. Quality Control, 11th Edition, 2005, Tata McGraw Hill Publishing Ltd, TTTI, Madras..

Course outcomes:

After the course, the students are expected to be able to:

MEU624E.1 Design and conduct experiments, analyse, interpret data and synthesize valid conclusions

MEU624E.2 Design a system, component, or process, and synthesize solutions to achieve desired needs

MEU624E.3 Use the techniques, skills, and modern engineering tools necessary for engineering practice

MEU624E.4 Design and perform experiments to determine critical areas of product development and analyse the results for quality improvement

MEU624E.5 Use Quality Management Tools recognized throughout industries to ensure the quality level of products.

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU624E.1	2	1	2	2	2	1	2	2	2	2	2	1	1	1	1
MEU624E.2	1	2	2	1	2	3	1	2	1	2	2	1	0	1	0
MEU624E.3	2	1	3	1	2	1	2	1	2	1	2	0	1	0	2
MEU624E.4	3	2	1	2	3	1	1	1	2	0	1	2	0	2	1
MEU624E.5	1	2	2	1	2	2	3		1	1	1	2	2	1	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

MEU625A COMPUTATIONAL FLUID DYNAMICS

Teaching Scheme: 03 L+00T **Total: 03** **Credits: 03**
Evaluation Scheme: 30 MSE +10 TA+ 60 ESE **Total Marks: 100**
Duration of ESE: 2hrs.30min

Course Objectives:

I. To develop an understanding for the major theories, approaches and methodologies used in CFD
II. To build up the skills in the actual implementation of CFD methods (e.g. boundary conditions, turbulence modelling etc.) in using commercial CFD codes
III. To gain experience in the application of CFD analysis to real engineering designs.

Introduction to CFD: Computational approach to Fluid Dynamics and its comparison with experimental and analytical methods, Basics of PDE: Elliptic, Parabolic and Hyperbolic Equations.

Governing Equations: Review of Navier-Stokes Equation and simplified forms, Solution Methodology: FDM and FVM with special emphasis on FVM, Stability, Convergence and Accuracy.

Finite Volume Method: Domain discretization, types of mesh and quality of mesh, SIMPLE, pressure velocity coupling, Checkerboard pressure field and staggered grid approach.

Geometry Modelling and Grid Generation: Practical aspects of computational modelling of flow domains, Grid Generation, Types of mesh and selection criteria, Mesh quality, Key parameters and their importance.

Methodology of CFDHT: Objectives and importance of CFDHT, CFDHT for Diffusion Equation, Convection Equation and Convection-Diffusion Equation.

Solution of N-S Equations for Incompressible Flows: Semi-Explicit and Semi-Implicit Algorithms for Staggered Grid System and Non-Staggered Grid System of N-S Equations for Incompressible Flows

Text Books:

1. Computational Fluid Dynamics, The Basic with applications by John A. Anderson, Jr.,Mc-Graw Hill International Editions, Mechanical Engineering series.
2. Computational Fluid Dynamics: Principles and Applications, Blazek, J., Elsevier Science, 2001.

Reference Books:

1. An Introduction to Computational Fluid Flow (Finite Volume Method), H. K. Versteeg, W. Malalasekera, 2nd Edition, Prentice Hall, Pearson Education Limited, 2007.
2. Computational Methods for Fluid Dynamics, Ferziger and Peric, 3rd Edition, Springer Publication, 2002.
3. Numerical Methods in Fluid Flow and Heat Transfer, Dr. Suhas V. Patankar, CRC Press, Taylor and Francis, 1980.
4. An Introduction to Computational Fluid Mechanics by Example, Sedat Biringen and Chuen-Yen Chow, John Wiley & Sons, Inc., Hoboken, New Jersey, 2011.

5. Computational Fluid Flow and Heat Transfer, Murlidhar and Sundarrajan, Narosa Publishing House, 1995.

Course Outcomes:

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

MEU625A.1. Explain the basic concept of Computational Fluid Dynamics.
MEU625A.2. Illustrate theories, approaches and methodologies used in CFD.
MEU625A.3. Develop skills in the actual implementation of CFD methods.
MEU625A.4. Apply CFD as tool to solve the thermal-fluid related problems.
MEU625A.5. Create the base and interest to carry out the future research.

CO – PO –PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU625A.1	3	3	3	3	3	0	0	0	0	0	0	2	2	2	0
MEU625A.2	3	3	3	3	3	0	0	0	0	0	0	2	2	2	0
MEU625A.3	2	2	2	2	3	0	0	0	0	0	0	2	2	2	0
MEU625A.4	2	2	2	3	3	0	0	0	0	0	0	2	2	2	0
MEU625A.5	2	2	2	2	2	0	0	0	0	0	0	2	2	2	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

MEU625B TOTAL QUALITY MANAGEMENT

Teaching Scheme: 03 L　　Total: 03　　Credits: 03
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE　　Total Marks: 100
Duration of ESE: 2 hrs. 30 min.

Course Objectives:

I. To know the concept and importance of quality and philosophies of TQM
II. To illustrate the use of Total Quality Control tools
III. To understand the concept of Quality Circle, Kaizen, Six Sigma and JIT.
IV. To know the importance of Quality standards.

Introduction to TQM: Concept of Quality, Definitions of Quality, Dimensions of product and service quality, Definition of TQM, Importance and Benefits of TQM, pillars of TQM, Importance of Leadership for Successful TQM, Concept of Cost of Quality, Basics of Customer Satisfaction and Customer Satisfaction Index. Vision, Mission and Policy statements.

Approaches and Philosophies of TQM: Overview of the contributions of Deming, Juran, Crosby, Masaaki Imai, Feigenbaum, Ishikawa. TQM frameworks, Customer Orientation, Continuous improvement.

Tools of TQM: Basic analytical tools- Check sheet, Histogram, Pareto charts, Cause and Effect diagrams, Flow charts, Scatter diagram, Run charts. Quality functions development (QFD) – Benefits, Voice of customer, House of quality (HOQ), Bench- marking and POKA YOKE, 5S principles.

Quality Circles: Introduction, Implementation, Formation, Intangible impact of quality Circles. Kaizen: Introduction, Process, benefits, and Implementation.

Quality Standards and Just in Time (JIT): Introduction to ISO series of Quality Standards, Quality Awards, Need and benefits. Concept of JIT, Relevance and advantages, Importance of KANBAN in JIT.

Six Sigma Process: Concept of Six Sigma, Process of Six Sigma, Implementation in Manufacturing and Service sector.

Textbooks:

1. "What is Total Quality Control? The Japanese Way", Ishikawa and Lu, Prentice Hall, 1988.
2. "Total Quality Management", Tally D.J., ASQC Quality Press.
3. "Total Quality Management", A.V. Feigenbaum, 6th Edition, McGraw Hill International USA, 2009.

Reference Books:

1. "Out of Crisis", Deming W. Edward, MIT Publishing, 1982.
2. "Quality Control Handbook", Juran J.M., 5th edition, McGraw Hill Book Company, USA, 2009.
3. "Kaizen: The Key to Japan's Competitive Success", Masaaki Imai, McGraw Hill International, USA, 2009.

Course Outcomes:

After completing the course, the students will be able to:

MEU625B.1 Explain the concept of TQM and its benefits to industry
MEU625B.2 Illustrate and apply tools of Total Quality Management
MEU625B.3 Implement the concept of Quality Circle, Kaizen and JIT
MEU625B.4 Apply Six Sigma methodology for quality improvement
MEU625B.5 Illustrate and apply Quality standards

CO – PO –PSO Mapping:

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU625B.1	0	0	0	0	0	0	0	0	0	0	3	1	0	0	0
MEU625B.2	1	2	2	0	3	0	0	0	0	0	2	0	2	3	2
MEU625B.3	1	2	2	0	3	0	0	0	0	0	2	0	2	3	2
MEU625B.4	1	2	2	3	3	0	0	0	0	0	2	0	2	3	2
MEU625B.5	1	2	2	0	3	0	0	0	0	0	2	0	2	3	2

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

MEU625C INDUSRTRIAL ROBOTICS

Teaching Scheme: 03 L+00T **Total: 03** **Credits: 03**
Evaluation Scheme: 30 MSE +10 TA+ 60 ESE **Total Marks: 100**
Duration of ESE: 2hrs.30min

Course objectives:

I. To learn various types of Industrial robots in industries.
II. To understand various types of Robot Control System in industries.
III. To study various types of End Effectors and Sensors, transformations and its kinematics in robotics
IV. To understand robot programming methods in robotic system.
V. To study the approach for Robot implementation issues in robotics.

Introduction: Basic concepts - Robot anatomy - Robot configurations - Basic robot motions –Types of robots-Types of drives - Applications - Material handling - processing -Assembly and Inspection -safety considerations.

Fundamentals of Industrial Robots: Specifications and Characteristics, Basic components, configurations, Criteria for selection, various industrial applications.

Transformations and Kinematics

Vector operations - Translational transformations and Rotational transformations– Properties ofTransformation matrices-Homogeneous transformations and Manipulator – Forward solution -Inverse solution.

Robotic Control Systems: Actuators, Power transmission systems, Robot controllers, Dynamic properties of robots- stability, control resolution, spatial resolution, accuracy, Repeatability,compliance.

Robotic End Effectors and Sensors: Transducers and sensors- sensors in robotics and their classification, Touch (Tactile) sensors, proximity and range sensors, force and torque sensing, End Effectors- Types, grippers, various process tools as end effectors ,Robot- End effectors, interface, Active and passive compliance, Gripper selection and design.

Robot Programming: Lead through method, Robot program as a path in space, Methods of defining positions in space, Motion interpolation, branching; Textual robot programming languages

Robot Implementation Issues: Approach for implementing Robotics, Safety, Training and Maintenance Social Aspects of Robotics

Text Books:

1. Industrial Robotics: Technology, Programming and Applications, M. P. Grover, McGraw-Hill International Editions

2. Robotics and Control, Nagrath and Mittal, Tata McGraw-Hill, 2005.

3. Robot Dynamics and Control, Spong and Vidhyasagar,John Wiley and sons, 2008.

4 Robotics Technologies and Flexible Automation, Deb, S. R. Deb. S, McGraw Hill 2010

Reference books:

1. Robotics for Engineers, Y. Koren, McGraw Hill International Editions
2. Robotic Engineering: An Integrated Approach, Richard D. Klafter, at.el, Prentice Hall of India
3. Handbook of Robotics, Noff, Shimon Y. ,John Wiley & Sons
4. Robotics for Engineers, Y. Koren, McGraw Hill, 1985
5. Robotics, Control, Sensing, Vision and Intelligence, Fu. K.S, Gonzalez, R.C., Lee, C.S.G,McGraw Hill International, 1987
6. Fundamentals of Robotics, Analysis & Control, Ed Schilling, Robert J, Prentice Hall of India, ISBN: 81-203-1047-0, (2004)

Course Outcomes:

On successful completion of this course student should be able to

MEU625C.1 Explain the manipulators and its kinematics.

MEU625C.2 Classify the actuators, types of robotic configurations and study their characteristics

MEU625C.3 Understand the motions of robots and its control and various implementing issues.

MEU625C.4 Determination of the solution to inverse kinematics and trajectory planning in robot movements.

MEU625C.5 Acquire the knowledge of sensors, robot programming used in robots

CO – PO –PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU625C.1	3	0	0	1	0	1	1	0	0	0	0	0	1	2	0
MEU625C.2	2	2	0	1	3	2	0	0	0	0	0	1	0	0	1
MEU625C.3	2	2	2	1	2	1	0	3	0	0	0	0	0	1	0
MEU625C.4	2	3	3	1	0	3	0	3	0	2	0	0	1	0	0
MEU625C.5	2	0	0	1	3	0	1	0	0	0	0	1	0	0	2

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

MEU625D HYDRAULICS AND PNEUMATICS

Teaching Scheme: 03 L+00T **Total: 03** **Credits: 03**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **TOTAL MARKS: 100**
Duration of ESE: 2 hrs. 30 min

Course Objectives:

I. To understands the basicfeatures and functions of Hydraulic motors.
II. To understands the working of actuators and flow control valves.
III. To learn the difference between hydraulics and pneumatic circuit.
IV. To study the concept of pneumatic circuit and system.
V. To apply various methods for trouble shooting of hydraulic and pneumatic system.

Hydraulic Actuators and Control Components: Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Hydraulic motors - Control Components : Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Servo and Proportional valves – Applications – Accessories : Reservoirs, Pressure Switches – Applications – Fluid Power ANSI Symbols – Problems.

Hydraulic Circuits and Systems: Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double- Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems.

Pneumatic and Electro Pneumatic Systems: Properties of air – Perfect Gas Laws – Compressor – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit – Cascade method – Electro Pneumatic System – Elements – Ladder diagram – Problems, Introduction to fluidics and pneumatic logic circuits.

Trouble Shooting and Applications: Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications. Design of Pneumatic circuits for Pick and Place applications and tool handling in CNC Machine tools – Low cost Automation – Hydraulic and Pneumatic power packs.

Text Books:

1. Fluid Power with Applications ,Anthony Esposito, Pearson Education 2005.
2. Oil Hydraulics Systems- Principles and Maintenance , Majumdar S.R.,Tata McGraw-Hill, 2001.

Reference Books:

1. Pneumatic controls, Joji,P., Wiley India Pvt. Ltd., 2008.
2. Oil Hydraulic Power and its Industrial Applications , Ernst, W., New York, McGraw Hill.
3. Design of Hydraulic Control Systems, Lewis, E. E., and H. Stern, New York, McGraw Hill..
4. Hydraulic and Pneumatic Controls, Shanmugasundaram. K, Chand & Co, 2006.

5. The analysis and Design of Pneumatic Systems, Blaine W. Andersen., John Wiley and Sons, Inc.
6. Fluid Power Control, Blackburn, J.F., G. Reethof, and J.L. Shearer, , New York, Technology Press of M. I. T.

Course Outcomes:

On completion of course, student will be able to:

MEU625D.1. Explain the working of hydraulic motor

MEU625D.2. Summarize the features and functions actuators and Flow control valves.

MEU625D.3. Explain the different types of Hydraulic circuits and systems.

MEU625D.4. Explain the working of different pneumatic circuits and systems.

MEU625D.5. Summarize the various trouble shooting methods and applications of hydraulic and pneumatic systems.

CO –PO – PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU625.1	3	0	1	0	0	0	0	0	0	0	0	0	3	0	0
MEU625.2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
MEU625.3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
MEU625.4	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
MEU625.5	0	0	0	0	0	0	3	0	0	3	0	0	0	3	2

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

MEU625E OPERATIONS RESEARCH TECHNIQUES

Teaching Scheme: 03 L+00T **Total: 03** **Credit: 03**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2 hrs. 30 min.

Course Objectives:

I. To illustrate the importance and need of operations research models in industry.
II. To learn the mathematical tools that are needed to solve optimization problem.
III. To gain ability to apply the techniques of OR to solve real life problems in industry.

Introduction: Definitions, Characteristics, Phases, and limitations of OR, Classification of O.R. Models.

Linear programming: Problem formulation, Graphical method, Simplex method, introduction to duality.

Transportation Models: Introduction, formulation of transportation problems, methods for finding initial solution, Optimization by MODI method, Special cases.

Assignment Models: Introduction, Mathematical formulation, Hungarian method, Special cases.

Network Models: Network construction, PERT analysis, CPM analysis, Cost analysis.

Waiting line models and Simulation: Introduction, Elements of Queuing system, Characteristics, Classification, analysis of M/M/1.Introduction to Simulation, Applications, Generation of Random numbers.

Sequencing Models: Introduction, Assumptions, Processing of n jobs through 2 machines, Processing of n jobs through 3 machines.

Replacement Models: Introduction, Individual replacement policies.

Dynamic Programming: Introduction, Concept, Characteristics, Principle of Optimality, Method, Applications.

Inventory model: Introduction, Classifications of Inventories, Cost associated with Inventory, Deterministic models, Economic Order Quantity (EOQ),ABC analysis.

Text Books:

1. Operation Research, H. A. Taha, 7th Edition, PHI.
2. Introduction to Operations Research, Billy E. Gillett, 2nd Edition, Tata McGraw Hill.
3. Operations Research, Panneerselvan , 3nd Edition , PHI.

Reference Books:

1. Operation Research, Natarajan, Balasubramani, and Tamilarasi, 3rd Edition, Pearson Education.
2. System Simulation with Digital Computer, NarsinghDeo, PHI.
3. Linear Programming, N. Paul Loomba, TMH Edition, Tata McGraw -Hill.

Course Outcomes:

On successful completion of the course, student will be able to:

MEU625E.1 Explain the importance, benefits, and applications of Operations Research.
MEU625E.2 Identify and formulate Operations Research problems in industry.
MEU625E.3 Solve the linear programming, Transportation and Assignment problems.
MEU625E.4 Apply PERT and CPM for project scheduling and management
MEU625E.5 Apply the techniques of OR to solve real life problems in industry.

CO – PO –PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU625E.1	0	0	0	0	0	0	0	0	0	0	3	1	0	0	0
MEU625E.2	1	3	0	0	0	0	0	0	0	0	3	0	3	0	1
MEU625E.3	2	3	0	0	0	3	0	0	0	0	0	0	2	0	1
MEU625E.4	0	3	0	0	0	3	0	0	0	0	0	0	2	3	2
MEU625E.5	2	3	0	0	0	3	0	0	0	0	0	0	1	3	2

0- Not correlated   1 - Weakly Correlated   2- Moderately Correlated   3- Strongly Correlated

MEU626A THERMAL AND FLUID ENGINEERING

Teaching Scheme: 03 L+ 00T Total: 03 **Credits: 03**
Evaluation Scheme: 30 MSE +10 TA+ 60 ESE **Total Marks: 100**
Duration of ESE: 2hrs.30min

Course Objectives:

I. To integrate the concepts, laws and methodologies from the first course in thermodynamics
II. To study the thermodynamic concepts into various thermal application
III. To understand the various properties of fluid and instruments for measurement of pressure
IV. To study the behavior of fluid at rest and in motion
V. To understand the concept of laminar and turbulent flow and flow of fluid in pipe

Fundamental Concepts and Definitions Thermodynamic systems; properties, processes and cycles. Thermodynamic equilibrium, Quasi-static process, Macroscopic vs. Microscopic viewpoint, Work and heat Transfer: Zeroth law of thermodynamics, specific heat and latent heat, point function, path function.

First Law of Thermodynamics: First law of thermodynamics for a closed system undergoing a cycle and change of state, Energy, different forms of energy, Enthalpy, PMM-I control volume. Application of first law of steady flow processes (nozzle, turbine, compressor pump, boiler, throttle valve etc.), Second Law of Thermodynamics Limitation of first law of thermodynamics, cycle heat engine, refrigerator and heat pump, Kelvin- Plank and Clausius statements and their equivalence, Reversibility

Basics Definition of fluid, fluid properties such as viscosity, vapor pressure, compressibility, surface tension, capillarity, Mach number etc., pressure at a point in the static mass of fluid, variation of pressure, Pascal's law, pressure measurement by simple and differential manometers using manometric expression.

Fluid Statics: Hydrostatic forces on the plane and curved surfaces, center of pressure, Buoyancy, center of buoyancy, stability of floating bodies, metacenter

Fluid Kinematics: Velocity of fluid particle, types of fluid flow, description of flow, continuity equation, rotational and irrotational flow,

Fluid Dynamics: Euler's equation to obtain Bernoulli's equation, Bernoulli's theorem, Types of Flow, Laminar Flow, Turbulent Flow: Reynolds's experiment, frictional loss in pipe flow, shear stress in turbulent flow

Text Books:

1. P.K. Nag, Engineering Thermodynamics, Tata McGraw-Hill, 2012 Ed.
2. Thermal Engineering / Mahesh Rathore, Tata McGraw Hill, New Delhi, 2010 Ed.
3. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, S.K. Kataria & Sons

Reference Books:

1. Engineering Thermodynamics, J.P.Holman, McGraw-Hill.
2. Thermodynamics: an engineering approach, Y.A,Cengel & M.A.Boles,Tata McGrawHill.
3. Engineering Thermodynamics, P.L.Dhar, Elsevier Publication.
4. Fluid Mechanics and Hydraulic Machines by R.K. Bansal, Laxmi Prakashan
5. Introduction to Fluid power, Thomson, PrentcieHall 2012.

Course Outcomes:

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

MEU626A.1. Illustrate the basic concepts of thermodynamics such as heat, work, state etc.

MEU626A.2. Apply First Law of thermodynamics to open & closed systems, and study the fundamental knowledge of Second Law of thermodynamics

MEU626A.3. Calculate various properties of fluid

MEU626A.4. Apply Bernoulli's equation to simple problems in fluid mechanics

MEU626A.5. Analyse the laminar and turbulent flows on pipes

CO – PO –PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU626A.1	3	2	0	0	1	0	0	0	0	0	0	2	2	3	0
MEU626A.1	3	2	0	0	0	0	0	0	0	0	0	2	1	1	0
MEU626A.1	3	3	0	0	0	0	0	0	0	0	0	1	3	1	0
MEU626A.1	2	3	0	0	0	0	0	0	0	0	0	1	3	2	0
MEU626A.1	0	3	0	0	0	0	0	0	0	0	0	1	1	2	0

0- Not correlated   1 - Weakly Correlated   2- Moderately Correlated   3- Strongly Correlated

MEU626B OPERATIONS RESEARCH

Teaching Scheme: 03 L +00T **Total: 03** **Credit: 03**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2 hrs. 30 min.

Course Objectives:

I. To illustrate the importance and need of operations research models in industry.
II. To learn the mathematical tools that are needed to solve optimization problem.
III. To gain ability to apply the techniques of OR to solve real life problems in industry.

Introduction: Definitions, Characteristics, Phases, and limitations of OR, Classification of O.R. Models.

Linear programming: Problem formulation, Graphical method, simplex method, introduction to duality.

Transportation Models: Introduction, applications, formulation of transportation problems, methods for finding initial solution, Optimization by Modi method.

Assignment Models: Introduction, mathematical statement, Methods of assignment problems, variations of assignment problems.

Network Models: Network construction, PERT analysis, CPM analysis, cost analysis.

Waiting line models and Simulation: introduction, classification, analysis of M/M/1.Introduction to simulation, applications, generation of random numbers.

Sequencing Models: Processing of n jobs through 2 machines, n jobs through 3 machines,

Replacement Models: Introduction, individual replacement policies.

Dynamic Programming: Introduction, characteristics, Examples involving discrete variables.

Inventory model: Introduction, Deterministic models, Discount models

Textbooks:

1. Operation Research, H. A. Taha, PHI, 7th Edition.
2. Introduction to Operations Research, Billy E. Gillett, Tata McGraw Hill, 2nd Edition
3. Operations Research, Panneerselvan , PHI, 3nd Edition.

Reference Books:

1. Operation Research, Natarajan, Balasubramani, and Tamilarasi, Pearson Education, 3rd Edition,2008
2. System Simulation with Digital Computer, NarsinghDeo, PHI.
3. Linear Programming, N. Paul Loomba, Tata McGraw -Hill TMH Edition.

Course Outcomes:

After completion of course, students will be able to:

MEU626B.1 Explain the importance, benefits, and applications of Operations Research.
MEU626B.2 Identify and formulate Operations Research problems in industry.
MEU626B.3 Solve the linear programming, Transportation and Assignment problems.
MEU626B.4 Apply PERT and CPM for project scheduling and management

MEU626B.5 Apply the techniques of OR to solve real life problems in industry.

CO – PO –PSO Mapping:

CO	PO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU626B.1	0	0	0	0	0	0	0	0	0	0	3	1	0	0	0
MEU626B.2	1	3	0	0	0	0	0	0	0	0	3	0	3	0	1
MEU626B.3	2	3	0	0	0	3	0	0	0	0	0	0	2	0	1
MEU626B.4	0	3	0	0	0	3	0	0	0	0	0	0	2	3	2
MEU626B.5	2	3	0	0	0	3	0	0	0	0	0	0	1	3	2

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

MEU626C INDUSTRIAL MANAGEMENT & QUALITY CONTROL

Teaching Scheme: 03 L+00T Total: 03 **Credit: 03**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2 hrs. 30 min.

Course Objectives:

I. To impart fundamental knowledge and skill sets required in the industrial management and engineering profession
II. To develop ability to apply basic knowledge of mathematics, probability and statistics, and domain knowledge of industrial management and engineering,
III. To produce graduates with the ability to adopt a system approach to design, develop, implement and innovate integrated systems
IV. To enable students to understand the interactions between engineering, business, technological and environmental spheres in the modern society.
VI. To enable students to understand their role as engineers and their impact to society at large

Introduction: Concept, principles and techniques of management, evolution of management thoughts, scientific management, modern management, principles of management, management and administration, functions of management, various areas of management. Organization structure and relationship.

Marketing Management: Different types of market research, various marketing strategies, new product development, product life cycle, and advertising media.

Financial Management: Need for finance, elements of cost, waste and scrap, financial ratios, profit and loss statements, balance sheet.

Personnel Management: Functions of Personnel Management, human resources planning, recruitment and training, workers participation in management, industrial safety.

Materials Management, Estimating & Costing: Classes of materials, purchasing methods and procedure, inventory control, stores, EOQ, ABC analysis. Objectives of estimating and costing, elements of cost,

Quality functions in Industry: Introduction, dimensions of product quality, Three aspect of quality, Evolution of Quality, Quality costs, Customer-Orientation: Internal & External Customer Concept, seven basic quality control tools.

Statistical Quality Control: - Process Capability, Measuring process capability, Control Charts, types of control charts, Variables charts: (X bar and R- charts), Attribute charts:(p, c, u charts) , Construction and analysis of above mentioned charts.

Sampling Inspection: - Introduction to Sampling Inspection, Types of sampling plan,: (Single sampling, Double sampling and Sequential Sampling Plan).

Operating Characteristics (OC) Curve: Introduction, Parameters of OC Curves - (Producer's Risk, Consumer's Risk, Acceptance Quality Level (AQL) etc, Zone of Acceptance, Rejection and Indecision

Text Books:

1. Essentials of Management, Koontz, Harold, McGraw Hill Education India Ltd. New Delhi , 2009 Edition.
2. Purchasing and Materials Management ,Gopalkrishnan, McGraw Hill Education India Ltd. New Delhi , 2010 Edition.
3. Statistical Quality Control, E.L.Grant, R.S.Leavenworth, Tata McGraw Hill Publishing Ltd, New Delhi, 6^{th} Edition, 2005.

Reference Books:

1. Total Quality Management, L.Suganthi, A.A.Samuel, Prentice Hall of India, New Delhi, 2^{nd} Edition, 2005.
2. Quality Engineering Handbook, Thomas Pyzdek, Roger W. Berger, Tata McGraw Hill Publication, New Delhi, 1996.
3. Quality Handbook, J.M Juran, McGraw Hill Publication, New Delhi, 4^{th} Edition, 2005.
4. Quality Control and TQM, P.L.Jain, Tata McGraw Hill Publishing Ltd, New Delhi, 6^{th} Edition, 2001.
5. Quality Control, Tata McGraw Hill Publishing Ltd, TTTI, Madras, 11^{th} Edition, 2005.
6. http://nptel.iitm.ac.in

Course outcomes:

After the course, the students are expected to be able to:

MEU626C.1. Design and conduct experiments, analyze, interpret data and synthesize valid conclusions

MEU626C.2. Design a system, component, or process, and synthesize solutions to achieve desired needs

MEU626C.3. Use the techniques, skills, and modern engineering tools necessary for engineering practice

MEU626C.4. Design and perform experiments to determine critical areas of product development and analyze the results for quality improvement

MEU626C.5. Use statistical process control techniques (SPC) recognized throughout industries to ensure the quality level of products.

CO – PO –PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU626C.1	2	1	2	2	2	1	2	2	2	2	2	1	1	1	1
MEU626C.2	1	2	2	1	2	3	1	2	1	2	2	1	0	1	0
MEU626C.3	2	1	3	1	2	1	2	1	2	1	2	0	1	0	2
MEU626C.4	3	2	1	2	3	1	1	1	2	0	1	2	0	2	1
MEU626C.5	1	2	2	1	2	2	3	0	1	1	1	2	2	1	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

MEU627 DESIGN LAB

Teaching Scheme: 02 P   Total: 02 **Credit: 01**
Evaluation Scheme: 25 ICA + 25ESE **Total Marks: 50**

Course Objectives:

I. To acquire the skill of design and drafting
II. To develop an ability to design a system, component to meet desired needs within realistic constraints.
III. To develop an ability to identify, formulate, and solve engineering problems.
IV. To understand the use of design data book for selection of material, strength and standard dimensions

Minimum Six Experiments to be performed to achieve course outcomes.

It is representative list of practical. The instructor may choose minimum Six experiments as per his/her requirement (so as to cover entire content of course MEU623 Machine Design II) and to fulfill the course outcomes from the list given below

List of the Experiments:

1. Design of shaft
2. Design of bushed pin type flexible coupling.
3. Design of Chain Drive.
4. Design of Belt Drive
5. Design of Antifriction Bearing
6. Design of Journal Bearing
7. Design of Brake
8. Design of Clutch

Note: Team Work shall consist of drawing sheet based on above exercise and design report.

ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A&B

ESE: The end semester Exam for practical may/shall be based on performance in one of the experiments and may be followed by sample questions.

Course Outcomes: After completion of course, students will be able to:

MEU627.1. Demonstrate knowledge on basic machine elements used in machine design for a given application
MEU627.2. Apply fundamental principle of design while designing components such as Shaft and Coupling
MEU627.3. Select sliding and rolling contact bearings using Data book

MEU627.4. Analyze spur, helical, bevel and worm gears under strength and wear considerations

CO – PO –PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU627.1	3	2	1	0	0	0	0	0	0	0	0	0	3	2	0
MEU627.2	2	2	3	2	0	0	0	0	0	0	0	0	0	3	0
MEU627.3	2	2	2	3	0	0	0	0	0	0	0	0	0	2	0
MEU627.4	2	2	3	3	0	0	0	0	0	0	0	0	0	2	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

MEU628 MINOR PROJECT

Teaching Scheme: 06 P **Total: 06** **Credit: ~~01~~ 03**
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks: 50**

Course Objectives:

I. To prepare the students to examine any design or process or phenomenon.
II. To encourage the process of independent thinking and working.
III. To develop for solving the conceive problem by designing and analysing.
IV. To build the ability of working in a team for the betterment of the society.

Minor project includes topics such as,

1. Design,
2. Fabrication,
3. Analysis,
4. Simulations,
5. Field study
6. Market survey and
7. Case Study

The guide would be allotted by the department to the batch of 15 students. However the topic may be given to the individual student or a group of not more than three students. Students shall prepare and submit the report in consultation with the guide in three copies based on the work done. Committee of two faculties is set up to review the report and attend the presentation of the students. Marks would be given by the committee based on the quality of the work, report and presentation.

Note:

ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A&B

ESE: The end semester Exam for practical shall be based on performance in one of the experiments and may be followed by sample questions

Course Outcomes

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

MEU628.1. Integrate the fundamentals knowledge of subjects to search the related literature and devise solution.

MEU628.2. Conceive a problem statement either from rigorous literature survey or from the requirements raised from need analysis.

MEU628.3. MEU628.3 Generate and implement innovative ideas for social benefit.

MEU628.4. MEU628.4 Design, implement and test the prototype/algorithm in order to solve the conceived problem.

MEU628.5. MEU628.5 Write comprehensive report on mini project work.

CO – PO – PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MEU628.1	3	2	3	0	2	3	2	1	3	3	2	2	3	3	3
MEU628.2	3	2	3	3	2	0	2	1	3	3	2	0	3	3	0
MEU628.3	0	2	3	3	2	3	2	1	0	3	2	2	0	3	3
MEU628.4	3	0	3	3	2	3	0	1	3	3	2	2	3	3	3

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

GOVT. COLLEGE OF ENGINEERING
AMRAVATI

DEPARTMENT OF MECHANICAL ENGINEERING

CURRICULUM

For

B. TECH. (Mechanical Engineering)

From 2019 – 20 batch

PROGRAM OBJECTIVES

I. To prepare students for successful careers in industry/ higher studies /R&D institutions that meet global needs.

II. To provide students with solid foundation in basic science and basic engineering required to solve and analyze mechanical engineering problems.

III. To develop ability among students to solve industrial, environmental, Techno-social problems with latest and appropriate mechanical engineering techniques and tools available

IV. To inculcate professional skill, ethical responsibility, team work and leadership qualities in students.

V. To promote awareness of entrepreneurship, self-education, lifelong learning and to develop sense of social responsibility.

PROGRAM OUTCOMES

I. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

II. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

III. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

IV. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

V. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

VI. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

VII. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

VIII. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

IX. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

X. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

XI. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

XII. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES

1. Identify Mechanical Engineering related real life issues/ problems in industries, society and provide feasible solution

2. Apply the knowledge of the basic streams of Mechanical Engineering viz. thermal, design and production system to design mechanical system and product development

3. Plan and implement the activities in the small, medium and large enterprises as a part of team or as an individual

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GOVERNMENT COLLEGE OF ENGINEERING, AMRAVATI

MECHANICAL ENGINEERING DEPARTMENT

SCHEME FOR III & IV Semester B. Tech. (Mechanical Engineering) as per AICTE guidelines

Category	Course Code	Name of the Course	Teaching Scheme (Hrs./week)				Evaluation scheme						Credits
							Theory			Practical			
			L	T	P	Total	MSE	TA	ESE	ICA	ESE	Total	
	Semester – III												
BSC	SHU321 A *SHU322A	Differential Equations and Probability *Integral Calculus and Probability	3	-	-	3	30	10	60	-	-	100	3
PCC	MEU321	Thermodynamics	4	-	-	4	30	10	60	-	-	100	4
PCC	MEU322	Manufacturing Processes	4	-	-	4	30	10	60	-	-	100	4
PCC	MEU323	Materials Engineering	4	-	-	4	30	10	60	-	-	100	4
ESC	MEU324	Machine Drawing	3	-	-	3	30	10	60	-	-	100	3
MC	SHU323	Introduction to Constitution of India	1	-	-	1	-	20	30	-	-	50	0
LC	MEU325	Materials Engineering Lab	-	-	2	2	-	-	-	25	25	50	1
LC	MEU326	Machine Drawing Lab	-	-	2	2	-	-	-	25	25	50	1
			19	**-**	**4**	**23**	**150**	**70**	**330**	**50**	**50**	**650**	**20**
	Semester – IV												
BSC	SHU425	Human value and ethics	1	-	-	1		20	30	-	-	50	0
PCC	MEU421	Applied Thermodynamics-I	4	-	-	4	30	10	60	-	-	100	4
PCC	MEU422	Fluid Mechanics	4	-	-	4	30	10	60	-	-	100	4
PCC	MEU423	Manufacturing Technology	4	-	-	4	30	10	60	-	-	100	4
PCC	CEU430	Strength of Material	4	-	-	4	30	10	60	-	-	100	4
MC	SHU422	Environmental ~~Science~~ Studies	1	-	-	1	-	20	30	-	-	50	0
LC	MEU424	Fluid Mechanics Lab	-	-	2	2	-	-	-	25	25	50	1
LC	CEU431	Strength of Material Lab	-	-	2	2	-	-	-	25	25	50	1
			18		**4**	**22**	**120**	**80**	**300**	**50**	**50**	**600**	**18**

L – Theory lecture, T – Tutorial; P – lab work: Numbers under teaching scheme indicated contact clock hours
BSC- Basic Science; PCC – Program Core Course; ESC- Engineering Science; MC – Mandatory Course; LC- Lab Course
MSE- Mid Semester examination; **TA**- Teacher Assessment; **ICA** – Internal Continuous Assessment; **ESE** – End Semester Examination

*For the students directly admitted to second year (Lateral entry)

GOVERNMENT COLLEGE OF ENGINEERING, AMRAVATI

MECHANICAL ENGINEERING DEPARTMENT

SCHEME FOR V & VI Semester B. Tech. (Mechanical Engineering) as per AICTE guideline

Category	Course Code	Name of the Course	Teaching Scheme (Hrs./week)				Evaluation scheme						Credits
							Theory			Practical		Total	
			L	T	P	Total	MSE	TA	ESE	ICA	ESE		
		Semester – V											
PCC	MEU 521	Heat Transfer	4	-	-	4	30	10	60	-	-	100	4
PCC	MEU522	Machine Design –I	4	-	-	4	30	10	60	-	-	100	4
PCC	MEU523	Applied Thermodynamics-II	4	-	-	4	30	10	60	-	-	100	4
PCC	MEU524	Theory of Machines	4	-	-	4	30	10	60	-	-	100	4
PCC	MEU525	Turbo machines	4	-	-	4	30	10	60	-	-	100	4
MC	SHU522	Essence of Indian Traditional Knowledge	-	-	-	-	-	-	30	-	-	30	0
LC	MEU526	Thermal Lab-I	-	-	2	2	-	-	-	25	25	50	1
LC	MEU527	Theory of Machine Lab	-	-	2	2	-	-	-	25	25	50	1
PCC	MEU528	Seminar	-	-	2	2	-	-	-	50	-	50	1
			20		**6**	**26**	**150**	**50**	**330**	**100**	**50**	**680**	**23**
		Semester – VI											
PCC	MEU621	Instrumentation & Control	4	-	-	4	30	10	60	-	-	100	4
PCC	MEU622	New and Renewable Energy Sources	4	-	-	4	30	10	60	-	-	100	4
PCC	MEU623	Machine Design-II	4	-	-	4	30	10	60	-	-	100	4
PEC	MEU624	Program Elective-I	3	-	-	3	30	10	60	-	-	100	3
PEC	MEU625	Program Elective-II	3	-	-	3	30	10	60	-	-	100	3
OEC	MEU626	Open Elective-I	3	-	-	3	30	10	60	-	-	100	3
LC	MEU627	Design Lab	-	-	2	2	-	-	-	25	25	50	1
PROJECT	MEU628	Minor Project	-	-	6	6	-	-	-	50	50	100	3
			20		**8**	**29**	**180**	**60**	**360**	**75**	**75**	**750**	**25**

L – Theory lecture, T – Tutorial; P – lab work: Numbers under teaching scheme indicated contact clock hours

BSC- Basic Science; PCC – Program Core Course; ESC- Engineering Science; MC – Mandatory Course; LC- Lab Course

MSE- Mid Semester examination; **TA-** Teacher Assessment; **ICA** – Internal Continuous Assessment; **ESE** – End Semester Examination

GOVERNMENT COLLEGE OF ENGINEERING, AMRAVATI

MECHANICAL ENGINEERING DEPARTMENT

SCHEME FOR VII & VIII Sem. B. Tech. (Mechanical Engineering) as per AICTE guidelines

Category	Course Code	Name of the Course	Teaching Scheme (Hrs./week)				Evaluation scheme						Credits
							Theory			Practical		Total	
			L	T	P	Total	MSE	TA	ESE	ICA	ESE		
	Semester – VII												
PCC	MEU 721	Automation in Manufacturing	4	-	-	4	30	10	60	-	-	100	4
PCC	MEU 722	Gas Dynamics and Jet Propulsion	3	-	-	3	30	10	60	-	-	100	3
PEC	MEU 723	Program Elective-III	3	-	-	3	30	10	60	-	-	100	3
PEC	MEU724	Program Elective-IV	3	-	-	3	30	10	60	-	-	100	3
PEC	MEU 725	Program Elective-V	3	-	-	3	30	10	60	-	-	100	3
OEC	MEU 726	Open Elective-II	3	-	-	3	30	10	60	-	-	100	3
LC	MEU727	Manufacturing Lab	-	-	2	2	-	-	-	25	25	50	1
LC	MEU 728	Thermal Lab-II	-	-	2	2	-	-	-	25	25	50	1
			19	-	**4**	**23**	**180**	**60**	**360**	**50**	**50**	**700**	**21**
	Semester – VIII												
PEC	MEU 821	*Program Elective-VI	3	-	-	3	30	10	60	-	-	100	3
PROJECT	MEU 822	Project and Seminar / Industry Internship Project	-	-	24	24	-	-	-	200	200	400	12
			3	-	**24**	**27**	**30**	**10**	**60**	**200**	**200**	**500**	**15**

***Students going for Industrial Project/Thesis will complete above course through online platform such as MOOCs. , NPTL etc or by self-study mode and will directly appear for ESE only. (Total internal marks (MSE+TA) will be awarded proportional to ESE marks secure)**

L – Theory lecture, T – Tutorial; P – lab work: Numbers under teaching scheme indicated contact clock hours
BSC- Basic Science; PCC – Program Core Course; ESC- Engineering Science; MC – Mandatory Course; LC- Lab Course
MSE- Mid Semester examination; **TA-** Teacher Assessment; **ICA** – Internal Continuous Assessment; **ESE** – End Semester Examination

Government College of Engineering, Amravati

(Equivalence of Courses in Old Scheme with New Scheme

B. Tech : Mechanical Engineering

Year : Second Year (Semester – III & IV)

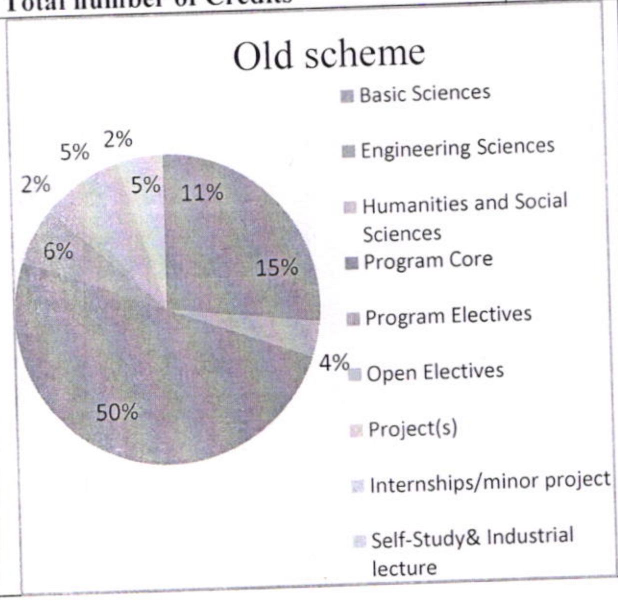
Sr. No.	Course in old scheme			Course in new Scheme		
	Course Code	Course name	No. of Credits	Course Code	Course name	No. of Credits
1.	MEU301	Material Science and Engineering	03	MEU323	Materials Engineering	4
2.	SHU301	General Proficiency - II	02	No equivalence		
3.	MEU302	Engineering Thermodynamics	04	MEU321	Thermodynamics	4
4.	SHU302	Engineering Mathematics -III	03	SHU321A *SHU322A	Differential Equations and Probability *Integral Calculus and Probability	4
5.	CEU303	Strength of Materials	04	CEU425	Strength of Material	4
6.	MEU303	Material Science and Engineering Lab.	01	MEU325	Materials Engineering Lab	1
7.	MEU307	Strength of Materials Lab.	01	CEU431	Strength of Material Lab	1
8.	EEU311	Electric Drives and Control	04	No equivalence		
9.	EEU312	Electric Drives and Control Lab.	01	No equivalence		
10.	MEU401	Fluid Mechanics	04	MEU422	Fluid Mechanics	4
11.	MEU402	Kinematics of Machines	04	No equivalence		
12.	MEU403	Thermal Engineering & Energy Conversion	4	MEU421	Applied Thermodynamics-I	4
13.	MEU404	Manufacturing Processes	04	MEU322	Manufacturing Processes	4
14.	MEU405	Machine Drawing	02	MEU324	Machine Drawing	3
15.	MEU406	Fluid Mechanics Lab	01	MEU424	Fluid Mechanics Lab	1
16.	MEU407	Kinematics of Machines Lab	01	No equivalence		
17.	MEU408	Manufacturing Processes Lab	01	No equivalence		
18.	MEU409	Computer Aided Drafting Lab	02	MEU326	Machine Drawing Lab	1
				MEU423	Manufacturing Technology	4
19.	No equivalence			SHU425	Human value and ethics	0
20.	No equivalence			SHU422	Environmental Science	0
21.	No equivalence			SHU323	Introduction to Constitution of India	0
22.	No equivalence					

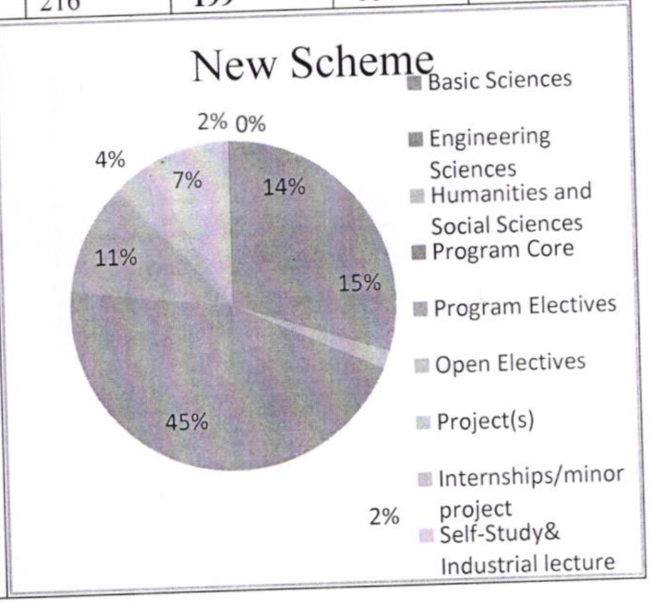
Department of Mechanical Engineering
Equivalence Scheme for *online courses*
Programme Name:-B.Tech. Mechanical Engineering

Course Code	Name of the Course	Credits	Equivalent NPTEL/MOOC Course of duration 12-14week and covering 80% course contents / Virtual lab link for lab course	Credits	Course Starting date
Semester – III					
SHU321	Engineering Mathematics-III	4	--	--	--
MEU321	Thermodynamics	4	NPTEL Course: Concepts of Thermodynamics by Prof. Suman Chakraborty & Prof. Aditya Bandopadhyay, IIT, Kharagpur. Link for the course: https://nptel.ac.in/courses/112/105/112105266/ Duration – 12 Weeks	4	Enrolment Ends: September 21, 2020 Course Start Date: 14.09.2020 Course End Date: 04.12.2020 Exam Date: December 18-20, 2020 Exam Registration Date: 14.09.2020
MEU322	Manufacturing Processes	4	Theory of Production Processes 12 weeks duration 14 September to 04 December 2020 Exam date 20 December 2020 https://nptel.ac.in/courses/112/107/112107239/	3	14 September 2020
MEU323	Materials Engineering	4	Basics of Materials Engineering https://swayam.gov.in/nd1_noc20_me78/preview		14 Sep – 20 Dec, 2020
MEU324	Machine Drawing	2	--	--	--
SHU322	Introduction to Constitution of India	0	--	--	--
MEU325	Materials Engineering Lab	1	--	--	--
MEU326	Machine Drawing Lab	1	--	--	--

COMPONENTS OF CURRICULUM
(Program Duration : 4 Years)

Course Component	Curriculum Content (% of total number of credits of the program)		Total number of contact hours		Total number of credits	
SCHEME	OLD	**NEW**	OLD	**NEW**	OLD	**NEW**
Basic Sciences	11.41	**14.63**	23	**26**	21	**24**
Engineering Sciences	15.21	**15.24**	35	**35**	28	**25**
Humanities and Social Sciences	03.80	**01.82**	11	**04**	07	**03**
Program Core	50.00	**45.12**	112	**82**	92	**74**
Program Electives	05.97	**10.97**	13	**18**	11	**18**
Open Electives	01.63	**03.65**	03	**06**	03	**06**
Project(s)	05.43	**06.70**	12	**22**	10	**11**
Internships/minor project	01.63	**01.82**	2	**06**	03	**03**
Self-Study& Industrial lecture	04.89	-	2		09	
Total number of Credits			216	**199**	184	**164**





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Equivalence B. Tech. Second Year SH Courses A.Y. 2020-21

S.N.	Course in old scheme			Equivalent course in new Scheme		
	Course Code	Course name	No. of Credits	Course Code	Course name	No. of Credits
1	SHU301	Engineering Mathematics- III	03	SHU321A	Differential Equations And Probability	03
2		No Equivalence		SHU322A	Integral Calculus And Probability	03
3	SHU304	Engineering Mathematics- III	03	SHU321B	Transform And Linear Algebra	04
4		No Equivalence		SHU322B	Differential Equation And Transform	04
5	SHU303	Engineering Mathematics- III	03	SHU321C	Transform And Statistical Methods	04
6		No Equivalence		SHU322C	Integral Calculus And Probability	04
7		No Equivalence		SHU323	Introduction To Constitution Of India	00
8		No Equivalence		SHU324	Effective Technical Communication	03
9		No Equivalence		SHU325	Human Values And Ethics	00
10	SHU203	Environmental Studies	03	SHU422	Environmental Studies	00
11		No Equivalence		SHU425	Human Values And Ethics	00
12		No Equivalence		SHU525	Human Values And Ethics	00
13		No Equivalence		SHU725	Human Values And Ethics	00
14	SHU305	General Proficiency- II	2		No Equivalence	
15	SHU401	Engineering Mathematics- IV	3		No Equivalence	
16	SHU402	Engineering Mathematics Lab	2		No Equivalence	
17	SHU403	Engineering Mathematics Lab	2		No Equivalence	

Gulhane
F/ Head, Mathematics

P. Tale
Member secretary
BoS Science & Humanities

S. V. Shinde
Chairman
BoS Science & Humanities

SHU321A DIFFERENTIAL EQUATIONS AND PROBABILITY

Teaching Scheme: 03 L **Total: 03** **Credits: 03**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **TOTAL MARKS: 100**
Duration of ESE: 2 hrs. 30 min

Course Objectives:

I. To learn Laplace transform and its properties. Apply it to solve differential equation.
II. To introduce the solution methodologies for second order Partial Differential Equations.
III. To study applications of partial differential equations in vibration of string and heat flow.
IV. To equip students with the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and science.

Laplace Transform: Definition, Properties of Laplace Transform, Laplace transform of periodic functions. Inverse Laplace transform, convolution theorem, unit step function, delta function, evaluation of integrals by Laplace transform, solving ODEs by Laplace Transform method.

Partial Differential Equations: Solutions of first order linear PDEs, Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method.

Applications of Partial Differential Equations: Method of separation of variables, equation of vibrating string, solution of wave equation by D'Alembert's method, one dimensional heat flow, two dimensional heat flow.

Random variables and Probability Distributions: Basic concepts of probability and its properties; Conditional probability and independent events; Random variables, discrete and continuous random variables, Mean and variance of Binomial, Poisson and Normal distributions and applications.

Textbooks:

1. Higher Engineering Mathematics, B.S. Grewal, Khanna Publishers,2020,44th edition.
2. A text book of Engineering Mathematics,N.P. Bali and Manish Goyal, Laxmi Publications, Reprint,2010.

References:

1. Advanced Engineering Mathematics,Erwin Kreyszig, 9th Edition, John Wiley & Sons, 2006.
2. Introduction to Probability Theory,P. G. Hoel, S. C. Port and C. J. Stone, Universal Book Stall, 2003(Reprint).
3. A First Course in Probability, S. Ross, 6th Ed., Pearson Education India,2002.
4. Advanced Engineering Mathematics, H.K.Das, S.Chand& Company Pvt.Ltd,2014.
5. Higher Engineering Mathematics, B.V,Ramana,TataMcGraw Hill Publishing company Ltd.,New Delhi,2008,6th edition.

Course Outcomes: After successful completion of this course student will be able to

SHU321A.1 Develop different techniques of solving partial differential equations.
SHU321A.2 Implement these techniques to evaluate the engineering problems.
SHU321A.3 Develop techniques needed to calculate probabilities and describe the

	properties of discrete and continuous distribution functions.
SHU321A.4	Use the knowledge of Laplace Transform to solve differential equations.

*SHU322A INTEGRAL CALCULUS AND PROBABILITY

Teaching Scheme: 03 L **Total: 03** **Credits: 03**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **TOTAL MARKS: 100**
Duration of ESE: 2 hrs. 30 min

Course Objectives:

I. To equip students with solution techniques of ordinary differential equations of higher order.
II. To learn Laplace transform, its properties and apply it to solve differential equations.
III. To equip students with the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and science.
IV. To introduce the solution methodologies for second order Partial Differential Equations.
V. To learn special functions and utilize it in the evaluation of multiple integral.

Course Contents:

Ordinary differential equations of higher orders: Linear differential equation with constant coefficient, complementary function, particular integral, complete solution; method of variation of parameters.

Integral Calculus: Beta and Gamma functions and their properties; Evaluation of double integrals (Cartesian &polar), change of order of integration.

Laplace Transform: Definition, Properties of Laplace Transform, Laplace transform of periodic functions. Inverse Laplace transform, convolution theorem, unit step function, delta function, solving ODEs by Laplace Transform method.

Partial Differential Equations: Solutions of first order linear PDEs, Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method.

Random variables and Probability Distributions: Basic concepts of probability and its properties; Conditional probability and independent events; Random variables, discrete and continuous random variables, Binomial, Poisson and Normal distributions and applications.

Text Books:

1. Higher Engineering Mathematics, B.S. Grewal, Khanna Publishers,2020, 44th edition.
2. A text book of Engineering Mathematics, N.P. Bali and Manish Goyal, Laxmi Publications, Reprint, 2010.

Reference books:

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2. Introduction to Probability Theory, P. G. Hoel, S. C. Port and C. J. Stone, Universal Book Stall, 2003 (Reprint).
3. A First Course in Probability, S. Ross, 6th Ed., Pearson Education India, 2002.
4. Advanced Engineering Mathematics, H. K. Das, S. Chand & Company Pvt.Ltd, 2014.
5. Higher Engineering Mathematics, B.V Ramana, Tata Mc Graw Hill Publishing company

Ltd., New Delhi,2008, 6^{th} edition.

Course Outcomes: After completion of course, the students will be able to:

SHU321.1A	Develop different techniques of solving partial differential equations.
SHU321.2A	Evaluate double integrals with the help of special functions
SHU321.3A	Solve ordinary differential equations of higher order.
SHU321.4A	Develop techniques needed to calculate probabilities and describe the properties of discrete and continuous distribution functions
SHU321.5A	Find Laplace transform of given function and apply it to solve differential equations.

MEU321 THERMODYNAMICS

Teaching Scheme: 04 L **Total: 04** **Credits: 04**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **TOTAL MARKS: 100**
Duration of ESE: 2 hrs. 30 min

Course Objectives:

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

Course Contents:

Fundamentals - System & Control volume; Property, State & Process; Exact & Inexact differentials; Work - Thermodynamic definition of work; examples; Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work.

Temperature, Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers- Definition of heat; examples of heat/work interaction in systems- First Law for Cyclic & Non-cyclic processes; Concept of total energy E ; Demonstration that E is a property; Various modes of energy, Internal energy and Enthalpy.

Pure Substances - Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures, Compressibility charts- Properties of two phase systems - Const. temperature and Const. pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables and R134a tables; Saturation tables; Superheated tables; Identification of states & determination of properties, Mollier's chart.

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

Second law - Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale.

Clausius inequality; Definition of entropy S ; Demonstration that entropy S is a property;

Evaluation of *S* for solids, liquids, ideal gases and ideal gas mixtures undergoing various

processes; Determination of *S* from steam tables- Principle of increase of entropy; Illustration of processes in T-s coordinates; Definition of Isentropic efficiency for compressors, turbines and nozzles- Irreversibility and Availability, Availability function for systems and Control volumes undergoing different processes, Lost work. Second law analysis for a control volume. Exergy balance equation and Exergy analysis.

Thermodynamic cycles - Basic Rankine cycle; Basic Brayton cycle; Gas Power Cycles; Basic vapor compression cycle and comparison with Carnot cycle.

Text Books:

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1. Thermodynamics: An Engineering Approach, Yunus Cengel and Michael Boles, 9TH Edition, McGraw Hill, 2019
2. Engineering Thermodynamics, P. K. Nag, 6TH Edition, McGraw Hill, 2017

Reference books:

1. Fundamentals of Thermodynamics, Richard Sonntag, Claus Borgnakke ,9TH edition, John Wiley and Sons, 2016
2. Fundamentals of Engineering Thermodynamics, Michael J. Moran, Howard Shapiro, 8TH edition, John Wiley & Sons, 2014
3. Engineering Thermodynamics, Jones, J. B. and Duggan, R. E., Prentice Hall of India

Course Outcomes: After completion of course, the students will be able to:

MEU321.1	Apply energy balance to systems and control volumes, in situations involving heat and work interactions
MEU321.2	Evaluate changes in thermodynamic properties of substances
MEU321.3	Evaluate and compare the performance of energy conversion devices
MEU321.4	Differentiate between high grade and low grade energies

MEU322 MANUFACTURING PROCESSES

Teaching Scheme: 04 L **Total: 04** **Credits: 04**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **TOTAL MARKS: 100**
Duration of ESE: 2 hrs. 30 min

Course Objectives:

I Impart the critical knowledge of metal melting, casting, mechanical working of metals and different joining processes
II Prepare students understand working principles of additive manufacturing processes their selection based on quality and productivity
III Inculcate the fundamentals of unconventional machining processes

Course Contents:

Casting and Moulding: Pattern materials, allowances, Types of patterns, Design considerations in pattern making, Color codes for patterns and core boxes. Basic principle and Terminology of sand casting, gating system, types of gate, Directional and Progressive solidification. General properties of moulding sands, Types of sands, Preparation of sand moulds of different types, Moulding processes, core making.

Technology of Melting and Special Casting Methods: Melting furnaces pit, open hearth, gas fired cupola and electric hearth furnaces, Electric furnaces -Direct Arc, Indirect arc and electric induction furnace, Selection of furnace. Modernization and Mechanization of Foundries, permanent mold casting, slush casting, shell molding, Investment or lost wax casting, vacuum process, centrifugal casting, Die casting equipments and processes for Gravity, Pressure and Vacuum casting methods

Defects, Inspection and Testing of Casting: Various defects, their causes and remedies, cleaning and inspection methods of casting.

Additive Manufacturing Processes: Stereolithography (SLA), Liquid thermal polymerization (LTP), Fused Deposition Modeling (FDM), Ballistic Particle Manufacturing (BPM), Selective Laser Sintering (SLM), Laser engineered net shaping (LENS), Binder Jet Printing (BJP)

Mechanical Working of Metals: Principle of Hot and cold working processes, Different types of hot and cold working processes, e.g. Rolling, types of rolling forging operations, extrusion, piercing, pipe and tube production, manufacture of seamless pipe and tubing. Spinning, embossing and coining, squeezing and bending operations, rotary swaging

Joining Processes, Welding Defects, Testing and Inspection of Welds: Introduction to riveting, soldering, brazing and welding. Gas welding, working principle and its application, Arc welding: arc initiation, arc maintenance, and arc control, TIG/ MIG/ SAW/ Resistance welding: working principle and its application, Working principle and applications of Friction Welding, Forge Welding, Plasma arc, and Thermit Welding. Ultrasonic, Electro slag, Electron Beam, laser welding.Various welding defects, weld testing methods.

Unconventional Machining Processes Mechanical Processes: -Ultrasonic Machining principle and applications, process parameters, Abrasive and water abrasive jet machining. Thermal processes: -Election Beam Machining -Generation of beam, principle and applications, Laser Beam machining: Plasma-arc machining-Concept and generation of plasma, principle of PAM, applications. Electro Chemical Machining-Classification, fundamentals, Electro mechanical milling. Electric discharge Machining –EDM, wire EDM, Mechanism of material removal, process parameters, advantages and applications

Text Books:

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)- Pearson India, 2014
2. Workshop Technology, HajraChaudharyVol I , 10thEdition,DhanpatRai and Co (P) ltd

Reference Books:

1. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems
2. Degarmo, Black &Kohser, Materials and Processes in Manufacturing

Course Outcomes: After completion of course, the students will be able to:

MEU322.1. Illustrate the fundamentals of metal melting, casting, mechanical working of metals, their necessity and importance

MEU322.2. Explain working principles and classify additive manufacturing processes.

MEU322.3. Differentiate and compare joining processes in terms of application, function, advantages, disadvantages, quality and productivity

MEU322.4. Interpret necessity, principle, advantages, disadvantage, limitations, applications of unconventional machining processes

MEU323 MATERIALS ENGINEERING

Teaching Scheme: 04 L **Total: 04** **Credits: 04**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **TOTAL MARKS: 100**
Duration of ESE: 2 hrs. 30 min

Course Objectives:

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

Course Contents:

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

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

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

Alloys, Substitutional and Interstitial Solid Solutions- Phase Diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron Iron-carbide phase diagram and microstrctural aspects of ledeburite, austenite, ferrite and cementite, cast iron.

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

Alloying of steel, properties of stainless steel and tool steels, specifications of some commonly used steels for engineering applications (eg. EN, AISI, IS),maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupro-nickel; Aluminium and Al-Cu – Mg alloys- Nickel based superalloys and Titanium alloys

Text Books:

1. W. D. Callister, 2006, "Materials Science and Engineering-An Introduction", 6th Edition, Wiley India.

2. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
3. V. Raghavan, "Material Science and Engineering', Prentice Hall of India Private Limited, 1999.
4. U. C. Jindal, "Engineering Materials and Metallurgy", Pearson, 2011

Reference Books:

1. Mechanical Metallurgy, G.E. Dieter, 3rd Edition, Mc-Graw Hill International, London, 1999.
2. Physical Metallurgy for Engineers, 4th Edition, Clarke and Varney,. 2004.
3. Powder Metallurgy, A.K. Sinha 1st Edition., 1991.
4. Engineering Physical Metallurgy, Y. Lakhtin, 2nd Edition, Mir Publications, 1999.

Course Outcomes: After completion of course, the students will be able to:

MEU323.1	Identify crystal structures for various materials and understand the defects in such structures
MEU323.2	Understand how to tailor material properties of ferrous and non-ferrous alloys
MEU323.3	How to quantify mechanical integrity and failure in materials

MEU324 MACHINE DRAWING

Teaching Scheme: 03 L **Total: 03** **Credits: 03**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **TOTAL MARKS: 100**
Duration of ESE: 2 hrs. 30 min

Course Objectives:

I. Helping the student in drafting their technical ideas.
II. Creating knowledge about the various practices with regard to the dimensioning, sectioning and development of views.
III. Understanding the importance of the linking functional and visualization aspects in the preparation of the part drawings.
IV. Preparation of the part or assembly drawings as per the conventions.
V. Interpretation of machine drawings that in turn help the students in the preparation of the jobs, components, etc.

Course Contents:

Sectional Views: conversion of pictorial view into sectional orthographic projections, missing views.

Development of Surfaces: Development of surface of cubes, prisms, cylinder, pyramids, cones etc

Intersection of Surfaces: Interpenetration of solids, prism and prism, cylinder and cylinder, cylinder and prism, cone and cylinder, cone and prism.

Assembly Drawing: Preparation of detailed and assembly drawing of simple machine assemblies like pedestal bearing, Plummer block, simple eccentric, stuffing box, cross head, connecting rod, tail stock, tool post, c-clamp, screw jack, boiler safety valve etc.

Introduction to Modelling by using Pro/Engineer /CATIA Software.

Text Books:

1. Machine drawing, N.D.Bhatt, 38th Edition ,Charotar Publisher, 2003
2. Machine Drawing, N.Sidheshwar, Shastry, Kanhaiah, 4th Edition, Tata Mcgraw Hill, 2005

Reference Books:

1. Machine Drawing, Narayan, K.L.Reddy, 2nd Edition, New AGE International Publishers, 2004
2. Machine Drawing, P.J.Shah, 3rd Edition, Shah Publishers, 1997
3. Computer Graphics & Design, P.Radhakrishnan, 3rd Edition, Dhanpat Rai & Sons, 2009
4. Using AUTOCAD, James E Fuller, 9th Edition, Denmark Publishing Company, 2004
5. Machine Drawing, R.K.Dhawan, 4th Edition, S.Chand& Co.,2006

Course Outcomes: After completion of course, the students will be able to:

MEU324.1. Draw the development of surfaces for sheet metal working applications.
MEU324.2. Understand the representation of materials used in machine drawing.
MEU324.3. Draw the machine elements including keys, couplings, cotters, riveted, bolted and welded joints.
MEU324.4. Construct an assembly drawing using part drawings of machine components.

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MEU324.5. Represent tolerances and the levels of surface finish of machine elements Develop skills to model the behaviour of structures under mechanical and thermo-mechanical loads.

SHU323 INTRODUCTION TO CONSTITUTION OF INDIA

Teaching Scheme: 01 L **Total: 01** **Credits: 00**
Evaluation Scheme: 20 TA+30 ESE **TOTAL MARKS: 50**
Duration of ESE: 1 hrs. 30 min

Course Objectives:

To acquaint students about constitution of India, Fundamental rights, fundamental duties, electoral process and role of central, state and local government and its administration

Course Contents:

Unit I: Introduction to Constitution of India
Salient features of the Constitution of India, Preamble of the Constitution, fundamental rights and fundamental duties, Directive Principles of State Policy and relevance of directive principles. Parliamentary Form of Government in India- President, Vice-President, Prime Minister along with council of Minister, Parliament, Supreme court, Electoral process in India. Amendment Procedure.

Unit II: State executives Governor, chief minister, state legislature, high courts of state,

Unit III: Role and functions of local self government- Municipalities in India, with special reference to 73^{rd} amendment. Panchayat Raj in India with special reference to 74^{th} amendment.

Course outcomes:

On the successful completion of this course, Students shall be able to-

1. Understand and remember the knowledge of basic information about Indian Constitution.
2. Apply the knowledge of fundamental rights and fundamental duties.

Reference Books:-

1. An Introduction to Constitution of India, M.V.Pylee, Vikas Publishing, 2002
2. Constitution of India, Dr. B. R. Ambedkar, Government of India Publication
3. Latest Publications of Indian Institute of Human Rights, New Delhi

MEU325 MATERIALS ENGINEERING LAB

Teaching Scheme: 02 P **Total: 02** **Credits: 01**
Evaluation Scheme: 25 Internal + 25 External **TOTAL MARKS: 50**

Course Objectives:

I. To reinforce the concepts learnt in the theory classes of Materials Engineering (MEU323) by carrying out various experiments

II. Students will learn specimen preparation for optical microscopy and by using optical microscope study microstructures of various metals/alloys which are used in industries for various applications

III. To compare the composition and properties of various ferrous and non-ferrous metals/alloys

IV. To carry out mechanical tests/heat treatments to evaluate various mechanical properties

Note: It is representative list of experiments. The instructor may choose minimum eight experiments as per his/her requirement (so as to cover entire content of course MEU323) from the list given below.

List of Experiments:

1. Study of metallurgical microscope.
2. Preparation of specimen for microstructure examination
3. Molding of specimen for microstructure examination with the help of mounting press/ cold setting resin.
4. Study and drawing of microstructure of annealed and normalized steels.
5. To carry out hardening and tempering of steel.
6. Study of Jominy end quench test for hardenability of steel.
7. To measure hardness using Rockwell Hardness Tester.
8. Study and drawing of microstructures of various cast irons.
9. Study and drawing of microstructures of various non –ferrous metals and alloys.
10. To study and perform impact test.
11. To measure hardness using Brinell Hardness Tester
12. Study of image analyzer
13. Study of scanning electron microscopy
14. Study of transmission electron microscopy
15. Study and drawing of microstructures of steels

Note:

ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired.

ESE: The end semester Exam for practical may/shall be based on performance in one of the experiments and may be followed by sample questions.

Course Outcomes: After completion of the laboratory course, students will be able to

MEU325.1. Prepare specimen for optical microscopy and use optical microscope for the study of microstructures of various metals/alloys and recognize/ identify various phases present in metals/alloys and their effect on mechanical properties

MEU325.2. Understand the effect of heat treatment on the microstructure of metals/alloys and thereby on its mechanical properties.

MEU325.3. Evaluate mechanical properties of various materials and compare it with their internal structure to establish structure property co-relation.

MEU326 MACHINE DRAWING LAB

Teaching Scheme: 02 P **Total: 02** **Credits: 01**
Evaluation Scheme: 25 Internal + 25 External **TOTAL MARKS: 50**

Course Objectives:

I. To impart students with the necessary skills for drafting and modelling machine components using CAD tools.
II. To impart the fundamental knowledge in designing and drafting.
III. To develop the Practical knowledge in the field components designing.

It is representative list of practical. The instructor may choose minimum eight Sheet as per his/her requirement (so as to cover entire content of course MEU326) from the list given below

List of Drawing

PART A: Sheets (one each) by using Pro Engineer /CATIA and Sketchbook
1. Sectional Views of objects
2. Developments of surfaces
3. Intersection of solids

PART B: Drawing of following machine elements using Pro/Engineer/CATIA Software (four Sheets)
1. Cotter Joints
2. Knuckle Joints
3. Flange Coupling
4. Wall Bracket
5. Plummer Block
6. Stuffing Box
7. Machine tool Components
8. Rivet and Rivet Joints

PART C: One sheet on: ISI Conventions for various components like bearing, gears, springs, keys and keyways, threads, tap holes and materials

Note:
ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A&B.
ESE: The end semester Exam for practical shall be based on performance in one of the experiments and may be followed by sample questions.

Course Outcomes: After completion of course, the students will be able to:

MEU326.1 Demonstrate the complete methodology of design &drafting.
MEU326.2 Develop skills in designing the automobile engine components using software like Pro Engineer/CATIA etc
MEU326.3 Model and assemble machine parts and Know about the industrial models and their usages in practical design and manufacturing fields.

SHU425 HUMAN VALUE AND ETHICS

Teaching Scheme: 01 L **Total: 01** **Credits: 00**
Evaluation Scheme: 20 TA + 30 ESE **TOTAL MARKS: 50**
Duration of ESE: 1 hrs. 30 min

Course Objectives:

1. To develop the importance of moral virtue through spiritual and yoga activities which leads to professional experience of students.
2. To understand the dimension of professional ethics.
3. To learn engineering ethics through theories which develop moral judgement among technical students.
4. To understand the global ethical issues and its dimension which leads to moral leadership

Human Values
Morals, values and Ethics, Integrity, Work ethic, Service learning, Civic virtue, Respect for others, Living peacefully, Caring, Sharing, Honesty, Courage, Valuing time, Cooperation, Commitment, Empathy, Self-confidence, Character, Spirituality, Introduction to yoga and meditation for professional excellence and stress management.

Professional Ethics
Definition of Ethics, Professional Ethics, Business Ethics, Corporate Ethics, Engineering Ethics, Personal Ethics; Profession, Professionalism, Professional Responsibility, Professional Ethics; Conflict of Interest, Gift Vs Bribery, Environmental breaches, Negligence, Deficiencies in state-of-the-art; Vigil Mechanism, Whistleblowing, protected disclosures.

Engineering Ethics
Senses of 'Engineering Ethics', Variety of moral issues, Types of inquiry, Moral dilemmas, Moral Autonomy, Kohlberg's theory, Gilligan's theory, Consensus and Controversy, Models of professional roles, Theories about right action, Self-interest, Customs and Religion, Uses of Ethical Theories

Global Issues
Multinational Corporations, Environmental Ethics, Computer Ethics, Weapons Development, Engineers as Managers, Consulting Engineers, Engineers as Expert Witnesses and Advisors, Moral Leadership, Code of Conduct, Corporate Social Responsibility

Text books:

1. "Ethics in Engineering", Mike W. Martin and Roland Schinzinger, Tata McGraw Hill, New Delhi, 2003.
2. "Engineering Ethics", Govindarajan M, Natarajan S, Senthil Kumar V. S, Prentice Hall of India, New Delhi, 2004.

Reference books:

1. "Engineering Ethics", Charles B. Fleddermann, Pearson Prentice Hall, New Jersey, 2004.

3. "Engineering Ethics – Concepts and Cases", Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, Cengage Learning, 2009
4. "Ethics and the Conduct of Business", John R Boatright, Pearson Education, New Delhi,2003
5. "Fundametals of Ethics for Scientists and Engineers", Edmund G Seebauer and Robert L Barry, Oxford University Press, Oxford, 2001
6. "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Laura P. Hartman and Joe Desjardins, Mc Graw Hill education, India Pvt. Ltd.,New Delhi
2013.
7. " Value Education", World Community Service Centre, Vethathiri publications, Erode, 2011

Outcomes:

After the successful completion of the course the student shall be able to

1. Make work life balance and found himself or herself with sound mindset at workplace.
2. Incorporate professional ethics at work place.
3. Manage moral dilemmas and conflicts at workplace.
4. Develop global perspective for ethical issues.

MEU421 APPLIED THERMODYNAMICS-I

Teaching Scheme: 04 L **Total: 04** **Credits: 04**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **TOTAL MARKS: 100**
Duration of ESE: 2 hrs. 30 min

Course Objectives:

I. To learn about the basic components and their functions in steam power plant
II. To learn about to evaluate heat, work and energy interactions in steam power plant
III. To adopt the most appropriate technique to optimize the performance of individual components in a steam power plant
IV. To develop skill to draw the velocity diagrams of steam turbines

Course Contents:

Steam Power Plant: Steam power cycles, Limitations of Carnot vapour cycle, efficiencies in reheat & regenerative cycle analysis limited to two stages only, typical layout of steam power plant, Concept of co-generation. Elementary simple problems on Steam power cycles

Steam Generators: Indian Boiler Regulations, Classification of Boiler, principle parts and their functions, modern water-tube type steam generator arrangements, Economiser, Superheater, Reheater, Steam Generator Control, Air Preheater, Principle of fluidized bed boiler, Cylone separator. Electrostatic precipitator.

Steam Nozzle: Classification of Nozzle, flow through nozzles, critical pressure ratio and choked flow, nozzle efficiency, determination of throat and exit areas, Concept of super saturated flow and Wilson line.Elementary simple problems on determination of throat and exit areas.

Steam Turbines: Types of steam turbines, Types of steam turbines such as impulse, reaction turbines, Compounding, Velocity diagrams. Graphical and analytical methods for work and power determination, axial thrust and efficiency. Need of Governing, Methods of Turbine governing and control.

Steam Condenser: Functions of a Condenser, Elements of a Condensing Plant, Types of steam condenser, Need of a condenser, Estimation of quantity of cooling water required, condenser and vacuum efficiency. Sources of air in condensers and its effect on performance, Air extraction, Cooling towers.

Energy Conservation in Boilers: Energy conservation options, waste minimization, methodology and economical viability.

Text Books:

1. Basic and Applied Thermodynamics, P.K. Nag, 2nd Edition, Tata Mc-Graw Hill Pub., 2010.
2. Thermal Engineering by Mahesh M Rathore, 3rd Edition, Tata Mc-Graw Hill, 2010

Reference books:

1. Thermodynamics-An Engineering Apporach, Y. A. Cengel and M. A. Boles, 3rd Edition, Mc-Graw Hill, 1998.
2. Applied Thermodynamics, Onkar Singh, 3rd Edition, New Age International Publishing, 2009.

3. Power Plant Engineering, P.K. Nag, 3rd Edition, Tata Mc-Graw Hill Publishing, 2008.

Course Outcomes: After completion of course, the students will be able to:

MEU421.1	Analyze the basic components in steam power plant
MEU421.2	Select the most appropriate method of compounding for steam turbines
MEU421.3	Evaluate and compare the performance of energy conversion devices
MEU421.4	Draw the velocity diagrams of turbine blade.
MEU421.5	Design the steam nozzle as per given parameters

MEU422 FLUID MECHANICS

Teaching Scheme: 04 L **Total: 04** **Credits: 04**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **TOTAL MARKS: 100**
Duration of ESE: 2 hrs. 30 min

Course Objectives:

I. To recognize the basic principles and equations of fluid mechanics
II. To distinguish the various types of fluid flow problems encountered in practice
III. To apply laws of mass and momentum conservation for fluid flow system
IV. To analyze the mathematical problem of different fluid flow systems
V. To formulate the equation by using methods of dimensional analysis

Course Contents:

Fluid Statics- Definition of fluid, Newton's law of viscosity, Units and dimensions-Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension, pressure at a point in fluid, variation of pressure with depth, fluid application to manometer, vapour pressure, cavitations.

Fluid Kinematics- Types of flow- Methods of describing fluid motion- Velocity and acceleration, Stream line, Streak line, Path line, Stream tube, Stream function, Velocity potential, Flow net- uses, limitations and methods of drawing, Discharge, Control volume-application of continuity equation and momentum equation, Incompressible flow.

Fluid Dynamics- Euler's equation of motion, Bernoulli's equation and its applications, assumption and limitations, Flow measurement, velocity measurement, Energy gradient line and Hydraulic gradient line, Impulse momentum equation, momentum correction factor.

Flow in Channels- Exact flow solutions in channels and ducts, Couette and Poiseuille flow, laminar flow through circular conduits and circular annuli- concept of boundary layer – measures of boundary layer thickness – Darcy Weisbach equation, friction factor, Moody's diagram, minor losses in pipes and fittings.

Dimensional Analysis– Need, Methods of dimension analysis – Similitude – types of similitude Dimensionless parameters – application of dimensionless parameters – Model analysis

Text Books:

1. Introduction to Fluid Mechanics and Fluid Machines, S. K. Som and G. Biswas, 2nd Ed Tata McGraw Hill Education Publishing Company Limited, 2007
2. Fluid mechanics and Hydraulic machines, Dr. R. K. Bansal , 9th Edition, Laxmi Publication, Delhi, 2005

Reference books:

1. Fluid Mechanics Fundamentals and Application, Yunus A. Cengel and John M. Cimbala, 4th Edition, McGraw Hill, 2013
2. Fluid Mechanics, F.M. White, 4th International Editions, McGraw-Hill, 2005
3. Fluid Mechanics, Streeter, 7th Edition, Tata McGraw Hill (SI), 2000

Course Outcomes: After completion of course, the students will be able to:

MEU422.1	Identify the fluid flow system and solve problems involving fluid properties.
MEU422.2	Apply conservation laws to fluid flow problems in engineering applications
MEU422.3	Recognize of laminar and turbulent flow in pipes and the analysis of fully developed flow
MEU422.4	Evaluate the major and minor losses associated with pipe flow in piping networks and determine the pumping power requirements
MEU422.5	Develop the equation by using methods of dimensional analysis

MEU423 MANUFACTURING TECHNOLOGY

Teaching Scheme: 04 L **Total: 04** **Credits: 04**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **TOTAL MARKS: 100**
Duration of ESE: 2 hrs. 30 min

Course Objectives:

I. Inculcate the fundamentals of metal cutting and cutting force analysis.
II. Articulate the working principles of lathe, drilling, boring, broaching, reaming, milling, grinding, shaper, planer machine tools.
III. Illustrate the concept of tolerance with design of limits gauges and control charts for attributes and variables
IV. Interpret different concepts of production planning and control

Course Contents:

Metal cutting: Mechanics of metal cutting, Cutting parameters, Tool nomenclature, Orthogonal and oblique cutting, Tool wear and tool life, Chip formation, Cutting tool materials, Cutting fluids, Merchant force circle, Various force components, Turning, Drilling, Milling and finishing processes, Introduction to CNC machining.

Machine Tools
Lathe: Mechanical Construction, classification of lathe machine, specifications, Operations and accessories of centre lathe, introduction of capstan &turret lathe, introduction to Automatic screw machines.

Drilling: Introduction, Working principle, Classification general purpose, Mass production and special purpose drilling machines, drill tool geometry.
Boring: Gear producing machines, Introduction, classification & mechanical construction og gear producing machines. Horizontal, Vertical and jig Boring machine.
Broaching and Reaming: Introduction, Working principle, classification, mechanical construction.

Milling: Introduction, Working principle, Classification, Types of Milling Cutters, Dividing head, Compound and differential indexing, Climb & conventional milling, applications

Grinding: Introduction, Working principle, Classification, types of bonds & Abrasive, grinding wheel specification, selection of wheel, super finishing processes.Shaper, Planer, Slotter: Introduction, Working principle, mechanical construction, classification

Metrology: Need of inspection; Accuracy, Precision and Errors in measurement; linear and angular measurements; Limits, fits and tolerances; gauge design; comparators; Geometric shapes, Acceptance tests for machine tools

Statistical Quality Control: Basic statistical concepts; frequency distribution, Control charts for Attributes and Variables; Acceptance Sampling

Production planning& control: Principles of production planning and control, Types of production, Sales forecasting, Economic batch quantity, PPC functions, PPC for different types of production, Inventory control: functions, objectives, Selective Inventory control, Inventory Management Systems, Economic Order Quantity (EOQ)

Text Books:

1. Workshop TechnologyVol II, B S Raghuwanshi, 10th Edition Dhanpat Rai & Sons, Delhi

2. Statistical Quality Control, M. Mahajan, Dhanpat Rai & Co.(P) Ltd
3. A Textbook of Production Engineering, P C Sharma, S. Chand & Company Ltd

Reference books:

1. Manufacturing Technology Volume II 4th Edition, P. N. Rao, McGraw Hill
2. Workshop Technology Vol II, H S Bawa, 2ndEdition, Tata Mc Graw Hill

Course Outcomes: After completion of course, the students will be able to:

MEU423.1	Explain working principles and classify lathe, drilling, boring, broaching, reaming, milling, grinding, shaper, planer and slotter operations.
MEU423.2	Differentiate and compare machining processes in terms of application, function, advantages, disadvantages, quality and productivity
MEU423.3	Calculate design tolerances using hole and shaft basis systems and Construct control charts for attributes and variables
MEU423.4	Articulate the concepts of production planning and control as per requirement

CEU430 STRENGTH OF MATERIAL

Teaching Scheme: 04 L **Total: 04** **Credits: 04**
Evaluation Scheme: 30 MSE+ 10 TA + 60 ESE **TOTAL MARKS: 100**
Duration of ESE: 2 hrs. 30 min

Course Objectives:

I. To establish an understanding of fundamental concepts of stresses, strains and response of elastic solid to external loadings.
II. To provide the knowledge principles, theorems required for analysis and design of various types of structural members subjected to axial, transverse shear, bending and tortional loadings.
III. To provide students with exposure to the systematic methods for solving engineering problems in solid mechanics
IV. To built the necessary theoretical background for further structural analysis and design courses.

Course Contents:

Simple Stresses and Strain: Concept of stress and strain, St. Venants principle, types of stresses and strains, Hooke's law, stress-strain diagram for mild steel and brittle material. Working stress, factor of safety, lateral strain, poissons ratio and volumetric strain. Elastic constants and relationship among them. Bars of varying section – composite bar of two materials only-temperature stresses. Strain energy-Resilience-Gradual, sudden, Impact and shock loading and their applications.

Principal Stresses and Principal Planes: General two dimensional stress system. Stress at a point on a plane, principal stresses and principal planes. Mohr's circle of stress, concept of ellipse of stress and its use. Principal strains and circle of strain.

Shear Force (S.F.) and Bending Moment (B.M.) Diagrams For Determinate Beams: S.F. and B.M. diagrams for cantilever, simply simply supported beams with and without overhangs. Calculation of maximum B.M. and S.F. and location of point of contra flexure due to concentrated load, uniformly distributed loads and uniformly varying loads and moments. Relation among shear force, bending moment and loading intensity.

Stresses in Beams (Flexural and Shear): (i) Flexural or bending stresses: Theory of simple bending – Assumption- Derivation of bending equation $M/I = F/Y = E/R$ Section modulus of rectangular and circular section (Solid and Hollow). Moment of resistance. Bending stress in solid, hollow and built up sections. Design of simple beam section. **(ii)** Shearing Stresses: Derivation for shear stress in beam, shear stress distribution across various beam sections like rectangular, circular and built up sections.

Torsion: (i) Derivation of equation and its assumptions. Polar modulus Application of equation to hollow and solid circular shaft, tortional, circular shaft subjected to combined bending and torsion. **(ii)** Thin cylinders and Spheres Derivation for circumferential stress and longitudinal stress. Calculation of circumferential and longitudinal stresses in a cylinder of thin sphere subjected to internal pressure.

Slope and Deflection of Determinate Beam: Relation between moment, slope and deflection, derivation of moment area theorems. Slope and deflection of statically determinate beams subjected to concentrated loads and uniformly distributed load by Macaulay's Method and Moment area method.(Numerical Examples) Concept of Conjugate Beam method (No numerical examples)

Combined Direct and Bending Stresses: Combined direct and bending stresses, applications to short columns with eccentric loads.

Text Books:

1. Mechanics of Materials, Beer and Johnston, Tata McGraw Hill Publication
2. Mechanics of Structures- vol-I, S.B. Junnarkar, Charotar publication house, 32 th Edition 2016
3. Strength of Materials, R.Subramanian, Oxford University Press, 2007

Reference Books:

1. Mechanics of Materials, Gere and Timoshenko, CBS Publishers
2. Engineering Mechanics of Solids, E.P. Popov, 2nd Edition, Prentice Hall India,1998
3. Strength of Materials, G.H. Ryder, Prentice Hall Publications, 3rd Edition, 2002.

Course Outcomes: After completion of course, the students will be able to:

CEU430.1	Understand basic concepts of stress-strain, and evaluate behavior and other physical properties of elastic isotropic materials.
CEU430.2	Determine the internal forces in structural elements under different types of loadings (axial, transverse shear, bending, tortional) and draw their graphical representation.
CEU430.3	Apply the concept of principal stresses and strains for analysis of structural element.
CEU430.4	Calculate the deflection at any point on a determinant beam subjected to combination of loads.

SHU422 ENVIRONMENTAL ~~SCIENCE~~ Studies

Teaching Scheme: 01 L **Total: 01** **Credits: 00**
Evaluation Scheme: 20TA+30 ESE **TOTAL MARKS: 50**
Duration of ESE: 1 hrs. 30 min

Course objectives: The objectives of offering this course are to-

- Be aware of various environmental factors and there preservation.
- Teach them how to protect Environment and natural resources.
- How to make equitable use of energy resources

Course contents:

The Multidisciplinary Nature of Environmental Studies:- Definition, scope and importance, Need for public awareness.
Social issues and Environment:- From Unsustainable to sustainable development, urban problems related to energy, Water conservation, rainwater harvesting, and watershed management Resettlement and rehabilitation of people, problems.
Environmental ethics:- Issues and possible solution, Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Wasteland reclamation. Consumerism and Waste products, Environment protection act, Air (prevention & control) act, Water (prevention and control) act, Wildlife protection act, Forest conservation act, Issues involved in enforcement of environmental legislation.
Human population and environment:- Environment and human health, Human rights, Role of Information Technology in Environment and human health, Public awareness.

Natural Recourses:- Conventional energy resources: definition, classification, composition, energy content types: coal, petroleum, natural gases, hydrogeothermal, nuclear, environmental implication of energy uses. Non conventional energy resources: solar energy, wind energy, tidal energy, geothermal energy, hydropowers and biogas.
Ecosystem and Biodiversity:-Concept of ecosystem, Structure and function of ecosystem, Producer, consumer, decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of following ecosystem: Forest ecosystem, Grass land ecosystem, Desert ecosystem Aquatic ecosystem (Rivers and ocean).
Introduction- definition: genetics, species and ecosystem, diversity. Biogeographically classification of India. Conservation of biodiversity- In-situ and Ex-situ conservation of Biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man wildlife conflicts. Endangered and endemic species of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, national and local level. India as mega diversity nation. Hot spot of biodiversity.

Environmental Pollution:- Definition, Causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution, Thermal pollution, Nuclear hazards, Solid waste, Management, Causes effects and control measures, Role of individual in prevention of pollution, Hazardous waste management, Biomedical waste management, Disaster management: floods, earthquake, cyclone and landslides.

Course outcomes:
After studying the course, the students will be able to:

- Convey the Environmental awareness among peoples.
- Apply Conservation of various natural resources and environmental factors.
- Aware about social and environmental issues.

Recommended Books:

1) The Biodiversity of India, Bharucha Erach ,Marin Publishing Pvt. Ltd., Ahmedabad
2) Brunner R.C., 1989,Hazardous Waste Incineration, McGraw Hill Inc.
3) Marine pollution, Clark R.S., Clanderson Press Oxford (TB)
4) Environmental Chemistry, De A.K. Wiley Estern Lmt.
5) Environmental Chemistry, Sharma B.K., 2001 Goel Publ., House, Meerat.
6) Environmental Management, Wagner K.D., 1998, W.B. Saunders Co., Philadel phia, USA
7) Environmental Studies, Benny Joseph, 1st edition,2005,Tata Mcgraw-Hill Publ.

MEU424 FLUID MECHANICS LAB

Teaching Scheme: 02 P **Total: 02** **Credits: 01**
Evaluation Scheme: 25 Internal + 25 External **TOTAL MARKS: 50**

Course Objectives:

I. To validate the various theory concept practically by demonstrating the experiments
II. To acquire hand on experience to use the various measuring instrument for the fluid flow
III. To analyze the various frictional losses in fluid flow
IV. To develop the practically evaluating ability in the different situation of fluid flow
V. To utilize this practical knowledge for upcoming related subject and research work

It is representative list of practical. The instructor may choose minimum eight experiments as per his/her requirement (so as to cover entire content of course MEU424) from the list given below:

List of Practical

1. Measurement of fluid pressure
2. Verification of Bernoulli's equation
3. Determination of Reynolds number
4. Determination of co-efficient of friction for pipes
5. Determination of Coefficient of Discharge of given Venturi meters
6. Determination of Coefficient of Discharge of given Orifice meters
7. Determination of the density and friction factor of oil flow in a pipe
8. Analysis of velocity distribution in Boundary layer and its thickness
9. Determination of head loss due to sudden enlargement and contraction
10. Determination of losses in bends and elbows
11. Analysis of flow through pipes in series and parallel

Note:
ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A&B
ESE: The end semester Exam for practical shall be based on performance in one of the experiments and may be followed by sample questions.

Course Outcomes: After completion of course, the students will be able to:

MEU424.1	Measure various properties of fluids
MEU424.2	Characterize the performance of fluid systems
MEU424.3	Analyze the various frictional losses in fluid flow
MEU424.4	Identify the types of flow by using flow demonstrator
MEU424.5	Develop the experimental set-up and analyze for performance

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CEU431 STRENGTH PF MATERIAL LAB

Teaching Scheme: 02 P **Total: 02** **Credits: 01**
Evaluation Scheme: 25 Internal + 25 External **TOTAL MARKS: 50**

Course Objectives:

I. To study the mechanical properties of materials when subjected to different types of loading.
II. To verify the principals studied in solid mechanics theory by performing experiments in laboratory.

It is a representative list of practicals. The instructor may choose experiment as per his/her requirements (so as to cover entire contents f the course CEU425) from the list or otherwise. Minimum eight experiments should be performed.

List of Practical

1. Tension test on mild steel or TOR steel.
2. Hardness tests (Brinell and Rockwell) on mild steel, copper, aluminum, brass and cast iron.
3. Impact test on mild steel, aluminum, copper, brass, cast iron.
4. Shear test on mild steel and aluminum.
5. Torsion test on mild steel and cast iron.
6. Fatigue test on mild steel.
7. Measurement of deflection in statically determinate beam.
8. Flexure test on wooden beam.
9. Determination of stiffness and modulus of rigidity of spring.
10. Compression test on wood (parallel and perpendicular to gins)
11. Strain measurement using Rossette strain guage
12. Compression test on metals.

Note:
ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A&B
ESE: The end semester Exam for practical shall be based on performance in one of the experiments and may be followed by sample questions.

Course Outcomes: After completion of course, the students will be able to:

CEU431.1. Performs, tension, shear, torsion and compression tests on solid materials.
CEU431.2. Determine the toughness of the material using Charpy and Izod test.
CEU431.3. Determine the Brinell and Rockwell hardness number of given metal specimen.
CEU431.4. Estimate the elastic constants through compression test on spring and deflection test on beams

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GOVT. COLLEGE OF ENGINEERING, AMRAVATI

DEPARTMENT OF MECHANICAL ENGINEERING

PROPOSED CURRICULUM

For

B. TECH. (MECHANICAL)

2019- 2020

PROGRAM OBJECTIVES

I. **To prepare students for successful careers in industry/ higher studies /R&D institutions that meet global needs.**

II. **To provide students with solid foundation in basic science and basic engineering required to solve and analyze mechanical engineering problems.**

III. **To develop ability among students to solve industrial, environmental, Techno-social problems with latest and appropriate mechanical engineering techniques and tools available**

IV. **To inculcate professional skill, ethical responsibility, team work and leadership qualities in students.**

V. **To promote awareness of entrepreneurship, self-education, lifelong learning and to develop sense of social responsibility.**

PROGRAM OUTCOMES

I. **Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.**

II. **Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.**

III. **Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.**

IV. **Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.**

V. **Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.**

VI. **The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and**

cultural issues and the consequent responsibilities relevant to the professional engineering practice.

VII. **Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.**

VIII. **Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.**

IX. **Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.**

X. **Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.**

XI. **Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.**

XII. **Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.**

PROGRAM SPECIFIC OUTCOMES

1. **Identify Mechanical Engineering related real life issues/ problems in industries, society and provide feasible solution**

2. **Apply the knowledge of the basic streams of Mechanical Engineering viz. thermal, design and production system to design mechanical system and product development**

3. **Plan and implement the activities in the small, medium and large enterprises as a part of team or as an individual**

GOVERNMENT COLLEGE OF ENGINEERING, AMRAVATI
MECHANICAL ENGINEERING DEPARTMENT
SCHEME FOR III & IV Semester B. Tech. (Mechanical Engineering) as per AICTE guidelines

Category	Course Code	Name of the Course	Teaching Scheme (Hrs./week)				Evaluation scheme						Credits
							Theory			Practical			
			L	T	P	Total	MSE	TA	ESE	ICA	ESE	Total	
	Semester – III												
BSC	SHU321A *SHU322A	Differential Equations and Probability *Integral Calculus and Probability	3	1	-	4	30	10	60	-	-	100	4
PCC	MEU321	Thermodynamics	4	-	-	4	30	10	60	-	-	100	4
PCC	MEU322	Manufacturing Processes	3	-	-	3	30	10	60	-	-	100	3
PCC	MEU323	Materials Engineering	4	-	-	4	30	10	60	-	-	100	4
ESC	MEU324	Machine Drawing	2	-	-	2	30	10	60	-	-	100	2
MC	SHU322	Introduction to Constitution of India	1	-	-	1	-	-	60	-	-	60	0
LC	MEU325	Materials Engineering Lab	-	-	2	2	-	-	-	25	25	50	1
LC	MEU326	Machine Drawing Lab	-	-	2	2	-	-	-	25	25	50	1
			17	**1**	**4**	**22**	**150**	**50**	**360**	**50**	**50**	**660**	**19**
	Semester – IV												
BSC	SHU423	Cyber law and ethics	2	-	-	2	30	10	60	-	-	100	2
PCC	MEU421	Applied Thermodynamics-I	4	-	-	4	30	10	60	-	-	100	4
PCC	MEU422	Fluid Mechanics	4	-	-	4	30	10	60	-	-	100	4
PCC	MEU423	Manufacturing Technology	4	-	-	4	30	10	60	-	-	100	4
PCC	CEU430	Strength of Material	4	-	-	4	30	10	60	-	-	100	4
MC	SHU422	Environmental Science	1	-	-	1	-	-	60	-	-	60	0
LC	MEU424	Fluid Mechanics Lab	-	-	2	2	-	-	-	25	25	50	1
LC	CEU431	Strength of Material Lab	-	-	2	2	-	-	-	25	25	50	1
			19		**4**	**23**	**150**	**50**	**360**	**50**	**50**	**660**	**20**

L – Theory lecture, T – Tutorial; P – lab work: Numbers under teaching scheme indicated contact clock hours
BSC- Basic Science; PCC – Program Core Course; ESC- Engineering Science; MC – Mandatory Course; LC- Lab Course
MSE- Mid Semester examination**; TA-** Teacher Assessment**; ICA** – Internal Continuous Assessment; **ESE** – End Semester Examination

*For the students directly admitted to second year (Lateral entry)

Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)

Equivalence of Courses in Old Scheme with New Scheme

B. Tech : Mechanical Engineering

Year : Second Year (Semester – III & IV)

Sr. No.	Course in old scheme			Course in new Scheme		
	Course Code	**Course name**	**No. of Credits**	**Course Code**	**Course name**	**No. of Credits**
1.	MEU301	Material Science and Engineering	03	MEU323	Materials Engineering	4
2.	SHU301	General Proficiency - II	02	**No equivalence**		
3.	MEU302	Engineering Thermodynamics	04	MEU321	Thermodynamics	4
4.	SHU302	Engineering Mathematics -III	03	SHU321	Engineering Mathematics-III	4
5.	CEU303	Strength of Materials	04	CEU430	Strength of Materials	4
6.	MEU303	Material Science and Engineering Lab.	01	MEU325	Materials Engineering Lab	1
7.	MEU307	Strength of Materials Lab.	01	CEU431	Strength of Materials Lab	
8.	EEU311	Electric Drives and Control	04	**No equivalence**		
9.	EEU312	Electric Drives and Control Lab.	01	**No equivalence**		
10.	MEU401	Fluid Mechanics	04	MEU422	Fluid Mechanics	4
11.	MEU402	Kinematics of Machines	04	No equivalence		
12.	MEU403	Thermal Engineering & Energy Conversion	4	MEU421	Applied Thermodynamics-I	4
13.	MEU404	Manufacturing Processes	04	MEU322	Manufacturing Processes	3
14.	MEU405	Machine Drawing	02	MEU324	Machine Drawing	2
15.	MEU406	Fluid Mechanics Lab	01	MEU424	Fluid Mechanics Lab	1
16.	MEU407	Kinematics of Machines Lab	01	**No equivalence**		
17.	MEU408	Manufacturing Processes Lab	01	**No equivalence**		
18.	MEU409	Computer Aided Drafting Lab	02	MEU326	Machine Drawing Lab	1
19.	**No equivalence**			MEU423	Manufacturing Technology	4
20.	**No equivalence**			SHU423	Cyber law and ethics	2
21.	**No equivalence**			SHU422	Environmental Science	0
22.	**No equivalence**			SHU322	Introduction to Constitution of India	0

Department of Mechanical Engineering
Equivalence Scheme for *online courses*
Programme Name:-B.Tech. Mechanical Engineering

Course Code	Name of the Course	Credits	Equivalent NPTEL/MOOC Course of duration 12-14week and covering 80% course contents / Virtual lab link for lab course	Credits	Course Starting date
Semester – III					
SHU321	Engineering Mathematics-III	4	--	--	--
MEU321	Thermodynamics	4	NPTEL Course: Concepts of Thermodynamics by Prof. Suman Chakraborty & Prof. Aditya Bandopadhyay, IIT, Kharagpur. Link for the course: https://nptel.ac.in/courses/112/105/112105266/ Duration – 12 Weeks	4	Enrolment Ends: September 21, 2020 Course Start Date: 14.09.2020 Course End Date: 04.12.2020 Exam Date: December 18-20, 2020 Exam Registration Date: 14.09.2020
MEU322	Manufacturing Processes	3	Theory of Production Processes 12 weeks duration 14 September to 04 December 2020 Exam date 20 December 2020 https://nptel.ac.in/courses/112/107/112107239/	3	14 September 2020
MEU323	Materials Engineering	4	Basics of Materials Engineering https://swayam.gov.in/nd1_noc20_me78/preview		14 Sep – 20 Dec, 2020
MEU324	Machine Drawing	2	--	--	--
SHU322	Introduction to Constitution of India	0	--	--	--
MEU325	Materials Engineering Lab	1	--	--	--
MEU326	Machine Drawing Lab	1	--	--	--

SHU321A DIFFERENTIAL EQUATIONS AND PROBABILITY

Teaching Scheme: 03 L+ 01T **Total: 04** **Credits: 04**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **TOTAL MARKS: 100**
Duration of ESE: 2 hrs. 30 min

Course Objectives:

I. To introduce the solution methodologies for second order Partial Differential Equations.
II. To study applications of partial differential equations in vibration of string and heat flow.
III. To equip students with the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and science.
IV. To introduce different sampling distributions and hypothesis tests.

Course Contents:

Laplace Transform: Definition, Properties of Laplace Transform, Laplace transform of periodic functions. Inverse Laplace transform, convolution theorem, unit step function, delta function, evaluation of integrals by Laplace transform, solving ODEs by Laplace Transform method.

Partial Differential Equations: Solutions of first order linear PDEs, Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method.

Applications of Partial Differential Equations: Method of separation of variables, equation of vibrating string, solution of wave equation by D'Alembert's method, one dimensional heat flow, two dimensional heat flow.

Random variables and Probability Distributions: Basic concepts of probability and its properties; Conditional probability and independent events; Random variables, discrete and continuous random variables, Mean and variance of Binomial, Poisson and Normal distributions and applications

Text Books:

1. Higher Engineering Mathematics, B.S. Grewal, Khanna Publishers,2020, 44th edition.
2. A text book of Engineering Mathematics, N.P. Bali and Manish Goyal, Laxmi Publications, Reprint, 2010.

Reference books:

1. Advanced Engineering Mathematics, Erwin Kreyszig, 9th Edition, John Wiley & Sons, 2006.
2. Introduction to Probability Theory, P. G. Hoel, S. C. Port and C. J. Stone, Universal Book Stall, 2003 (Reprint).
3. A First Course in Probability, S. Ross, 6th Ed., Pearson Education India, 2002.
4. Advanced Engineering Mathematics, H. K. Das, S. Chand & Company Pvt.Ltd, 2014.
5. Higher Engineering Mathematics, B.V Ramana, Tata Mc Graw Hill Publishing company Ltd., New Delhi,2008, 6th edition.

Course Outcomes: After completion of course, the students will be able to:

SHU321A.1. Develop different techniques of solving partial differential equations.
SHU321A.2. Implement these techniques to evaluate the engineering problems
SHU321A.3. Develop techniques needed to calculate probabilities and describe the properties of discrete and continuous distribution functions.
SHU321A.4. Do analysis of statistical data with the use of statistical tests in testing hypotheses.

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*SHU322A *INTEGRAL CALCULUS AND PROBABILITY

Teaching Scheme: 03 L+ 01T **Total: 04** **Credits: 04**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **TOTAL MARKS: 100**
Duration of ESE: 2 hrs. 30 min

Course Objectives:

I. To introduce the solution methodologies for second order Partial Differential Equations.
II. To study applications of partial differential equations in vibration of string and heat flow.
III. To equip students with the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and science.
IV. To introduce different sampling distributions and hypothesis tests.

Course Contents:

Ordinary differential equations of higher orders: Linear differential equation with constant coefficient, complementary function, particular integral, complete solution; method of variation of parameters.

Integral Calculus: Beta and Gamma functions and their properties; Evaluation of double integrals (Cartesian & polar),change of order of integration.

Laplace Transform: Definition, Properties of Laplace Transform, Laplace transform of periodic functions. Inverse Laplace transform, convolution theorem, unit step function, delta function, solving ODEs by Laplace Transform method.

Partial Differential Equations: Solutions of first order linear PDEs, Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method.

Random variables and Probability Distributions: Basic concepts of probability and its properties; Conditional probability and independent events; Random variables, discrete and continuous random variables, Binomial, Poisson and Normal distributions and applications.

Text Books:

1. Higher Engineering Mathematics, B.S. Grewal, Khanna Publishers,2020, 44th edition.
2. A text book of Engineering Mathematics, N.P. Bali and Manish Goyal, Laxmi Publications, Reprint, 2010.

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1. Advanced Engineering Mathematics, Erwin Kreyszig, 9th Edition, John Wiley & Sons, 2006.
2. Introduction to Probability Theory, P. G. Hoel, S. C. Port and C. J. Stone, Universal Book Stall, 2003 (Reprint).
3. A First Course in Probability, S. Ross, 6th Ed., Pearson Education India, 2002.
4. Advanced Engineering Mathematics, H. K. Das, S. Chand & Company Pvt.Ltd, 2014.
5. Higher Engineering Mathematics, B.V Ramana, Tata Mc Graw Hill Publishing company Ltd., New Delhi,2008, 6th edition.

Course Outcomes: After completion of course, the students will be able to:

SHU322A.1. Develop different techniques of solving partial differential equations.

SHU322A.2. Implement these techniques to evaluate the engineering problems

SHU322A.3. Develop techniques needed to calculate probabilities and describe the properties of discrete and continuous distribution functions.

SHU322A.4. Do analysis of statistical data with the use of statistical tests in testing hypotheses.

MEU321 THERMODYNAMICS

Teaching Scheme: 04 L **Total: 04** **Credits: 04**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **TOTAL MARKS: 100**
Duration of ESE: 2 hrs. 30 min

Course Objectives:

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

Course Contents:

Fundamentals - System & Control volume; Property, State & Process; Exact & Inexact differentials; Work - Thermodynamic definition of work; examples; Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work.

Temperature, Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers- Definition of heat; examples of heat/work interaction in systems- First Law for Cyclic & Non-cyclic processes; Concept of total energy E ; Demonstration that E is a property; Various modes of energy, Internal energy and Enthalpy.

Pure Substances - Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures, Compressibility charts- Properties of two phase systems - Const. temperature and Const. pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables and R134a tables; Saturation tables; Superheated tables; Identification of states & determination of properties, Mollier's chart.

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

Second law - Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale.

Clausius inequality; Definition of entropy S ; Demonstration that entropy S is a property;

Evaluation of *S* for solids, liquids, ideal gases and ideal gas mixtures undergoing various

processes; Determination of *S* from steam tables- Principle of increase of entropy; Illustration of processes in T-s coordinates; Definition of Isentropic efficiency for compressors, turbines and nozzles- Irreversibility and Availability, Availability function for systems and Control volumes undergoing different processes, Lost work. Second law analysis for a control volume. Exergy balance equation and Exergy analysis.

Thermodynamic cycles - Basic Rankine cycle; Basic Brayton cycle; Gas Power Cycles; Basic vapor compression cycle and comparison with Carnot cycle.

Text Books:

1. Thermodynamics: An Engineering Approach, Yunus Cengel and Michael Boles, 9TH Edition, McGraw Hill, 2019
2. Engineering Thermodynamics, P. K. Nag, 6TH Edition, McGraw Hill, 2017

Reference books:

1. Fundamentals of Thermodynamics, Richard Sonntag, Claus Borgnakke ,9TH edition, John Wiley and Sons, 2016
2. Fundamentals of Engineering Thermodynamics, Michael J. Moran, Howard Shapiro, 8TH edition, John Wiley & Sons, 2014
3. Engineering Thermodynamics, Jones, J. B. and Duggan, R. E., Prentice Hall of India

Course Outcomes: After completion of course, the students will be able to:

MEU321.1	Apply energy balance to systems and control volumes, in situations involving heat and work interactions
MEU321.2	Evaluate changes in thermodynamic properties of substances
MEU321.3	Evaluate and compare the performance of energy conversion devices
MEU321.4	Differentiate between high grade and low grade energies

MEU322 MANUFACTURING PROCESSES

Teaching Scheme: 03 L **Total: 03** **Credits: 03**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **TOTAL MARKS: 100**
Duration of ESE: 2 hrs. 30 min

Course Objectives:

I Impart the critical knowledge of metal melting, casting, mechanical working of metals and different joining processes
II Prepare students understand working principles of additive manufacturing processes their selection based on quality and productivity
III Inculcate the fundamentals of unconventional machining processes

Course Contents:

Casting and Moulding: Pattern materials, allowances, Types of patterns, Design considerations in pattern making, Color codes for patterns and core boxes. Basic principle and Terminology of sand casting, gating system, types of gate, Directional and Progressive solidification. General properties of moulding sands, Types of sands, Preparation of sand moulds of different types, Moulding processes, core making.

Technology of Melting and Special Casting Methods: Melting furnaces pit, open hearth, gas fired cupola and electric hearth furnaces, Electric furnaces -Direct Arc, Indirect arc and electric induction furnace, Selection of furnace. Modernization and Mechanization of Foundries, permanent mold casting, slush casting, shell molding, Investment or lost wax casting, vacuum process, centrifugal casting, Die casting equipments and processes for Gravity, Pressure and Vacuum casting methods

Defects, Inspection and Testing of Casting: Various defects, their causes and remedies, cleaning and inspection methods of casting.

Additive Manufacturing Processes: Stereolithography (SLA), Liquid thermal polymerization (LTP), Fused Deposition Modeling (FDM), Ballistic Particle Manufacturing (BPM), Selective Laser Sintering (SLM), Laser engineered net shaping (LENS), Binder Jet Printing (BJP)

Mechanical Working of Metals: Principle of Hot and cold working processes, Different types of hot and cold working processes, e.g. Rolling, types of rolling forging operations, extrusion, piercing, pipe and tube production, manufacture of seamless pipe and tubing. Spinning, embossing and coining, squeezing and bending operations, rotary swaging

Joining Processes, Welding Defects, Testing and Inspection of Welds: Introduction to riveting, soldering, brazing and welding. Gas welding, working principle and its application, Arc welding: arc initiation, arc maintenance, and arc control, TIG/ MIG/ SAW/ Resistance welding: working principle and its application, Working principle and applications of Friction Welding, Forge Welding, Plasma arc, and Thermit Welding. Ultrasonic, Electro slag, Electron Beam, laser welding.Various welding defects, weld testing methods.

Unconventional Machining Processes Mechanical Processes: -Ultrasonic Machining principle and applications, process parameters, Abrasive and water abrasive jet machining. Thermal processes: -Election Beam Machining -Generation of beam, principle and applications, Laser Beam machining: Plasma-arc machining-Concept and generation of plasma, principle of PAM, applications. Electro Chemical Machining-Classification, fundamentals, Electro mechanical milling. Electric discharge Machining –EDM, wire EDM, Mechanism of material removal, process parameters, advantages and applications

Text Books:

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)-Pearson India, 2014
2. Workshop Technology, HajraChaudharyVol I , 10thEdition,DhanpatRai and Co (P) ltd

Reference Books:

1. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems
2. Degarmo, Black &Kohser, Materials and Processes in Manufacturing

Course Outcomes: After completion of course, the students will be able to:

MEU322.1. Illustrate the fundamentals of metal melting, casting, mechanical working of metals, their necessity and importance

MEU322.2. Explain working principles and classify additive manufacturing processes.

MEU322.3. Differentiate and compare joining processes in terms of application, function, advantages, disadvantages, quality and productivity

MEU322.4. Interpret necessity, principle, advantages, disadvantage, limitations, applications of unconventional machining processes

MEU323 MATERIALS ENGINEERING

Teaching Scheme: 04 L **Total: 04** **Credits: 04**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **TOTAL MARKS: 100**
Duration of ESE: 2 hrs. 30 min

Course Objectives:

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

Course Contents:

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

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

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

Alloys, Substitutional and Interstitial Solid Solutions- Phase Diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron Iron-carbide phase diagram and microstrctural aspects of ledeburite, austenite, ferrite and cementite, cast iron.

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

Alloying of steel, properties of stainless steel and tool steels, specifications of some commonly used steels for engineering applications (eg. EN, AISI, IS),maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupro-nickel; Aluminium and Al-Cu – Mg alloys- Nickel based superalloys and Titanium alloys

Text Books:

1. W. D. Callister, 2006, "Materials Science and Engineering-An Introduction", 6th Edition, Wiley India.

2. Kenneth G. Budinski and Michael K. Budinski, “Engineering Materials”, Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
3. V. Raghavan, “Material Science and Engineering’, Prentice Hall of India Private Limited, 1999.
4. U. C. Jindal, “Engineering Materials and Metallurgy”, Pearson, 2011

Reference Books:

1. Mechanical Metallurgy, G.E. Dieter, 3rd Edition, Mc-Graw Hill International, London, 1999.
2. Physical Metallurgy for Engineers, 4th Edition, Clarke and Varney,. 2004.
3. Powder Metallurgy, A.K. Sinha 1st Edition., 1991.
4. Engineering Physical Metallurgy, Y. Lakhtin, 2nd Edition, Mir Publications, 1999.

Course Outcomes: After completion of course, the students will be able to:

MEU323.1	Identify crystal structures for various materials and understand the defects in such structures
MEU323.2	Understand how to tailor material properties of ferrous and non-ferrous alloys
MEU323.3	How to quantify mechanical integrity and failure in materials

MEU324 MACHINE DRAWING

Teaching Scheme: 02 L **Total: 02** **Credits: 02**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **TOTAL MARKS: 100**
Duration of ESE: 2 hrs. 30 min

Course Objectives:

I. Helping the student in drafting their technical ideas.
II. Creating knowledge about the various practices with regard to the dimensioning, sectioning and development of views.
III. Understanding the importance of the linking functional and visualization aspects in the preparation of the part drawings.
IV. Preparation of the part or assembly drawings as per the conventions.
V. Interpretation of machine drawings that in turn help the students in the preparation of the jobs, components, etc.

Course Contents:

Sectional Views: conversion of pictorial view into sectional orthographic projections, missing views.

Development of Surfaces: Development of surface of cubes, prisms, cylinder, pyramids, cones etc

Intersection of Surfaces: Interpenetration of solids, prism and prism, cylinder and cylinder, cylinder and prism, cone and cylinder, cone and prism.

Assembly Drawing: Preparation of detailed and assembly drawing of simple machine assemblies like pedestal bearing, Plummer block, simple eccentric, stuffing box, cross head, connecting rod, tail stock, tool post, c-clamp, screw jack, boiler safety valve etc.

Introduction to Modelling by using Pro/Engineer /CATIA Software.

Text Books:

1. Machine drawing, N.D.Bhatt, 38th Edition ,Charotar Publisher, 2003
2. Machine Drawing, N.Sidheshwar, Shastry, Kanhaiah, 4th Edition, Tata Mcgraw Hill, 2005

Reference Books:

1. Machine Drawing, Narayan, K.L.Reddy, 2nd Edition, New AGE International Publishers, 2004
2. Machine Drawing, P.J.Shah, 3rd Edition, Shah Publishers, 1997
3. Computer Graphics & Design, P.Radhakrishnan, 3rd Edition, Dhanpat Rai & Sons, 2009
4. Using AUTOCAD, James E Fuller, 9th Edition, Denmark Publishing Company, 2004
5. Machine Drawing, R.K.Dhawan, 4th Edition, S.Chand& Co.,2006

Course Outcomes: After completion of course, the students will be able to:

MEU324.1. Draw the development of surfaces for sheet metal working applications.
MEU324.2. Understand the representation of materials used in machine drawing.
MEU324.3. Draw the machine elements including keys, couplings, cotters, riveted, bolted and welded joints.
MEU324.4. Construct an assembly drawing using part drawings of machine components.

MEU324.5. Represent tolerances and the levels of surface finish of machine elements Develop skills to model the behaviour of structures under mechanical and thermo-mechanical loads.

SHU322 INTRODUCTION TO CONSTITUTION OF INDIA

Teaching Scheme: 01 L **Total: 01** **Credits: 00**
Evaluation Scheme: 60 ESE **TOTAL MARKS: 60**
Duration of ESE: 2 hrs. 30 min

Course Objectives:

I. To conversant with Constitution Of India

Course Contents:

History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working)

Philosophy of the Indian Constitution: Preamble, Salient Features

Contours of Constitutional Rights &Duties: Fundamental Rights, Right to Equality Right to Freedom Right against Exploitation Right to Freedom of Religion Cultural and Educational Rights Right to Constitutional Remedies Directive Principles of State Policy Fundamental Duties.

Organs of Governance, Parliament Composition Qualifications and Disqualifications Powers and Functions Executive President Governor Council of Ministers Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

Election Commission: Election Commission: Role and Functioning Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women

Books Recommended:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015

Course Outcomes: After completion of course, the students will be able to:

SHU322.1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
SHU322.2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
SHU322.3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
SHU322.4. Discuss the passage of the Hindu Code Bill of 1956.

MEU325 MATERIALS ENGINEERING LAB

Teaching Scheme: 02 P **Total: 02** **Credits: 01**
Evaluation Scheme: 25 Internal + 25 External **TOTAL MARKS: 50**

Course Objectives:

I. To reinforce the concepts learnt in the theory classes of Materials Engineering (MEU323) by carrying out various experiments
II. Students will learn specimen preparation for optical microscopy and by using optical microscope study microstructures of various metals/alloys which are used in industries for various applications
III. To compare the composition and properties of various ferrous and non-ferrous metals/alloys
IV. To carry out mechanical tests/heat treatments to evaluate various mechanical properties

Note: It is representative list of experiments. The instructor may choose minimum eight experiments as per his/her requirement (so as to cover entire content of course MEU323) from the list given below.

List of Experiments:

1. Study of metallurgical microscope.
2. Preparation of specimen for microstructure examination
3. Molding of specimen for microstructure examination with the help of mounting press/ cold setting resin.
4. Study and drawing of microstructure of annealed and normalized steels.
5. To carry out hardening and tempering of steel.
6. Study of Jominy end quench test for hardenability of steel.
7. To measure hardness using Rockwell Hardness Tester.
8. Study and drawing of microstructures of various cast irons.
9. Study and drawing of microstructures of various non –ferrous metals and alloys.
10. To study and perform impact test.
11. To measure hardness using Brinell Hardness Tester
12. Study of image analyzer
13. Study of scanning electron microscopy
14. Study of transmission electron microscopy
15. Study and drawing of microstructures of steels

Note:
ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired.

ESE: The end semester Exam for practical may/shall be based on performance in one of the experiments and may be followed by sample questions.

Course Outcomes: After completion of the laboratory course, students will be able to

MEU325.1. Prepare specimen for optical microscopy and use optical microscope for the study of microstructures of various metals/alloys and recognize/ identify various phases present in metals/alloys and their effect on mechanical properties

MEU325.2. Understand the effect of heat treatment on the microstructure of metals/alloys and thereby on its mechanical properties.

MEU325.3. Evaluate mechanical properties of various materials and compare it with their internal structure to establish structure property co-relation.

MEU326 MACHINE DRAWING LAB

Teaching Scheme: 02 P **Total: 02** **Credits: 01**
Evaluation Scheme: 25 Internal + 25 External **TOTAL MARKS: 50**

Course Objectives:

I. To impart students with the necessary skills for drafting and modelling machine components using CAD tools.
II. To impart the fundamental knowledge in designing and drafting.
III. To develop the Practical knowledge in the field components designing.

It is representative list of practical. The instructor may choose minimum eight Sheet as per his/her requirement (so as to cover entire content of course MEU326) from the list given below

List of Drawing

PART A: Sheets (one each) by using Pro Engineer /CATIA and Sketchbook
1. Sectional Views of objects
2. Developments of surfaces
3. Intersection of solids

PART B: Drawing of following machine elements using Pro/Engineer/CATIA Software (four Sheets)
1. Cotter Joints
2. Knuckle Joints
3. Flange Coupling
4. Wall Bracket
5. Plummer Block
6. Stuffing Box
7. Machine tool Components
8. Rivet and Rivet Joints

PART C: One sheet on: ISI Conventions for various components like bearing, gears, springs, keys and keyways, threads, tap holes and materials

Note:
ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A&B
ESE: The end semester Exam for practical shall be based on performance in one of the experiments and may be followed by sample questions.

Course Outcomes: After completion of course, the students will be able to:

MEU326.1 Demonstrate the complete methodology of design &drafting.
MEU326.2 Develop skills in designing the automobile engine components using software like Pro Engineer/CATIA etc
MEU326.3 Model and assemble machine parts and Know about the industrial models and their usages in practical design and manufacturing fields.

SHU423 CYBER LAW AND ETHICS

Teaching Scheme: 02 L **Total: 02** **Credits: 02**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **TOTAL MARKS: 100**
Duration of ESE: 2 hrs. 30 min

Course contents will be displayed soon

MEU421 APPLIED THERMODYNAMICS-I

Teaching Scheme: 04 L **Total: 04** **Credits: 04**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **TOTAL MARKS: 100**
Duration of ESE: 2 hrs. 30 min

Course Objectives:

I. To learn about the basic components and their functions in steam power plant
II. To learn about to evaluate heat, work and energy interactions in steam power plant
III. To adopt the most appropriate technique to optimize the performance of individual components in a steam power plant
IV. To develop skill to draw the velocity diagrams of steam turbines

Course Contents:

Steam Power Plant: Steam power cycles, Limitations of Carnot vapour cycle, efficiencies in reheat & regenerative cycle analysis limited to two stages only, typical layout of steam power plant, Concept of co-generation. Elementary simple problems on Steam power cycles

Steam Generators: Indian Boiler Regulations, Classification of Boiler, principle parts and their functions, modern water-tube type steam generator arrangements, Economiser, Superheater, Reheater, Steam Generator Control, Air Preheater, Principle of fluidized bed boiler, Cylone separator. Electrostatic precipitator.

Steam Nozzle: Classification of Nozzle, flow through nozzles, critical pressure ratio and choked flow, nozzle efficiency, determination of throat and exit areas, Concept of super saturated flow and Wilson line.Elementary simple problems on determination of throat and exit areas.

Steam Turbines: Types of steam turbines, Types of steam turbines such as impulse, reaction turbines, Compounding, Velocity diagrams. Graphical and analytical methods for work and power determination, axial thrust and efficiency. Need of Governing, Methods of Turbine governing and control.

Steam Condenser: Functions of a Condenser, Elements of a Condensing Plant, Types of steam condenser, Need of a condenser, Estimation of quantity of cooling water required, condenser and vacuum efficiency. Sources of air in condensers and its effect on performance, Air extraction, Cooling towers.

Energy Conservation in Boilers: Energy conservation options, waste minimization, methodology and economical viability.

Text Books:

1. Basic and Applied Thermodynamics, P.K. Nag, 2nd Edition, Tata Mc-Graw Hill Pub., 2010.
2. Thermal Engineering by Mahesh M Rathore, 3rd Edition, Tata Mc-Graw Hill, 2010

Reference books:

1. Thermodynamics-An Engineering Apporach, Y. A. Cengel and M. A. Boles, 3rd Edition, Mc-Graw Hill, 1998.
2. Applied Thermodynamics, Onkar Singh, 3rd Edition, New Age International Publishing, 2009.

3. Power Plant Engineering, P.K. Nag, 3rd Edition, Tata Mc-Graw Hill Publishing, 2008.

Course Outcomes: After completion of course, the students will be able to:

MEU421.1	Analyze the basic components in steam power plant
MEU421.2	Select the most appropriate method of compounding for steam turbines
MEU421.3	Evaluate and compare the performance of energy conversion devices
MEU421.4	Draw the velocity diagrams of turbine blade.
MEU421.5	Design the steam nozzle as per given parameters

MEU422 FLUID MECHANICS

Teaching Scheme: 04 L **Total: 04** **Credits: 04**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **TOTAL MARKS: 100**
Duration of ESE: 2 hrs. 30 min

Course Objectives:

I. To recognize the basic principles and equations of fluid mechanics
II. To distinguish the various types of fluid flow problems encountered in practice
III. To apply laws of mass and momentum conservation for fluid flow system
IV. To analyze the mathematical problem of different fluid flow systems
V. To formulate the equation by using methods of dimensional analysis

Course Contents:

Fluid Statics- Definition of fluid, Newton's law of viscosity, Units and dimensions-Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension, pressure at a point in fluid, variation of pressure with depth, fluid application to manometer, vapour pressure, cavitations.

Fluid Kinematics- Types of flow- Methods of describing fluid motion- Velocity and acceleration, Stream line, Streak line, Path line, Stream tube, Stream function, Velocity potential, Flow net- uses, limitations and methods of drawing, Discharge, Control volume-application of continuity equation and momentum equation, Incompressible flow.

Fluid Dynamics- Euler's equation of motion, Bernoulli's equation and its applications, assumption and limitations, Flow measurement, velocity measurement, Energy gradient line and Hydraulic gradient line, Impulse momentum equation, momentum correction factor.

Flow in Channels- Exact flow solutions in channels and ducts, Couette and Poiseuille flow, laminar flow through circular conduits and circular annuli- concept of boundary layer – measures of boundary layer thickness – Darcy Weisbach equation, friction factor, Moody's diagram, minor losses in pipes and fittings.

Dimensional Analysis– Need, Methods of dimension analysis – Similitude – types of similitude Dimensionless parameters – application of dimensionless parameters – Model analysis

Text Books:

1. Introduction to Fluid Mechanics and Fluid Machines, S. K. Som and G. Biswas, 2nd Ed Tata McGraw Hill Education Publishing Company Limited, 2007
2. Fluid mechanics and Hydraulic machines, Dr. R. K. Bansal , 9th Edition, Laxmi Publication, Delhi, 2005

Reference books:

1. Fluid Mechanics Fundamentals and Application, Yunus A. Cengel and John M. Cimbala, 4th Edition, McGraw Hill, 2013
2. Fluid Mechanics, F.M. White, 4th International Editions, McGraw-Hill, 2005
3. Fluid Mechanics, Streeter, 7th Edition, Tata McGraw Hill (SI), 2000

Course Outcomes: After completion of course, the students will be able to:

MEU422.1	Identify the fluid flow system and solve problems involving fluid properties.
MEU422.2	Apply conservation laws to fluid flow problems in engineering applications
MEU422.3	Recognize of laminar and turbulent flow in pipes and the analysis of fully developed flow
MEU422.4	Evaluate the major and minor losses associated with pipe flow in piping networks and determine the pumping power requirements
MEU422.5	Develop the equation by using methods of dimensional analysis

MEU423 MANUFACTURING TECHNOLOGY

Teaching Scheme: 04 L **Total: 04** **Credits: 04**
Evaluation Scheme: 30 MSE + 10 TA + 60 ESE **TOTAL MARKS: 100**
Duration of ESE: 2 hrs. 30 min

Course Objectives:

I. Inculcate the fundamentals of metal cutting and cutting force analysis.
II. Articulate the working principles of lathe, drilling, boring, broaching, reaming, milling, grinding, shaper, planer machine tools.
III. Illustrate the concept of tolerance with design of limits gauges and control charts for attributes and variables
IV. Interpret different concepts of production planning and control

Course Contents:

Metal cutting: Mechanics of metal cutting, Cutting parameters, Tool nomenclature, Orthogonal and oblique cutting, Tool wear and tool life, Chip formation, Cutting tool materials, Cutting fluids, Merchant force circle, Various force components, Turning, Drilling, Milling and finishing processes, Introduction to CNC machining.

Machine Tools
Lathe: Mechanical Construction, classification of lathe machine, specifications, Operations and accessories of centre lathe, introduction of capstan &turret lathe, introduction to Automatic screw machines.

Drilling: Introduction, Working principle, Classification general purpose, Mass production and special purpose drilling machines, drill tool geometry.
Boring: Gear producing machines, Introduction, classification & mechanical construction og gear producing machines. Horizontal, Vertical and jig Boring machine.
Broaching and Reaming: Introduction, Working principle, classification, mechanical construction.

Milling: Introduction, Working principle, Classification, Types of Milling Cutters, Dividing head, Compound and differential indexing, Climb & conventional milling, applications

Grinding: Introduction, Working principle, Classification, types of bonds & Abrasive, grinding wheel specification, selection of wheel, super finishing processes.Shaper, Planer, Slotter: Introduction, Working principle, mechanical construction, classification

Metrology: Need of inspection; Accuracy, Precision and Errors in measurement; linear and angular measurements; Limits, fits and tolerances; gauge design; comparators; Geometric shapes, Acceptance tests for machine tools

Statistical Quality Control: Basic statistical concepts; frequency distribution, Control charts for Attributes and Variables; Acceptance Sampling

Production planning& control: Principles of production planning and control, Types of production, Sales forecasting, Economic batch quantity, PPC functions, PPC for different types of production, Inventory control: functions, objectives, Selective Inventory control, Inventory Management Systems, Economic Order Quantity (EOQ)

Text Books:

1. Workshop TechnologyVol II, B S Raghuwanshi, 10th Edition Dhanpat Rai & Sons, Delhi

2. Statistical Quality Control, M. Mahajan, Dhanpat Rai & Co.(P) Ltd
3. A Textbook of Production Engineering, P C Sharma, S. Chand & Company Ltd

Reference books:

1. Manufacturing Technology Volume II 4th Edition, P. N. Rao, McGraw Hill
2. Workshop Technology Vol II, H S Bawa, 2ndEdition, Tata Mc Graw Hill

Course Outcomes: After completion of course, the students will be able to:

MEU423.1	Explain working principles and classify lathe, drilling, boring, broaching, reaming, milling, grinding, shaper, planer and slotter operations.
MEU423.2	Differentiate and compare machining processes in terms of application, function, advantages, disadvantages, quality and productivity
MEU423.3	Calculate design tolerances using hole and shaft basis systems and Construct control charts for attributes and variables
MEU423.4	Articulate the concepts of production planning and control as per requirement

CEU430 STRENGTH OF MATERIAL

Teaching Scheme: 04 L **Total: 04** **Credits: 04**
Evaluation Scheme: 30 MSE+ 10 TA + 60 ESE **TOTAL MARKS: 100**
Duration of ESE: 2 hrs. 30 min

Course Objectives:

I. To establish an understanding of fundamental concepts of stresses, strains and response of elastic solid to external loadings.
II. To provide the knowledge principles, theorems required for analysis and design of various types of structural members subjected to axial, transverse shear, bending and tortional loadings.
III. To provide students with exposure to the systematic methods for solving engineering problems in solid mechanics
IV. To built the necessary theoretical background for further structural analysis and design courses.

Course Contents:

Simple Stresses and Strain: Concept of stress and strain, St. Venants principle, types of stresses and strains, Hooke's law, stress-strain diagram for mild steel and brittle material. Working stress, factor of safety, lateral strain, poissons ratio and volumetric strain. Elastic constants and relationship among them. Bars of varying section – composite bar of two materials only-temperature stresses. Strain energy-Resilience-Gradual, sudden, Impact and shock loading and their applications.

Principal Stresses and Principal Planes: General two dimensional stress system. Stress at a point on a plane, principal stresses and principal planes. Mohr's circle of stress, concept of ellipse of stress and its use. Principal strains and circle of strain.

Shear Force (S.F.) and Bending Moment (B.M.) Diagrams For Determinate Beams: S.F. and B.M. diagrams for cantilever, simply simply supported beams with and without overhangs. Calculation of maximum B.M. and S.F. and location of point of contra flexure due to concentrated load, uniformly distributed loads and uniformly varying loads and moments. Relation among shear force, bending moment and loading intensity.

Stresses in Beams (Flexural and Shear): (i) Flexural or bending stresses: Theory of simple bending – Assumption- Derivation of bending equation M/I = F/Y = E/R Section modulus of rectangular and circular section (Solid and Hollow). Moment of resistance. Bending stress in solid, hollow and built up sections. Design of simple beam section. **(ii)** Shearing Stresses: Derivation for shear stress in beam, shear stress distribution across various beam sections like rectangular, circular and built up sections.

Torsion: (i) Derivation of equation and its assumptions. Polar modulus Application of equation to hollow and solid circular shaft, tortional, circular shaft subjected to combined bending and torsion**. (ii)** Thin cylinders and Spheres Derivation for circumferential stress and longitudinal stress. Calculation of circumferential and longitudinal stresses in a cylinder of thin sphere subjected to internal pressure.

Slope and Deflection of Determinate Beam: Relation between moment, slope and deflection, derivation of moment area theorems. Slope and deflection of statically determinate beams subjected to concentrated loads and uniformly distributed load by Macaulay's Method and Moment area method.(Numerical Examples) Concept of Conjugate Beam method (No numerical examples)

Combined Direct and Bending Stresses: Combined direct and bending stresses, applications to short columns with eccentric loads.

Text Books:

1. Mechanics of Materials, Beer and Johnston, Tata McGraw Hill Publication
2. Mechanics of Structures- vol-I, S.B. Junnarkar, Charotar publication house, 32 th Edition 2016
3. Strength of Materials, R.Subramanian, Oxford University Press, 2007

Reference Books:

1. Mechanics of Materials, Gere and Timoshenko, CBS Publishers
2. Engineering Mechanics of Solids, E.P. Popov, 2nd Edition, Prentice Hall India,1998
3. Strength of Materials, G.H. Ryder, Prentice Hall Publications, 3rd Edition, 2002.

Course Outcomes: After completion of course, the students will be able to:

CEU430.1	Understand basic concepts of stress-strain, and evaluate behavior and other physical properties of elastic isotropic materials.
CEU430.2	Determine the internal forces in structural elements under different types of loadings (axial, transverse shear, bending, tortional) and draw their graphical representation.
CEU430.3	Apply the concept of principal stresses and strains for analysis of structural element.
CEU430.4	Calculate the deflection at any point on a determinant beam subjected to combination of loads.

SHU422 ENVIRONMENTAL SCIENCE

Teaching Scheme: 01 L **Total: 01** **Credits: 00**
Evaluation Scheme: 60 ESE **TOTAL MARKS: 60**
Duration of ESE: 2 hrs. 30 min

The Multidisciplinary Nature of Environmental Studies:- Definition, scope and importance, Need for public awareness.
Social issues and Environment:- From Unsustainable to sustainable development, urban problems related to energy, Water conservation, rainwater harvesting, and watershed management Resettlement and rehabilitation of people, problems.
Environmental ethics:- Issues and possible solution, Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Wasteland reclamation. Consumerism and Waste products, Environment protection act, Air (prevention & control) act, Water (prevention and control) act, Wildlife protection act, Forest conservation act, Issues involved in enforcement of environmental legislation.
Human population and environment:- Environment and human health, Human rights, Role of Information Technology in Environment and human health, Public awareness.

Natural Recourses:- Conventional energy resources: definition, classification, composition, energy content types: coal, petroleum, natural gases, hydrogeothermal, nuclear, environmental implication of energy uses. Non conventional energy resources: solar energy, wind energy, tidal energy, geothermal energy, hydropowers and biogas.
Ecosystem and Biodiversity:-Concept of ecosystem, Structure and function of ecosystem, Producer, consumer, decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of following ecosystem: Forest ecosystem, Grass land ecosystem, Desert ecosystem Aquatic ecosystem (Rivers and ocean).
Introduction- definition: genetics, species and ecosystem, diversity. Biogeographically classification of India. Conservation of biodiversity- In-situ and Ex-situ conservation of Biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man wildlife conflicts. Endangered and endemic species of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, national and local level. India as mega diversity nation. Hot spot of biodiversity.

Environmental Pollution:- Definition, Causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution, Thermal pollution, Nuclear hazards, Solid waste, Management, Causes effects and control measures, Role of individual in prevention of pollution, Hazardous waste management, Biomedical waste management, Disaster management: floods, earthquake, cyclone and landslides.

Recommended Books:
1) The Biodiversity of India, Bharucha Erach ,Marin Publishing Pvt. Ltd., Ahmedabad
2) Brunner R.C., 1989,Hazardous Waste Incineration, McGraw Hill Inc.
3) Marine pollution, Clark R.S., Clanderson Press Oxford (TB)
4) Environmental Chemistry, De A.K. Wiley Estern Lmt.
5) Environmental Chemistry, Sharma B.K., 2001 Goel Publ., House, Meerat.
6) Environmental Management, Wagner K.D., 1998, W.B. Saunders Co., Philadel phia, USA
7) Environmental Studies, Benny Joseph, 1st edition,2005,Tata Mcgraw-Hill Publ.

Course outcomes:

After studying the course, the students will be able to:

- Convey the Environmental awareness among peoples.
- Apply Conservation of various natural resources and environmental factors.
- Aware about social and environmental issues.

MEU424 FLUID MECHANICS LAB

Teaching Scheme: 02 P	**Total: 02**	**Credits: 01**
Evaluation Scheme: 25 Internal + 25 External		**TOTAL MARKS: 50**

Course Objectives:

I. To validate the various theory concept practically by demonstrating the experiments
II. To acquire hand on experience to use the various measuring instrument for the fluid flow
III. To analyze the various frictional losses in fluid flow
IV. To develop the practically evaluating ability in the different situation of fluid flow
V. To utilize this practical knowledge for upcoming related subject and research work
.

It is representative list of practical. The instructor may choose minimum eight experiments as per his/her requirement (so as to cover entire content of course MEU424) from the list given below:

List of Practical

1. Measurement of fluid pressure
2. Verification of Bernoulli's equation
3. Determination of Reynolds number
4. Determination of co-efficient of friction for pipes
5. Determination of Coefficient of Discharge of given Venturi meters
6. Determination of Coefficient of Discharge of given Orifice meters
7. Determination of the density and friction factor of oil flow in a pipe
8. Analysis of velocity distribution in Boundary layer and its thickness
9. Determination of head loss due to sudden enlargement and contraction
10. Determination of losses in bends and elbows
11. Analysis of flow through pipes in series and parallel

Note:
ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A&B
ESE: The end semester Exam for practical shall be based on performance in one of the experiments and may be followed by sample questions.

Course Outcomes: After completion of course, the students will be able to:

MEU424.1	Measure various properties of fluids
MEU424.2	Characterize the performance of fluid systems
MEU424.3	Analyze the various frictional losses in fluid flow
MEU424.4	Identify the types of flow by using flow demonstrator
MEU424.5	Develop the experimental set-up and analyze for performance

CEU431 STRENGTH OF MATERIAL LAB

Teaching Scheme: 02 P **Total: 02** **Credits: 01**
Evaluation Scheme: 25 Internal + 25 External **TOTAL MARKS: 50**

Course Objectives:

I. To study the mechanical properties of materials when subjected to different types of loading.
II. To verify the principals studied in solid mechanics theory by performing experiments in laboratory.

It is a representative list of practicals. The instructor may choose experiment as per his/her requirements (so as to cover entire contents f the course CEU425) from the list or otherwise. Minimum eight experiments should be performed.

List of Practical

1. Tension test on mild steel or TOR steel.
2. Hardness tests (Brinell and Rockwell) on mild steel, copper, aluminum, brass and cast iron.
3. Impact test on mild steel, aluminum, copper, brass, cast iron.
4. Shear test on mild steel and aluminum.
5. Torsion test on mild steel and cast iron.
6. Fatigue test on mild steel.
7. Measurement of deflection in statically determinate beam.
8. Flexure test on wooden beam.
9. Determination of stiffness and modulus of rigidity of spring.
10. Compression test on wood (parallel and perpendicular to gins)
11. Strain measurement using Rossette strain guage
12. Compression test on metals.

Note:
ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A&B
ESE: The end semester Exam for practical shall be based on performance in one of the experiments and may be followed by sample questions.

Course Outcomes: After completion of course, the students will be able to:

CEU431.1. Performs, tension, shear, torsion and compression tests on solid materials.
CEU431.2. Determine the toughness of the material using Charpy and Izod test.
CEU431.3. Determine the Brinell and Rockwell hardness number of given metal specimen.
CEU431.4. Estimate the elastic constants through compression test on spring and deflection test on beams

Govt. College of Engineering Amravati

(An Autonomous Institute of Govt. of Maharashtra)

Curriculum
for

VII and VIII Semesters.

of

B. Tech. (Mechanical Engineering)

Department of Mechanical Engineering

WEF 2014-2015 (NEW)

GOVERNMENT COLLEGE OF ENGINEERING, AMRAVATI

MECHANICAL ENGINEERING DEPARTMENT

SCHEME FOR B. Tech. (Mechanical Engineering) from academic year 2011-2012

Course Code	Name of the Course	Teaching Scheme (Hrs./week)				Evaluation scheme							Credits
						Theory				Practical			
		L	T	P	Total	TA	CT1	CT2	ESE	ICA	ESE	Total	
Semester – III													
SHU301	Engineering Mathematics-III	3	-	-	3	10	15	15	60	-	-	100	3
CEU303	Strength of Materials	3	1	-	4	10	15	15	60	-	-	100	4
EEU311	Electrical Drives and Control	4	-	-	4	10	15	15	60	-	-	100	4
MEU301	Material Science and Engineering	3	-	-	3	10	15	15	60	-	-	100	3
MEU302	Engineering Thermodynamics	4	-	-	4	10	15	15	60	-	-	100	4
CEU307	Strength of Materials Lab.	-	-	2	2	-	-	-	-	25	25	50	1
EEU312	Electrical Drives & Control Lab.	-	-	2	2	-	-	-	-	25	25	50	1
MEU303	Material Science and Engineering Lab	-	-	2	2	-	-	-	-	25	25	50	1
SHU305	General Proficiency-II	1	-	2	3	-	-	-	-	25	25	50	2
		18	1	8	27	50	75	75	300	100	100	700	23
Semester – IV													
MEU401	Fluid Mechanics	4	-	-	4	10	15	15	60	-	-	100	4
MEU402	Kinematics of Machines	3	1	-	4	10	15	15	60	-	-	100	4
MEU403	Thermal Engineering & Energy	4	-	-	4	10	15	15	60	-	-	100	4
MEU404	Manufacturing Processes	4	-	-	4	10	15	15	60	-	-	100	4
MEU405	Machine Drawing	2	-	-	2	4	8	8	30	-	-	50	2
MEU406	Fluid Mechanics Lab.	-	-	2	2	-	-	-	-	25	25	50	1
MEU407	Kinematics of Machines Lab.	-	-	2	2	-	-	-	-	25	25	50	1
MEU408	Manufacturing Processes Lab.	-	-	2	2	-	-	-	-	25	25	50	1
MEU409	Computer Aided Drafting Lab.	-	-	4	4	-	-	-	-	50	50	100	2
		17	1	10	28	44	68	68	270	125	125	700	23

GOVERNMENT COLLEGE OF ENGINEERING, AMRAVATI
MECHANICAL ENGINEERING DEPARTMENT
SCHEME FOR V and VI Sem. B. Tech. (Mechanical Engineering) from academic year 2012-2013

Course Code	Name of the Course	Teaching Scheme (Hrs./week)				Evaluation scheme							Credits
						Theory				Practical			
		L	T	P	Total	TA	CT1	CT2	ESE	ICA	ESE	Total	
Semester – V													
MEU501	Machine Design – I	3	-	-	3	10	15	15	60	-	-	100	3
MEU502	Dynamics of Machines	3	-	-	3	10	15	15	60	-	-	100	3
MEU503	Machining Processes	3	-	-	3	10	15	15	60	-	-	100	3
MEU504	Metrology and Measurement system	4	-	-	4	10	15	15	60	-	-	100	4
MEU505	Hydraulic Machines	3	-	-	3	10	15	15	60	-	-	100	3
MEU506	Machine Design-I Lab.	-	-	2	2	-	-	-	-	25	-	25	1
MEU507	Dynamics of Machines Lab.	-	-	2	2	-	-	-	-	25	25	50	1
MEU508	Machining Processes Lab.	-	-	2	2	-	-	-	-	25	25	50	1
MEU509	Metrology Measurement Systems	-	-	2	2	-	-	-	-	25	25	50	1
MEU510	Hydraulic Machine Lab	-	-	2	2	-	-	-	-	25	25	50	1
MEU511	Self study -I	-	-	-	-	25	-	-	-	-	-	25	2
		16	**0**	**10**	**26**	**75**	**75**	**75**	**300**	**125**	**100**	**750**	**23**
Semester – VI													
MEU601	Operation Research Management	3	-	-	3	10	15	15	60	-	-	100	3
MEU602	Machine Design-II	3	-	-	3	10	15	15	60	-	-	100	3
MEU603	Heat Transfer	3	-	-	3	10	15	15	60	-	-	100	3
MEU604	Control Systems Engineering	3	-	-	3	10	15	15	60	-	-	100	3
MEU605	Industrial Management and Quality	3	-	-	3	10	15	15	60	-	-	100	3
MEU606	Computational Lab.	-	-	2	2	-	-	-	-	25	25	50	1
MEU607	Machine Design – II Lab.	-	-	2	2	-	-	-	-	25	-	25	1
MEU608	Heat Transfer Lab.	-	-	2	2	-	-	-	-	25	25	50	1
MEU609	Control Systems Engineering Lab.	-	-	2	2	-	-	-	-	25	25	50	1
MEU610	Minor Project	-	-	2	2	-	-	-	-	25	25	50	2
MEU611	Self Study-II	-	-	-	-	25	-	-	-	-	-	25	2
MEU612	Industrial Lecture - I	1	-	-	1	-	-	-	-	-	-	-	-
		16	**0**	**10**	**26**	**75**	**75**	**75**	**300**	**125**	**100**	**750**	**23**

The ESE (Theory) duration for all courses shall be 2hrs 30 min except courses MEU101, MEU501 and MEU602 for which the ESE duration will be 3hrs.

ICA - Internal Continuous Assessment; ESE - End Semester Examination

Assessment of course MEU612 Industrial Lecture -I is scheduled in VII semester with course MEU711 Industrial Lecture - II

The course MEU511 Self Study-I is based on the basis of 20% curriculum of the courses MEU502, MEU503, MEU504 and MEU505 declared by the respective course coordinator at the beginning of the semester

The course MEU611 Self Study-II is based on the basis of 20% curriculum of the courses MEU601, MEU603, MEU604 and MEU605 declared by the respective course coordinator at the beginning of semester

One Faculty member shall be appointed as Course Coordinator for the course Self Study and his/ her teaching workload shall be considered as 01 hr per week

Government College of Engineering, Amravati

Mechanical Engineering Department

SCHEME FOR VII and VIII Sem. B. Tech. (Mechanical Engineering) from academic year 2014-2015

Course Code	Name of the Course	Teaching Scheme (Hrs./week)				Evaluation scheme							Credits
						Theory				Practical			
		L	T	P	Total	TA	CT1	CT2	ESE	ICA	ESE	Total	
Semester – VII													
MEU701	Refrigeration and Air Conditioning	3	-	-	3	10	15	15	60	-	-	100	3
MEU702	Computer Aided Design	3	-	-	3	10	15	15	60	-	-	100	3
MEU703	Elective-I	3	-	-	3	10	15	15	60	-	-	100	3
MEU704	Institute Level Elective	3	-	-	3	10	15	15	60	-	-	100	3
MEU705	Refrigeration and Air Conditioning Lab	-	-	2	2	-	-	-	-	25	25	50	1
MEU706	Computer Aided Design Lab.	-	-	2	2	-	-	-	-	25	25	50	1
MEU707	Elective-I Lab.	-	-	2	2	-	-	-	-	25	25	50	1
MEU708	Project Stage-I	-	-	4	4	-	-	-	-	50	-	50	2
MEU709	Seminar	-	-	2	2	-	-	-	-	50	-	50	1
MEU710	Industrial Training / Visit	-	-	-	-	-	-	-	-	50	-	50	2
MEU711	Industrial Lecture - II	1	-	-	1	-	-	-	-	25	-	25	1
MEU712	Self Study-III	-	-	-	-	25	-	-	-	-	-	25	2
		13	**0**	**12**	**25**	**65**	**60**	**60**	**240**	**250**	**75**	**750**	**23**
Semester – VIII													
MEU801	Internal Combustion Engines	3	-	-	3	10	15	15	60	-	-	100	3
MEU802	Mechatronics	3	-	-	3	10	15	15	60	-	-	100	3
MEU803	Elective-II	3	-	-	3	10	15	15	60	-	-	100	3
MEU804	Elective-III	3	-	-	3	10	15	15	60	-	-	100	3
MEU805	Internal Combustion Engines Lab.	-	-	2	2	-	-	-	-	25	25	50	1
MEU806	Mechatronics Lab.	-	-	2	2	-	-	-	-	25	25	50	1
MEU807	Elective-III Lab.	-	-	2	2	-	-	-	-	25	25	50	1
MEU808	Project	-	-	6	6	-	-	-	-	75	100	175	6
MEU809	Self Study-IV	-	-	-	-	25	-	-	-	-	-	25	2
		12	**0**	**12**	**24**	**65**	**60**	**60**	**240**	**150**	**175**	**750**	**23**

The ESE (Theory) duration for all courses shall be 2hrs 30 min except courses MEU101, MEU501 and MEU602 for which the ESE duration will be 3hrs.

ICA – Internal Continuous Assessment; ESE – End Semester Examination

Assessment of course MEU612 Industrial Lecture -I is scheduled in VII semester with course MEU711 Industrial Lecture - II

The course MEU712 Self Study-III is based on the basis of 20% curriculum of the courses MEU701, MEU702 and MEU703 declared by the respective course coordinator at the beginning of the semester

The course MEU809 Self Study-IV is based on the basis of 20% curriculum of the courses MEU801, MEU802, MEU803 and MEU804 declared by the respective course coordinator at the beginning of semester

One Faculty member shall be appointed as Course Coordinator for the course Self Study and his/ her teaching workload shall be considered as 01 hr per week

Students of this department will select any one Interdisciplinary Elective offered by other other departments. Interdisciplinary Elective shown below will be offered to the students of other departments.

MEU704(E) Interdisciplinary Elective Foundation skills in Integrated Product Development (FSPID) shall also available to Mechanical Engineering students along with students of other departments.

Sr. No.	MEU703 ELECTIVE-I	MEU704 INTERDISCIPLINARY ELECTIVE	MEU803 ELECTIVE-II	MEU804 ELECTIVE-III
A	New and Renewable Energy Sources	Quality System Engineering	Power Plant Engineering	Automobile Engineering
B	Tool Engineering	Human Resource Management	Production Management	Mechanical Vibrations
C	Experimental Stress Analysis	Entrepreneurship Development	Machine Tool Design	Finite Element Method
D		Thermal Engineering	Lean Manufacturing	Computer Integrated Manufacturing Systems
E		Foundation skills in Integrated Product Development (FSIPD)		

MEU701 REFRIGERATION AND AIR CONDITIONING

Teaching Scheme: 03 L + 00 T **Total : 03** **Credit : 03**
Evaluation Scheme: 15 CT1 + 15 CT2 + 10 TA + 60 ESE **Total marks : 100**
Duration of ESE: 2 hrs. 30 min.

Course Objectives:

I. Identify basic refrigeration methods and their applications
II. Explain the standard cycles referred for refrigeration
III. Describe the working principle of multiple components refrigeration systems
IV. Explain different refrigerant properties &designation of refrigerants
V. Describe construction, working and applications of air-conditioning systems
VI. Explain the concept of psychometry and psychometric terms
VII. Understand the basic steps for Air-conditioning system design

Introduction: History, methods and applications of refrigeration; Types and applications of air conditioning systems; current status and future trends; air cycle refrigeration systems
Vapour compression refrigeration (VCR) systems: Analysis of simple VCR system; Use of *p-h* and *T-s* charts; Effect of operating conditions such as condenser and evaporator pressure, superheating and sub-cooling; Actual VCR system
Refrigerants: Classification, desirable properties and designation of refrigerants; merits and demerits of commonly used refrigerants
Multi pressure vapour compression systems: classification; compound compression systems, multi-evaporator systems, individual and multiple expansion valves
Vapour absorption systems: Simple vapour absorption cycle; practical absorption systems, comparison of vapour compression and absorption cycles
Refrigeration system components and controls: Brief description of compressors, condensers, evaporators, defrosting methods, expansion devices, accessories and refrigeration controls
Psychrometry of air conditioning processes: Properties of moist air; Psychrometric chart, Psychrometric processes, Psychrometric processes related to air conditioning
Air conditioning systems: Unitary system, window type and split type air conditioning; Central system: direct expansion system, all water and all air systems; winter, summer and year round air conditioning
Heating and cooling load calculations: Basic considerations, heat gain/losses, sensible and latent, heating load estimates, sensible heat factor, bypass factor, apparatus dew point

Text Books

1. Heat Refrigeration and air conditioning, Ahmadul Ameen, Prentice Hall of India, New Delhi, 2006
2. Text Refrigeration and air conditioning, C P Arora, Tata McGraw-Hill, 2nd edition, 2003

Reference Books:

1. Refrigeration and air conditioning, W F Stoecker, JW Jones, McGraw-Hill, 1982
2. The ASHRAE Handbooks with CDs, 2005-2008
3. Refrigeration and Air Conditioning Technology, Tomczyk, J. A., Whitman, W. C., Johnson, W. M., Pub: Delmar S. Africa, 4th edition, 2000.

Course Outcomes: After completion of course, student will be able to:
MEU701.1. Analyze the basic refrigeration system components problems and suggest suitable remedies
MEU701.2. Design the proper type of multiple component refrigeration system as per given requirement
MEU701.3. Select the proper type of refrigerant for suitable application
MEU701.4. Implement general safety norms in refrigeration and Air-conditioning industry
MEU701.5. Evaluate the required parameters for Air-conditioning system from given design data

MEU702 COMPUTER AIDED DESIGN

Teaching Scheme	**: 03 L**	**Total = 03**	**Credit**	**: 03**
Evaluation Scheme	**: 15 CT1 + 15 CT2 + 10 TA + 60 ESE**		**Total Marks**	**:100**
Duration of ESE	**: 2 hrs. 30 min.**			

Course Objectives:

I. To learn about engineering design through the use of computer aided design (CAD) software and hardware.
II. To learn about graphical user interface, graphics systems and standards, different geometric modeling techniques like wire frame modeling, solid modeling etc.
III. To learn the fundamental concepts of the theory of the finite element method and to develop the skills needed to apply Finite Element Methods to Problems in Mechanical Engineering.
IV. To enable the students to formulate the design 1D and 2D Problems into FEA.

Fundamentals of CAD/CAM: Definition of CAD, implementation CAD, Design Process, Manufacturing Process, Application of computers for design, Benefits of CAD/CAM.

Computer Graphics Software: Display Devices, Ground rules for Graphics Software, The Software Configuration of a Graphics System, and Functions of a Graphics System, Constructing the Geometry, Transformation, Database Structure and Contents.

Automated Drafting: Configuration of typical drafting packages, layers, entities, editing, display commands, hatching, dimensioning, Text plotting, Script files, DXF and IGES files, blocks, Parametric programming, Customization of drafting packages and graphic standards.

Wire Frame, Surface and Solid Modeling: Modeling of curves and surfaces, Techniques of splining, cubic splines, Bezier splines Schemes for representing solid objects, Construction, Solid geometry and boundary representation, Feature of solid modeling packages.

Finite Element Methods: Introduction**,** Importance, and Applications of FEA, Fundamental concepts, Discrimination, Numbering, Stress strain equilibrium, Stress –Strain relationship, Boundary and support conditions, and general steps of finite element method.

1D/2D Problems: Coordinate and Linear Shape Functions, The potential energy approach, The Galerkin approach, The global stiffness matrix, Boundary conditions , Penalty and Elimination Methods, Quadratic Shape Functions, Constant Strain Triangle CST, Isoperimetric representations, Development of Truss equations, Introduction to FEA packages.

Text Books:

1. Computer Aided Design and Manufacturing , Groover,M.P., Prentice-Hall of India , 5th Edition ,2005
2. CAD/CAM Theory and Practice, Zeid Ibrahim, Tata McGraw Hill,4th edition,2001.
3. An Introduction to the Finite element Methods, Reddy, J.N., Tata McGraw Hill, 3rd Edition, 2005

Reference Books:

1. Automation Production Systems and Computer Integrated Manufacturing, Groover, M. P., Prentice-Hall of India, 2nd Edition.
2. CNC Machines , Pabla, B.S., New Age International Publications,1st Edition , Reprint 2005.
3. CAD/CAM Principals and Applications, Rao, P.N. Tata McGraw Hill, 2002.

Course Outcomes: After completion of course, student will be able to:
MEU702.1. Acquire the Knowledge of data bases, software s and hardware's for computer design and the concepts of surface modeling, wire frame modeling, solid modeling.
MEU702. 2.Able to obtain an understanding of the fundamental theory of the FEA method.
MEU702.3. Able to formulate simple design problems into finite elements.

MEU703 ELECTIVE - I

(A) NEW AND RENEWABLE ENERGY SOURCES

Teaching Scheme: 03 L + 00T **Total: 03** **Credits: 03**
Evaluation Scheme: 15 CT1 + 15 CT2 + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2hrs.30 min.

Course Objectives:

I. To provide students an overview of global energy resources.
II. To introduce students to Wind Energy, Tidal and Ocean Energy, Geothermal Energy and Magneto Hydrodynamics, Nuclear Energy and solar energy.
III. To expose students to future energy systems and energy use scenarios with a focus on promoting the use of renewable energy resources and technologies.

Principles of solar radiation: Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

Solar energy collection: Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

Solar energy storage and applications: Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating, cooling techniques, solar distillation and drying, photovoltaic energy conversion.

Wind Energy: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria.

Bio-Mass: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, ICEngines operation on Bio-mass and their economic aspects.

Geothermal Energy: Resources, types of wells, methods of harnessing the energy, potential in India.

Ocean Energy: Ocean Thermal Energy Conversion, Principles utilization, setting of Ocean Thermal Energy Conversion plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.

Direct Energy Conversion: Need for direct energy conversion, Carnot cycle and its limitations, principles of direct energy conversion. Thermo-electric generators, see-beck, Peltier and Joule-Thomson effects, Figure of merit, materials, applications, MHD generators, principles, dissociation and ionization, hall effect, magnetic flux, MHD accelerator, MHD Engine, power generation systems, electron gas dynamic conversion, economic aspects. Fuel cell principle, Faraday's law, thermodynamic aspects, selection of fuels and operating conditions.

Text Books:

1. Fundamentals of Renewable Energy Resources, G. N.Tiwari and M. K. Ghosal, Narosa Publishing House, 2007
2. Solar Energy, Sukhatme, 3rd Edition, Tata McGraw-Hill Education, 2008

Reference Book:

1. Renewable Energy Resources, John Twidell & Anthony D. Weir, 2nd Edition, Taylor & Francis, 2006
2. Thermal Energy, Mahesh Rathore, Tata McGraw-Hill Education, 2010
3. Principles of Solar Energy, D. Yogi Goswami, Frank Krieth & John F Kreider, 2nd Edition, Taylor & Francis, 2000
4. Non-Conventional Energy, Ashok V Desai, Wiley Eastern Ltd. New Delhi, 2003
5. Non-Conventional Energy Systems, K. Mittal, Wheeler Publishing, 1997
6. Renewable Energy Technologies, R. Ramesh, K. Uday Kumar, M. Anandakrishnan, Narosa Publishing House, 1997
7. Non-Conventional Energy Sources, G.D. Rai, 4th Edition, Khanna publishers, 2009

Course Outcomes: After completion of course, student will be able to:

MEU703A.1 Identify renewable energy sources and their utilization.

MEU703A.2 Understand the basic concepts of solar radiation and analyze the working of solar PV and thermal systems.

MEU703A.3 Understand principles of energy conversion from alternate sources including wind, geothermal, ocean, biomass, biogas and hydrogen.

MEU703A.4 Understand the concepts and applications of fuel cells, thermoelectric convertor and MHD generator.

MEU703A.5 Identify methods of energy storage for specific applications.

MEU703 ELECTIVE - I
(B) TOOL ENGINEERING

Teaching Scheme: 03 L + 00 T **Total: 03** **Credits: 03**

Evaluation Scheme: 15 CT1 + 15 CT2 + 10 TA + 60 ESE **Total Marks: 100**

Duration of ESE: 2hrs.30 min.

Course Objectives:

I. The course provides students with fundamental knowledge and principles in material removal processes.
II. In this course, the students apply the fundamentals and principles of metal cutting to practical applications through multiple labs using lathes, milling machines, grinding machines, and drill presses, Computer Numerical Control etc.
III. To demonstrate the fundamentals of machining processes and machine tools.
IV. To develop knowledge and importance of metal cutting parameters.
V. To develop fundamental knowledge on tool materials, cutting fluids and tool wear mechanisms.
VI. To apply knowledge of basic mathematics to calculate the machining parameters for different machining processes.

Tool materials and Heat treatment: Properties of tool materials, ferrous tooling materials, Nonferrous tooling materials, nonmetallic tooling materials, heat treatment, factors affecting heat treating

Cutting Tools:

Single point cutting tool: Geometry, classification, nomenclature, Design

Twist drill and Reamers: Geometry, types, cutting force, power, and torque

Broach: Introduction and geometry of broach, designing of broach, cutting force and Power

Milling Cutter: Geometry of plain milling cutter, types of milling cutters, forces acting on plain milling cutter

Threaded cutting tools: geometry of tap and dies

Press Tools: Classification of presses, Press characteristics, safety devices, principles of feeding and unloading, Design principals of presses

Design of Dies: Types of dies, shear in die cutting operation, clearance, cutting forces, shear on punch and die, Design of: blanking dies, piercing dies, bending dies, and drawing dies.

Jigs and Fixtures: classification, fundamental principles and applications, Location and clamping: principle of location, different types of locators and clamps, Simple design for drilling jigs and milling fixtures etc, Indexing of jigs and fixture.

Text Books:

1. Fundamentals of Metal Cutting & M/c Tools, Juneja B. L., Sekhon G. S. and Seth Nitin, 2nd Edition New Age Int. Publishers, 2008
2. Tool Design, Donaldson, C., LeCain G. H. and Goold V. C., 3rd Edition, Tata McGraw Hill, 2006

Reference Book:

1. Fundamental of Tool Engineering, Basu, Mishra and Mukharjee, 2nd Edition, Oxford and IBH Publishing Co., 2007
2. Metal Cutting Theory and Practice, Bhattacharya, A, 2nd Edition, Central Book Publisher, 2008

Course Outcomes: After completion of course, student will be able to:

MEU703 1. Apply cutting mechanics to metal machining based on cutting force and power consumption.

MEU703 2. Operate lathe, milling machines, drill press, grinding machines, etc.

MEU703 3. Select cutting tool materials and tool geometries for different metals.

MEU703 4. Select appropriate machining processes and conditions for different metals.

MEU703 ELECTIVE - I
(C) EXPERIMENTAL STRESS ANALYSIS

Teaching Scheme: 03 L + 00 T **Total: 03** **Credits: 03**

Evaluation Scheme: 15 CT1 + 15 CT2 + 10 TA + 60 ESE **Total Marks: 100**

Duration of ESE: 2hrs.30 min.

Course Objectives:

I. To study Stress analysis utilizing experimental techniques including transmission photo elasticity, strain gauges, digital image correlation for 2D (planar) surfaces, digital image correlation for 3D objects

II. To study the basic concepts in optics including imaging principles and their use in computer vision. Basic concepts in coherent optics in stress analysis with emphasis on engineering applications

Basic equations in elasticity: state of strain, brittle coating method, and crack patterns produced by direct loading, refrigeration method, releasing method, effect of coating thickness and environment

Photoelasticity methods: behavior of light, plane polarized and circular polariscope, isochromatic and isoclinic fringe patterns for two dimensional photoelasticity, three dimensional photoelasticity, model slicing and shear difference method, birefringent coating method.

Strain measurement methods: types of gauges, electric strain gauge, strain rosette analysis, three element, delta, four element rosette, strain gauge circuits and recording instrument.

Moire fringe technique: surface strain measurements and flexural studies. Grid analysis. X-ray techniques and holography, Motion measurements.

Text Books:

1. Experimental Stress Analysis, Dove and Adam, Tata McGraw Hill Publications, Third edition Reprint 2004.
2. Experimental Stress Analysis, Dally and Riley, Tata McGraw Hill Publications Fourth edition 2006.

Reference Books:

1. Modern Experimental Stress Analysis, Doyle James, Johan Wiley Publications First edition 2007

Course Outcomes: After completion of course, student will be able to:
MEU703C.1 Understand the overall concepts of stress/strain analysis by experimental means.
MEU703C.2 Demonstrate a basic understanding of experimental methods (e.g. strain gages, photoelasticity, image correlation) commonly used in experimental solid mechanics.
MEU703C.3 Acquire the knowledge on Brittle and bi-refrigent coatings and working of strain gauges.
MEU703C.4 Demonstrate the ability to analyze experimental data and develop appropriate, logical conclusions based on comparisons to theoretical results and other experimental evidence.

MEU704 INTERDISCIPLINARY ELECTIVE
(A) QUALITY SYSTEM ENGINEERING

Teaching Scheme: 03 L + 00 T **Total: 03** **Credits: 03**
Evaluation Scheme: 15 CT1 + 15 CT2 + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2hrs.30 min.

Course Objectives:

I. To learn various types of Inspection methods in industries
II. To understand Selection of quality inspection methodology
III. To understand Reliability factor for each component

Introduction

Meaning of quality, evolution of quality, importance of quality, quality of design, quality of conformance, quality of Assurance, reliability, and maintainability.

Inspection
Types of inspection : 100% inspection and Sampling inspection , Advantages and limitations of sampling inspection, Introduction to Operating Characteristic (OC) curve, AQL, LTPD, Producers' risk, Consumers' risk, Types of sampling plan: single, double, multiple sampling plan.

Statistical Quality Control
Meaning, importance, chance causes, and assignable causes, control chart for variables: X bar and R-chart, control charts for attributes: p-chart and c-chart, introduction to process capability.

Quality Assurance
Meaning, advantages, stages of assurance, quality audit, quality circle.

Quality-Systems Economics
Cost of quality: costs of prevention, costs of appraisal, costs of failures, value of cost.

Quality systems
ISO9000 series standard: ISO 9000, ISO 9001, ISO 9002, ISO 9003, ISO 9004, Total Quality Management: meaning, principles, and characteristics

Text Books:

1. Statistical Quality Control, E. L. Grant, R.S. Leavenworth 6th Edition, Tata Mc Graw Hill, 2005
2. Quality Control and TQM, P.L. Jain, 6th Edition, Tata Mc Graw Hill, 2001

Reference Book:

1. Quality Handbook, J.M. Juran, 4th Edition, Tata Mc Graw Hill, 2005
2. Quality Control, TTTI Madras, 11th Edition, Tata Mc Graw Hill, 2005

Course Outcomes: After completion of course, student will be able to:
MEU704.1 Explain meaning of quality and its influence
MEU704.2 Describe, distinguish and use statistical tools of quality management
MEU704.3 Describe ISO standards and principles of TQM
MEU704.4 Describe the working of quality audit and apply the concept of quality circle

MEU704 INTERDISCIPLINARY ELECTIVE
(B) HUMAN RESOURCE MANAGEMENT

Teaching Scheme: 03 L +00T **Total: 03** **Credit: 03**
Evaluation Scheme: 15 CT1 + 15 CT2 + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2 hrs. 30 min.

Course Objectives:

Introduction: Evolution of Human Resources Management (HRM), human capital management, comparison of HCM, PM, HRM, factors affecting HRP, scope of HRM in industries, HR issues for integrating new technologies, internal forces, organizational culture and conflict, personal productivity through motivation.

Human Resources Management: Integrating HR strategy with business strategy, strategic HRM and conventional HRM, barriers to strategic HRM, model of strategic HRM, strategy formulation and integration, relation of Job satisfaction with work behavior.

Human Resources Planning: Potential uses of HRP, career planning, career management framework, group behavior and the dynamics of interpersonal influence, personality and stress management.

Recruitment, Selection and Performance Appraisal: Introduction, objectives, different models and methods of selection and assessment, techniques of human resources demand forecasting, HRD audit process¬ human resource accounting and information system¬ HRM strategic development, personal records, promotion policies, transfers..

Wage Administration & Wage Policy : Goal setting and self¬ efficacy; job design practices; performance evaluation, reinforcement theory, rewards , employment fringe benefits, industrial relations, personnel motivation, industrial relations and industrial disputes – some case studies on current issues.

Text Books:

1. Personnel Management and Industrial Relations, R.S. Davar, Vikas Pub. House Pvt..Ltd. New Delhi, 2001 edition
2. Personnel Management, E.B. Filippo, Hill Education India Ltd. New Delhi, 2005 edition.

Reference Books:

1. Essentials of Management,, Koontz, Harold, McGraw Hill Education India Ltd. New Delhi, 2009 edition.
2. Purchasing and Materials Management, Gopalkrishnan, McGraw Hill Education India Ltd. New Delhi, 2010 edition.
3. Human Resource Management, Gary Dessler, Prentice Hall New Delhi, 2009 edition
4. Wayne Cascio, Ranjeet Nambudiri, Managing Human Resources: Productivity, Quality of Work Life, Profits, McGraw-Hill Education, New Delhi 2010.

Course Outcomes: After completion of course, student will be able to:

MEU704 INTERDISCIPLINARY ELECTIVE
(C) ENTREPRENEURSHIP DEVELOPMENT

Teaching Scheme: 03 L+00T **Total :03** **Credit: 03**
Evaluation Scheme: 15 CT1 + 15 CT2 + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2 hrs. 30 min.

Course Objectives:

I. To develop solid understanding of business and management
II. To develop critical thinking in students for data collection, interpretation and analysis
III. To develop effective communication and interaction skills
IV. To develop global perspective so as to understand the impact of globalization on business operations, opportunities and challenges
V. To understand the basics of finance, banking regulations, taxation and various financial support mechanisms for SME sector

Introduction: Concept, characteristics, types of entrepreneurs, Entrepreneurial traits, true motivation and leadership, understanding of Entrepreneurial process, women entrepreneurs and problems, rural entrepreneurship, factors affecting entrepreneurship, entrepreneurship development agencies and their role in encouraging entrepreneurship, entrepreneurship in Indian scenario, future prospects in India and emerging economies..

Start up of Small Business: Relationship between SSIs and large scale industries, objectives of entrepreneurship in industries, project identification and selection, criteria of selection, project appraisal, different types of ownership structures and some case studies.

Institutional Finance to Entrepreneurs : Various financing institutions and their mechanisms of financing to various enterprises **,** taxation benefits to SSIs, government policies for SSIs, industrial sickness and methods of avoiding industrial sickness.

Inventory and Working Capital Management: Types of inventories, objectives, make or buy decision, simple models of inventory management, working capital objectives, simple numerical examples on inventory management and working capital management in SSIs.

International Marketing: Scope of international marketing for SSIs, documents, procedures of export business, E- commerce, problems of international marketing, government schemes and policies for export marketing for SSIs, some case studies.

Text Books:

1. Patterns of Entrepreneurship, J.M. Kaplan, John Wiley & Sons (Asia), Pvt. Ltd. Singapore, 2010 edition
2. Entrepreneurship Development, S.S. Khanka,, S. Chand & Sons, New Delhi ,2010 edition

Reference Books:

1. Koontz, Harold, Essentials of Management,, McGraw Hill Education India Ltd. New Delhi, 2009 edition.
2. Gopalkrishnan, Purchasing and Materials Management, McGraw Hill Education India Ltd. New Delhi, 2010 edition.
3. Services Marketing and Management, B. Balaji, S. Chand & Sons, New Delhi, 2009 edition

Course Outcomes: After completion of course, student will be able to:

MEU704C.1 Demonstrate strong understanding of business environment, regulations and management

MEU704C.2 Analyze critically the relevant data to strategize business policies in accordance with the market trends

MEU704C.3 Interact effectively with all stakeholders through strong communication skills
MEU704C.4 Understand and analyze the current market trends to be able to develop global perspective for business growth
MEU704C.5 Develop financial acumen required of a successful entrepreneur

MEU704 INTERDISCIPLINARY ELECTIVE
(D) THERMAL ENGINEERING

Teaching Scheme: 03 L + 00 T **Total: 03** **Credits: 03**
Evaluation Scheme: 15 CT1 + 15 CT2 + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2hrs.30 min.

Course Objectives:

I. Understand thermal related basic components and their uses
II. Explain the different thermodynamic processes
III. Explain the working principles of IC engines, Boiler, condensers, & jet-propulsion
IV. Understand construction, working and applications of centrifugal and reciprocating compressors
V. Explain working and applications of Gas turbine turbines and air compressor
VI. Understand the need & types of non-conventional energy sources

Basic concepts and properties: introduction, thermodynamic system, control volume, macroscopic and microscopic approaches, properties of a system, continuum, state and equilibrium, processes and cycles, quasi-static process, point and path functions, steady flow process, energy concept, Properties of Pure Substances and ideal gas. First law of thermodynamics, second law of thermodynamics.

Steam power plant: Steam power cycle, reheat, regenerative cycles, analysis, layout of steam power plant, , Steam generators, flow through nozzles, critical pressure ratio and choked flow, nozzle efficiency, determination of throat and exit areas, concept of super saturated flow and Wilson line (no numerical), type of steam turbines, Types of steam turbines, Compounding, Velocity diagrams. Graphical and analytical methods for work and power developed, Turbine governing and control, need of a condenser and its types, quantity of cooling water required, condenser and vacuum efficiency. Sources of air in condensers and its effect on performance, concept of co-generation

Air Compressors: Industrial uses of compressed air, types of compressor, Methods of compression and efficiencies of compression, clearance volume and its effect on work done and volumetric efficiency, condition for minimum work, Intercooling and its effects..

I.C. Engines: Classification of I.C. engines, General description of Petrol and Diesel engine, working, performance parameter and characteristic, Gas Turbines, Closed cycle and open cycle plant arrangement, advantages, Effect of reheating, Performance of Gas turbine power plant. Components of GT power plant. Introduction to jet propulsion, Ramjet, turbojet.

Refrigeration and Air conditioning: Vapor compression Refrigeration and COP, vapor absorption refrigeration. Air conditioning: classification and applications. Psychometric charts elementary treatment with simple problems.

Non conventional energy sources: Introduction to non conventional energy sources i.e. Solar, Wind, Tidal & Ocean, Geothermal energy and Magneto Hydrodynamics, its advantages, disadvantages.

Text Books

1. Thermal Engineering by Mahesh M Rathore, 3rd Edition, Tata Mc-Graw Hill, 2010
2. Power Plant Engineering, P.K. Nag, 3rd Edition, Tata Mc-Graw Hill Publishing, 2008.

Reference Books:

1. Gas Turbines, V Ganesan, 3nd Edition, Tata McGraw Hill, 2010.
2. Thermodynamics-An Engineering Apporach, Y. A. Cengel and M. A. Boles, 3rd Edition, Mc-Graw Hill, 1998.
3. Refrigeration and air conditioning, C P Arora, Tata McGraw-Hill, 2nd edition, 2003

Course Outcomes: After completion of course, student will be able to:

MEU704D.1 Rectify basic thermal engineering components problems and their suggest suitable remedies

MEU704D.2 Select the proper type of IC engines, Boiler, condensers, Gasturbine for engineering applications

MEU704D.3 Identify the right types of Gasturbine turbines and air compressor

MEU704D.4 Implement general safety norms in mechanical engineering industries

MEU704D.5 Demonstrate common troubles / problems in IC engines, Boiler, condensers, Gasturbine turbines and air compressor

MEU704 INTERDISCIPLINARY ELECTIVE

(E) FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT (FSIPD)

Teaching Scheme: 03 L + 00 T **Total: 03** **Credits: 03**

Evaluation Scheme: 15 CT1 + 15 CT2 + 10 TA + 60 ESE **Total Marks: 100**

Duration of ESE: 2hrs.30 min.

Course Objectives:

I. Explain the effects of various trends on product decision

II. Understand PESTLE analysis

III. Get an overview of various types of products and services

IV. Explore through different product development methodologies

Fundamentals of Product Development:

Global Trends Analysis and Product decision: Types of various trends affecting product decision - Social Trends (Demographic, Behavioral, Psychographic), Technical Trends (Technology, Applications, Tools, Methods), Economical Trends (Market, Economy, GDP, Income Levels, Spending Pattern, target cost, TCO), Environmental Trends (Environmental Regulations and Compliance), Political/Policy Trends (Regulations, Political Scenario, IP Trends and Company Policies); PESTLE Analysis.

Introduction to Product Development Methodologies and Management: Overview of Products and Services (Consumer product, Industrial product, Specialty products etc); Types of

Product Development (NPD/ Re-Engineering (Enhancements, Cost Improvements)/ Reverse Engineering/ Design Porting & Homologation); Overview of Product Development methodologies (Over the Wall/ Waterfall/ V-Model/ Stage-Gate Process/ Spiral/Systems Engineering/ Agile); Product Life Cycle (S-Curve, Reverse Bathtub Curve); Product Development Planning and Management (Budgeting, Risk, Resources and Design Collaboration, Scheduling, Change Management, Product Cost Management).

Requirements and System Design

Requirement Engineering: Types of Requirements (Functional, Performance, Physical, Regulatory, Economical, Behavioral, Technical, Stakeholder, Environmental, Industry specific, Internal-Company Specific); Requirement Engineering (Gathering (VOC), Analysis (QFD), Design Specification); Traceability Matrix and Analysis; Requirement Management.

System Design & Modeling: Introduction to System Modeling; System Optimization; System Specification; Sub-System Design; Interface Design.

Design and Testing

Conceptualization: Industrial Design and User Interface Design; Introduction to Concept generation Techniques; Concept Screening & Evaluation - Concept Design, S/W Architecture, Hardware Schematics and simulation.

Detailed Design: Component Design and Verification; High Level Design/Low Level Design of S/W Programs, S/W Testing; Hardware Schematic, Component design, Layout and Hardware Testing.

Prototyping: Types of Prototypes (Mockups, Engineering Assessment Prototype, Alpha, Beta, Gama); Introduction to Rapid Prototyping and Rapid Manufacturing.

System Integration, Testing, Certification and Documentation: Manufacturing/Purchase and Assembly of Systems; Integration of Mechanical, Embedded and S/W systems; Introduction to Product verification processes and stages – Industry specific (DFMEA, FEA, CFD); Introduction to Product validation processes and stages - Industry specific (Sub-system Testing/ Integration Testing/ Functional Testing/ Performance Testing / Compliance Testing); Product Testing standards and Certification – Industry specific; Product Documentation (Compliance Documentation, Catalogue, Brochures, user manual, maintenance Manual, Spares Parts List, Warranty, Disposal Guide, IETMS, Web Tools).

Sustenance Engineering and End-of-Life (EoL) Support

Sustenance: Maintenance and Repair; Enhancements.

Product EoL: Obsolescence Management; Configuration Management; EoL Disposal.

Business Dynamics – Engineering Services Industry

The Industry: Engineering Services Industry – overview; Product development in Industry versus Academia.

The IPD Essentials: Introduction to vertical specific product development processes; Product development Trade-offs; Intellectual Property Rights and Confidentiality; Security and configuration management.

Note: The course material for the subject will be provided by NASSCOM

Course Outcomes: After completion of course, student will be able to:
MEU704E.1 Analyze various global trends and decide on the scope of a new product
MEU704E.2 Identify requirement engineering and know how to collect, analyze and arrive at Requirements for new product development and convert them in to design specification
MEU704E.3 Identify system modeling for system, sub-system and their interfaces and arrive at The optimum system specification and characteristics
MEU704E.4 Develop prototype plan and coordinate the respective activities with prototype Manufacturing facility.

MEU705 REFRIGERATION AND AIR CONDITIONING LAB

Teaching Scheme: 02P **Total : 02** **Credit: 01**
Evaluation Scheme: 25 ICA + 25 ESE **Total marks: 50**
Duration of ESE: 3 hrs.

Course Outcomes:

I. Identify the basic components of vapour compression refrigeration system
II. Explain the methodology adopted for the evaluation of COP
III. Explain the working principle of various refrigeration systems components
IV. Describe construction, working and applications of air-conditioning systems
V. Understand the location of various air conditioning system components
VI. Understand various controls of refrigeration and air conditioning systems

It is representative list of practical. The instructor may choose minimum **Six** experiments as per his/her requirement (so as to cover entire content of course MEU701 Refrigeration and Air conditioning) from the list given below

Minimum Six experiments should be performed:

1. Determination of COP of simple vapor compression system
2. Determination of Capacity of ice plant
3. Determination of temperature drop by desert cooler
4. Determine the capacity of water cooler
5. Determination of COP of Electrolux system
6. Determination of temperature separation by vortex tube.
7. Performance of household refrigerator
8. Trial on air conditioning tutor system

9. Trial of window/ split air conditioner
10. Visit and study of cold storage plant
11. Demonstration of various controls of refrigeration and air conditioning systems.

ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A&B.

ESE: The end semester Exam for practical shall be based on performance in one of the experiments and may be followed by sample questions.

Course Outcomes: After completion of course, student will be able to:

MEU705.1.	Rectify basic refrigeration system components problems and their suggest suitable remedies
MEU705.2.	Perform experiments on Refrigeration & Air-conditioning experimental tutor/test rig.
MEU705.3.	Identify the location of various air conditioning system components & controls
MEU705.4.	Implement general safety norms in refrigeration and Air-conditioning industry
MEU705.5.	Suggest solutions to common problems in VCR systems through visit and case study of cold storage plants
MEU705.6	Evaluate the performance parameter (COP) from recorded data

MEU706 COMPUTER AIDED DESIGN LAB

Teaching Scheme: 02 P **Total: 02** **Credit: 01**

Evaluation Scheme: 25 ICA +25 ESE **Total Marks: 50**

Duration of ESE: 3 hrs.

Course Objectives:

I. To learn 3D modeling software packages and hardware components used in CAD/CAM systems.
II. To create sketches 2D and 3D drawing of machine components using product modeling software packages.
III. To learn introduction of FEA and study performance of FEA software for structural, thermal and flow analysis.

It is representative list of practical. The instructor may choose minimum **Six** experiments as per his/her requirement (so as to cover entire content of course MEU702 Computer Aided Design) from the list given below

1) Study and introductory training on 3-D Modeling software packages like CATIA, PROE, and SOLID EDGE etc.
2) Study of hardware components used in CAD/CAM System.

3) Creation of 2-D drawing (sketching) of any three machine components using 3-D product modeling software package.- 2 experiments
4) Creation of 3-D drawing of any two machine parts using 3-D product modeling software package.- 2 experiments
5) Creation of 3-D detailed part of any two sheet metal components using 3-D product modeling software package.
6) Creation of any one assembly design using 3-D product modeling software package.
7) Introduction to Finite Element Analysis
8) Study and performance on FEA software package for structural, Thermal and flow analysis.

ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A&B

ESE: The end semester Exam for practical shall be based on performance in one of the experiments and may be followed by sample questions

Course Outcomes: After completion of course, student will be able to:
MEU706.1. Use 3-D Modeling software packages like CATIA, PROE and SOLID EDGE etc,
MEU706.2. Create of 2-D and 3-D drawing (sketching) of machine components using 3-D product modeling software package.
MEU706.3. Create of 3-D detailed part of sheet metal components and assembly design using 3-D product Modeling software package.
MEU706.4. Perform basic structural, Thermal and flow analysis on FEA software package

MEU707 ELECTIVE – I LAB
(A) NEW AND RENEWABLE ENERGY SOURCES LAB

Teaching Scheme: 02P **Total : 02** **Credit: 01**
Evaluation Scheme: 25 ICA + 25 ESE **Total marks: 50**
Duration of ESE: 3 hrs.

Course Objectives:

I. To acquire skill to solar radiations
II. describe the solar heating system
III. Perceive the fundamental characteristic of PV system
IV. Focus on the economical aspect of renewable energy generation plant

It is representative list of practical’s. The instructor may choose experiments as per his/her requirements (so as to cover entire content of the course MEU703 (1) new and renewable energy sources lab) from the list or otherwise. Minimum 6 experiments should be performed:

1. Testing on measurement of global radiation.
2. Trial on a sunshine recorder.

3. Testing of a flat plate collector.
4. Testing on performance of wind mill.
5. Testing of a photovoltaic system.
6. Testing on concentrating collector.
7. Visit to wind mill and submission of report.
8. Visit to a Biogas plant and submission of report.
9. Trial on gasifier

ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A&B.

ESE: The end semester Exam for practical shall be based on performance in one of the experiments and may be followed by sample questions

Course Outcomes: After completion of course, student will be able to:
MEU707A.1 Measure bright sunshine hours and solar radiation
MEU707A.2 Determine and compare the performance of solar heating system
MEU707A.3 Estimate the characteristic of PV system
MEU707A.4 Focus on fundamental and economical aspect of renewable energy generation plant

MEU707 ELECTIVE – I LAB
(B) TOOL ENGINEERING LAB

Teaching Scheme: 02P **Total : 02** **Credit: 01**
Evaluation Scheme: 25 ICA + 25 ESE **Total marks: 50**
Duration of ESE: 3 hrs.

Course Objectives:

I. To demonstrate the fundamentals of machining processes and machine tools.
II. To develop knowledge and importance of metal cutting parameters.
III. To develop fundamental knowledge on tool materials, cutting fluids and tool wear mechanisms.
IV. To apply knowledge of basic mathematics to calculate the machining parameters for different machining processes.

It is representative list of practical. The instructor may choose minimum **Six** experiments as per his/her requirement (so as to cover entire content of course MEU703 (2) Tool Engineering) from the list given below:

1. Design and drawing of single point cutting tool.
2. Design and drawing of form tool.
3. Design and drawing of broach.
4. Measurement of cutting force in orthogonal cutting by Dynamometer.
5. Design and drawing of blanking die.

6. Design and drawing of bending die.
7. Design and drawing of jigs.
8. Design and drawing of fixtures.

ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A&B.

ESE: The end semester Exam for practical shall be based on performance in one of the experiments and may be followed by sample questions

Course Outcomes: After completion of course, student will be able to:

MEU707B.1 Apply cutting mechanics to metal machining based on cutting force and power consumption.

MEU707B.2 Operate lathe, milling machines, drill press, grinding machines, etc.

MEU707B.3 Select cutting tool materials and tool geometries for different metals.

MEU707B.4 Select appropriate machining processes and conditions for different metals.

MEU707 ELECTIVE – I LAB
(C) EXPERIMENTAL STRESS ANALYSIS LAB

Teaching Scheme: 02P **Total : 02** **Credit: 01**

Evaluation Scheme: 25 ICA + 25 ESE **Total marks: 50**

Duration of ESE: 3 hrs.

Course Objectives:

I. To identify the tools used for the stress analysis.
II. To explain the concept of photo elasticity
III. To describe photo elastic analysis of a Notched Specimen
IV. To describe photo elastic analysis of a Crack.

It is representative list of practical. The instructor may choose experiments as per his/ her requirement (so as to cover entire content of the course MEU703 (3) Experimental Stress Analysis) from the list or otherwise. Minimum six experiments should be performed:

1. Electrical Resistance Strain Gages.
2. Static Analysis of a Loaded Ring.
3. Thermoelastic Stress Analysis.
4. Introductory Photoelasticity.
5. Photoelastic Analysis of a Notched Specimen.
6. Photoelastic Analysis of a Crack.

ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A&B.

ESE: The end semester Exam for practical shall be based on performance in one of the experiments and may be followed by sample questions

Course Outcomes: After completion of course, student will be able to:

I. Utilize the tools used for the stress analysis.
II. Describe the concept of photo elasticity
III. Perform photo elastic analysis of a Notched Specimen
IV. Analyze photo elastic analysis of a Crack.

MEU708 PROJECT PHASE- I

Teaching Scheme: 04P **Total: 04** **Credits: 02**
Evaluation Scheme: 50 ICA **Total Marks: 50**

Course Objectives:

I. To collect information on novel and latest development in core and allied area of the subject.
II. To encourage the process of independent thinking and working together in a group.
III. To implement innovative ideas for social benefit.
IV. To develop a prototypes/models, experimental set-up and software systems.
V. To improve the ability of presentation skill and communication techniques.

1. In general, a group of 3-6 students should be allowed to complete the project on Approved topic.
2. Preferably more than 25 % projects shall be Industry / Research based / oriented.
3. Exhaustive survey of literature based on a clear definition of the scope and focus of the topic should be carried out by the students.
4. Students should finalize the topic for the project after literature survey in consultation with the Guide.
5. The Synopsis/Abstract on the selected topic should be submitted to the H.O.D. for approval.
6. On approval of the topic, students should initiate the topic based work.
7. Approximately more than 30% work(of the total quantum) should be completed by the end of VII semester.
8. At the end of semester, each batch should submit the progress report in following format:
   Title
   Introduction
   Concept
   Work completed
   Work to be completed

References

9. For uniform and continuous evaluation, the Evaluation Committee comprising of the Guide, Project Course Coordinator and Expert appointed by the Program Head will award the marks based on the work completed by the end of semester and the presentation based on the project work.

Note:

ICA: The Internal Continuous Assessment shall be based on the active participation of the students in the Project work and knowledge / skill acquired. Oral examination shall be conducted by the panel of examiners.

Course Outcomes: After completion of course, student will be able to:
MEU 708.1 Identify a topic in advanced areas of Mechanical Engineering.
MEU 708.2 Review literature to identify gaps and define objectives & scope of the work.
MEU 708.3 Generate and implement innovative ideas for social benefit.
MEU 708.4 Develop a prototypes/ models, experimental set-up and software systems necessary to meet the objectives.
MEU 708.5 Apply principles of ethics and standards, skill of presentation and communication techniques.

MEU709 SEMINAR

Teaching Scheme: 02P	**Total: 02**	**Credits: 01**
Evaluation Scheme: 50 ICA		**Total Marks: 50**

Course Objectives:

I. To collect information on novel and latest development in core and allied area of the subject.
II. To encourage the process of independent thinking and working together in a group.
III. To implement innovative ideas for social benefit.
IV. To develop the ability to describe, interpret and analyze technical issues.
V. To improve the ability of presentation skill and communication techniques.

1. Student shall select a topic for seminar which is not covered in curriculum.
2. Topics shall be registered within a month after beginning of VII Semester and shall be approved by the concerned guide and Program Head.
3. Students should know the functional and technical details of selected topic after carrying out the conceptual study.
4. Before the end of semester, student shall deliver a seminar and submit the seminar report in following format:
   Introduction
   Literature Survey
   Concept

Functional and Technical Details
Future scope
Applications
Comparison with similar topics / methods
References

5. Student shall deliver a seminar based on submitted report. The presentation and oral examination on selected seminar topic shall be assessed by panel of examiners

Note:
ICA: The Internal Continuous Assessment shall be based on the active participation of the students in the Seminar Topic and the knowledge acquired. The seminar shall be assessed by the examiner panel consisting of Project Guide, Course Coordinator Seminar and Expert appointed by Program Head.

Course Outcomes: After completion of course, student will be able to:
MEU709.1 Identify and compare technical and practical issues related to the area of course specialization.
MEU709.2 Outline interpreted bibliography of research demonstrating scholarly skills.
MEU709.3 Prepare a well organized report employing elements of technical writing and critical thinking.
MEU709.4 Demonstrate the ability to describe, interpret and analyze technical issues.
MEU709.5 Apply principles of ethics and standards, skill of presentation and communication techniques.
MEU709.6 Work in a group to develop the leadership/interpersonal skills for finishing task within timeframe.

MEU710 INDUSTRIAL TRAINING / VISIT

Teaching Scheme: 00 **Total: 00** **Credits: 02**
Evaluation Scheme: 50 ICA **Total Marks: 50**

Industrial Training shall have an option of Industrial Visit.

Industrial Training: List of renowned industries shall be prepared by the Departmental Coordinator of T & P Cell for the course. After approval from the Principal and with the consultation of Industry personnel, 02 weeks trainings shall be arranged during the vacations (after the VI semester). The students may be permitted to undergo the trainings of 02 weeks as per their choices for which all the official formalities will be completed by the students under the guidance of course coordinator. The students shall submit the report based on the Industrial training to the course coordinator which will be evaluated during the VII semester

Industrial Visit: An Industry Visits to minimum three industries shall be arranged for the students unable to complete the Industrial Training. The visit shall be arranged preferably during the vacation period. However in non-availability of permission for the visit during vacation period, same may be arranged during the regular VII semester. The students will be required to submit the report based on the Industrial Visit which will be evaluated by the course coordinator

Note:
ICA: The Internal Continuous Assessment shall be based on the active participation of the students in the training/visits and knowledge / skill acquired. The technical report submitted by the students shall be assessed, by the panel of examiners consisting of Project Guide, Course Coordinator and Expert appointed by the Program Head

MEU711 INDUSTRIAL LECTURE-II

Teaching Scheme: 01T **Total: 01** **Credit: 01**
Evaluation Scheme: 25 ICA **Total Marks: 25**

List of renowned persons from industry shall be prepared by the Departmental Coordinator of T & P Cell for the course. After approval from the Principal, Minimum twelve Industrial lectures shall be arranged, preferably once a week, which shall be delivered by the experts/Officials from Industries/Govt. organizations/ Private Sectors/Public Sectors covering the various aspects.
The assignments based on the Industry Lecture-I and Industry Lecture-II will be evaluated during VII semester

Topics of Industrial Lectures shall be Technical in nature and should not be the specific contents from the curriculum.

Students shall submit the report based on lectures.

Note:
ICA: The Internal Continuous Assessment shall be based on the active participation of the students in the lectures and knowledge acquired. The technical report submitted by the students shall be assessed, by the panel of examiners consisting of Project Guide, Course Coordinator and Expert appointed by the Program Head

MEU712 SELF STUDY-III

Teaching Scheme: 00 P **Total: 00** **Credit: 02**
Evaluation Scheme: 25 TA **Total Marks: 25**

Self Study-III is based on one class test each on the basis of 20% curriculum of the courses MEU701 Refrigeration and Air Conditioning, MEU702 Computer Aided Design, MEU703 Elective I declared by the respective course coordinator at the beginning of the semester.

MEU801 INTERNAL COMBUSTION ENGINES

Teaching Scheme: 03 L + 00 T **Total: 03** **Credits: 03**
Evaluation Scheme: 15 CT1 + 15 CT2 + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2hrs.30 min.

Course Objectives:

I. To understand types and configuration of spark ignition and diesel engines
II. To evaluate the engine performance parameters such as *bmep*, torque, *bsfc* and their relationship to operating conditions with conventional and alternative fuels and compare the performance parameters and emissions
III. To analyze air-standard, fuel-air and actual cycles of engine operation
IV. To understand the combustion process in both spark ignition and diesel engines with regards to flame structure, cycle-to-cycle variation, knock, ignition, fuel injection, octane number, ignition delay and cetane number
V. To investigate the constituents of engine exhaust emissions, influence of engine operating parameters on emissions, exhaust after treatment
VI. To introduce students to future internal combustion engine fuels and technology

Types of Cycles and their Analysis: Classification of I. C. engines, details of two stroke and four stroke cycles; air standard cycles, fuel air cycle and actual cycle, effect of variation of specific heat, dissociation, brief review of other losses
Fuels and alternative fuels: Elementary treatment to conventional and non-conventional fuels, fossil fuels and their limitations, potential alternative fuels-liquids and gaseous, additives and their functions.
Studies of fuel injection pump: Their working, different types of fuel feed systems, studies of injectors, nozzles, Bosch type fuel pump.
Combustion SI Engine: Combustion in SI engine, stages of combustion, normal and abnormal combustion, detonation, pre ignition, factors responsible for abnormal combustion, effect of detonation. octane rating of fuel, requirement of combustion chambers for SI engines, important types, relative advantages and disadvantages and application.
Combustion in CI Engine: Stages of combustion in CI engines, delay period, factor affecting delay period, effect of change in delay period. diesel knock, cetane rating, requirements of combustion chamber for CI engines, methods of generating turbulence in combustion chamber, types of combustion chambers for CI engines.
Performance test on IC engines: Methods of determination of BP, heat balance sheet, various modes of tests such as 5 mode, 8 mode, and 13 mode test.
Principles of Supercharging: Arrangements for supercharging, advantages and limitations of supercharging.
Review of Emissions from IC Engines: Effects of emissions on human health, causes of formation and approaches to control these pollutants, exhaust gas recirculation, water injection, after treatment technology, SCR, DPF, measurement of smoke, CO, HC, various smoke meters, infra Red detector, study of emission norms, BIS, EURO.
Recent trends in IC engine technology:
For SI engine: MPFI, direct in cylinder injection, after treatment, multi spark plug technology, variable valve timing
For CI engine: CRDI, catalytic convertor, microprocessor controls.

Text books:

1. Internal Combustion Engines, Ganesan V, Tata McGraw Hill, New Delhi, 1994
2. A course in Internal Combustion Engines, M. L. Mathur and R. P. Sharma, Dhanpat Rai and Sons, Delhi, 1994

Reference Books:

1. Internal Combustion Engines Fundamentals, John B. Heywood, McGrawHill, 1988.
2. Internal Combustion Engines, Colin R Ferguson, John Wiley and Sons, New York, 1986
3. Engineering Fundamentals of the Internal Combustion Engine, Pulkrabek Willard W, PHI, 2007

Course Outcomes: After completion of course, student will be able to:

MEU801.1 Identify the engine operation and apply engineering science (thermodynamics, fluid mechanics, heat transfer) to analyze the operation and performance of engines

MEU801.2 Demonstrate knowledge of the operating characteristic and thermodynamic analysis of common IC engine cycles

MEU801.3 Compare the engine performance and combustion characteristics for conventional and alternative fuels

MEU801.4 Identify the operational parameters governing exhaust emissions and investigate the emission control technologies

MEU801.5 Acquaint with future engine technologies and emission norms

MEU802 MECHATRONICS

Teaching Scheme: 03 L + 00T Total: 03 Credits: 03
Evaluation Scheme: 15 CT1 + 15CT2 + 10TA + 60ESE Total Marks: 100
Duration of ESE: 2 hrs. 30 min.

Course Objectives:

I. To provide knowledge on electrical circuits, signal conditioning
II. To make familiar about control system and power electronics in designing Mechatronics system

Introduction: Scope and applications of Mechatronics, Measurement System with its constituent elements; Open and Closed Loop Systems; Sequential Controllers; Micro-processor Based Controllers.

Electronics for Mechanical Engineers: Introduction to Conductors, Insulators and Semiconductors, Passive components used in Electronics, Transformers, Semiconductors, Transistors, Silicon Controlled Rectifiers, Integrated Circuits, Digital Circuits.

Construction and Configuration of CNC System: Machine Structure, Slide ways, Spindle, Drive Units, Elements of Motion Transmission, Location of Transducers/Sensors/Control, Configuration**,** Interfacing, Monitoring, Diagnostics, Machine Data, Compensations for Machine Accuracies.

Feedback System Devices: Sensors, Transducers, Types, Contact & Non Contact types, performance, Applications.

Mechanical Actuation System: Types of Motion, Kinematics chains, Cams, Gear Trains, Belt and Chain Drives, Bearings, Mechanical aspects of Motor Selection.
Electrical Actuation System: Electrical Systems, Mechanical Switches, Solid-State Switches, Solenoids, D.C. Motors, A.C. Motors, Stepper Motors.
Pneumatic & Hydraulic Actuation System: Actuation systems, Pneumatic and hydraulic systems, Directional control valves, Cylinders, Process control valves, Different control, Rotary actuators.
Digital Logic and Programmable Logic Controllers : A Review of Number Systems & Logic Gates; Boolean Algebra; Kanaugh Maps; Sequential Logic; Basic Structure of Programmable Logic Controllers; Input/ Output Processing; Programming; Timers, Internal Relays and Counters; Master & Jump Controls; Data Handling; Analogue Input/ Output; Selection of a PLC; Problems.

Text Books:

1. Mechatronics, HMT, Tata McGraw Hill, First Edition, 2005
2. Electronic Control Systems in Mechanical and Electrical Engineering, Bolton W., Pearsons Education, Third Edition, 2007

Reference Books:

1. Hydraulics and Pneumatics, S. Ilango, PHI, edition 2008
2. Feedback Control Systems, Bakshi U.A. ,Goyal S.C.,Technical Publications,Pune,2nd reprint 2003

Course Outcomes: After completion of course, student will be able to:
MEU802.1. Describe the mechatronic systems and overview of control systems & actuators.
MEU802.2. Differentiate between various sensors, transducers and actuators and their applications.
MEU802.3. Relate various signal conditioning units, amplifiers, logic gates and their role in programmable logic controllers.

MEU803 ELECTIVE- II
(A) POWER PLANT ENGINEERING

Teaching Scheme: 03 L + 00 T **Total: 03** **Credits: 03**
Evaluation Scheme: 15 CT1 + 15 CT2 + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2hrs.30 min.

Course Objectives:

I. To study basic power plants, site selection, comparison, working principle of hydro, thermal, and nuclear power plants with economics of power generation.
II. To study the working of various nuclear power plants along with nuclear waste disposal.
III. To study the fuels for thermal power plants including handling and storage, principle of fluidized bed combustion.

IV. To study the Working principle and thermodynamic analysis of Rankine cycle, steam nozzle and condenser.
V. To study the constructional details of impulse and reaction turbines along with velocity diagrams.

Introduction: Sources of Energy, Energy crisis and Development of Power in India.
Steam power plant: Plant Layout, Working of different Circuits, Types of coal, Properties of coal, coal handling equipments: traveling grate stokers, spreader stokers, retort stokers, overfeed and underfeed fuel beds, pulverized fuel burning system and its components, combustion needs and draught system, cyclone furnace, design and construction, Dust collectors, cooling towers and heat rejection. Corrosion and feed water treatment, Ash handling systems.
Internal combustion engine power plant: Introduction – IC Engines, Diesel power plant types, and construction– Plant layout with auxiliaries – fuel supply system, air starting equipments, lubrication and cooling systems – super charging.
Gas turbine power plant: Introduction-classification-construction-Layout with auxiliaries, Principles of working of closed and open cycle gas turbines. Combined Cycle Power Plants and their comparison.
Hydro-electric power plant: Water power – Hydrological cycle, flow measurement – drainage area characteristics – Hydrographs – storage and Pondage – classification of dams and spill ways. Hydro-projects Classification – Typical layouts – plant auxiliaries – plant operation pumped storage plants.
Non-conventional power sources: Utilization of Solar- Collectors- Principle of Working, Wind Energy – types – HAWT, VAWT -Tidal Energy, Solar energy, Fuel cells, Thermo electric and Thermo ionic, MHD generation.
Nuclear power plant: Nuclear fuel – breeding and fertile materials – Nuclear reactor types & their operation, Pressurized water reactor, Boiling water reactor, sodium-graphite reactor, fast Breeder Reactor, Homogeneous Reactor, Gas cooled Reactor, Radiation hazards and shielding – radioactive waste disposal.
Power plant economics & Environmental issues: Capital cost, investment of fixed charges, operating costs, general arrangement of power distribution, Load curves, Definitions of connected load, Maximum demand, demand factor, average load, load factor, diversity factor – related exercises. Effluents from power plants and Impact on environment, pollutants and pollution standards, Methods of Pollution control.

Text Books
1. A Text Book of Power Plant Engineering, R. K. Rajput, Laxmi Publications, New Delhi, 1995
2. A Course in Power Plant Engineering, S.C. Arora and S. Domkundwar, Dhanpat Rai, 1988

Reference Books
1. Power Plant Engineering, P.K.Nag, 2nd Edition, Tata McGraw-Hill Education, 2002
2. Power Plant Technology, M. M. ElWakil, McGraw-Hill, 1984
3. Power plant Engineering, K. K. Ramalingam, Scitech Publications (India) Pvt. Ltd., 2010
4. An Introduction to Power Plant Technology, G.D. Rai, 3rd Edition, Khanna publications, 1996
5. Power plant Engg, C. Elanchezhian, I K International Publishing House, 2007

Course Outcomes: After completion of course, student will be able to:

MEU803.1 describe the working principles of various power plants and their selection
MEU803.2 Identify the fuels for thermal power plants along with fluid handling systems.
MEU803.3 Describe the principle of working of various nuclear power plants, like BWR, PWR, CANDU types
MEU803.4 Describe the principles of working of high pressure boilers.
MEU803.5 Analyze the improved Rankine cycle to evaluate its performance.
MEU803.6 Evaluate cost of power generation.

MEU803 ELECTIVE- II
(B) PRODUCTION MANAGEMENT

Teaching Scheme: 03 L + 00 T **Total: 03** **Credits: 03**
Evaluation Scheme: 15 CT1 + 15 CT2 + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2hrs.30 min.

Course Objectives:

I. To produce the goods as per the quality demanded by the customers in most economic manner.
II. To sustain as well as to increase the level of customer satisfaction.
III. To make improvement in existing goods and services by regular innovations
IV. To maintain inventory at such levels that there may not be the blockage of working capital due to excessive stock and the production may not hamper due to unavailability of stock.
V. To ensure uninterrupted supply of goods and services in right quantity at right time and at right place.
VI. To keep proper maintenance of plant and machinery

Introduction to production and operation management
Introduction, evaluation of production management, concept of production, production system, classification of production system, production management, objective of production management. Plant location and layout, Introduction and meaning, need for selecting a suitable location, factor influencing the plant location, location theories, location economics, objectives and principles of plant layout, classification, organization of physical facilities.
Materials management
Introduction , meaning and scope, material planning parameters and procedures of purchasing, selection of supplier, stores management, codification and classification, inventory management, inventory control techniques, standardization and simplification and value analysis and engineering, EOQ, replenishment systems. Material handling-introduction and meaning, objectives and principles of material handling, selection of material handling equipments material handling equipments and guidelines for its utilization, relationship between plant layout and material handling
Production planning and control

Introduction, objectives and meaning of PPC**,** Phases of PPC, functions of PPC, operation planning and scheduling system, aggregate planning, master production schedule, routing, scheduling- inputs, strategies, types and methodology. Maintenance management**,** objective and types of maintenance, Maintenance planning and scheduling, control of waste and disposal of waste.

Work-study and productivity

Work and method study- objectives, scope of method study, steps involved in method study, recording techniques used in method study, motion study- principles, recording techniques, work measurement- objectives and methods, time study, steps in time study, computation of standard time and allowances. Factor influencing productivity, total and partial productivity measures, productivity improvement techniques.

Capacity planning: Roll of capacity planning in manufacturing, planning and control systems, capacity planning and control techniques. JIT in manufacturing planning and control, leveling the production, JIT applications, inventory control**,** inventory problems Computer aided materials management material requirement planning, Approaches to CAPP

Text Books:

1. Production and operations management, S. Anil Kumar and N. Suesh, ,New Age International Publishers
2. Production and operations management, P. Rama Murthy, New Age International Publishers Adam, Production and operations management
3. Production and operations management, K. C. Arora, Laxmi Publications, New Delhi

Reference Books:

1. Production and operations management, Buffa,
2. Materials management, PHI Publishers, Datta,

Course Outcomes: After completion of course, student will be able to:

MEU803.1 Explain major concepts in the functional areas of accounting, marketing, finance & management

MEU803.2 Evaluate the legal, social, and economic environments of business

MEU803.3 Describe the global environment of business

MEU803.4 Describe and explain the ethical obligations & responsibilities of business

MEU803.5 Apply decision-support tools to business decision making

MEU803.6 Apply knowledge of business concepts and functions in an integrated manner

MEU803.7 Use specialized knowledge in Operations Management to solve business processes.

MEU803 ELECTIVE- II
(C) MACHINE TOOL DESIGN

Teaching Scheme: 03 L + 00T **Total = 03** **Credits: 03**
Evaluation Scheme: 15 CT1 + 15CT2 + 10TA + 60ESE **Total Marks: 100**
Duration of ESE: 2 hrs. 30 min.

Course Objectives:

I. To Study of various machine internal parts
II. To understand the dynamics of machining by varying parameters

III. To learn the automation of machine parts

Introduction: General requirements of Machine Tool Design, Kinematics of machine tool, Various driving systems used in machine tools, Mechanical, Electrical, Hydraulic, Stepless regulation of speeds

Regulation of Speed and Feed Rates: Basic design consideration in the design of variable speed range in the machine tools, Layout of speed in geometric, logarithmic and arithmetic progression, Saw diagram, Range ratio, Graphical representation of speed on Structural and Ray diagram, Design of speed and feed boxes and their classification, Gear box design

Machine Tool Structure (bed, column, cross-rail): Functions and their requirements, design criterion for machine tool structure, design procedure, factors affecting stiffness of machine tool structure and their profile

Machine Tool Spindles: Functions of spindle, Materials and requirements for spindles, Design of spindles, Effect of Machine Tool Compliance on Machine Accuracy, Bearings for spindles

Machine Tool Guide-ways and Slide-ways: Design based on force of beds, slide ways, carriage, tables of Lathes, shapes of guide-ways and slide-ways of Milling machines, Materials, Methods of adjusting clearance in guide-ways, Design of slide-ways for wear resistance, Hydraulic guide-way, Antifriction guide-way, Protecting devices for slide-way

Vibrations of Machine Tools: Effects of vibration on machine tool on cutting controls, work piece, tool life. Sources of vibrations, Types of vibrations (forced, chatter, stickup vibrations) and its minimization, Shock absorbers

Control systems in Machine Tools: Functions, Requirements and classification, control systems for speeds and feeds, various motions etc. Manual and Automatic control systems**.**

Machine Tools Testing: Static and Dynamic rigidity, Methods of increasing rigidity of structure, Procedure for assessing dynamic stability, Dynamic characteristics, Experimental determination of dynamic characteristics of machine tool, Dynamic characteristics of cutting process, Stability analysis, Static and dynamic testing of machines as per Schlesinger's test and Tobias stability.

Text Books:

1. Machine Tool Design and Numerical Control, N. K Mehta, Tata McGraw Hill, Second Edition, 2005
2. Design of Machine Tools, D. K. Pal and S. K. Basu, Oxford-IBH, Second Revised Edition, 2005

Reference Books:

1. Machine Tool Design Handbook, Central Machine Tool Institute, Bangalore, Tata McGraw Hill, First Edition, 2005
2. Principles of Machine Tools, A. Bhattacharya and G. C. Sen, New Central Book Agency, Calcutta, 3rd Edition,1973
3. Numerical Control and Computer Aided Manufacturing, T. Kundra, P.N. Rao, N. K. Tiwari, Tata McGraw Hill, 3rd Edition, 2000

Course Outcomes: After completion of course, student will be able to:

MEU803C.1. Demonstrate knowledge of standard machine tool movements

MEU803C 2. Define dimensional measurement and explain its importance

MEU803C.3. Describe tool design methods and punch and die manufacturing techniques

MEU803C.4.Select material for cutting tools and gages; classify various cutting tools and gages and identify their nomenclature
MEU803C.5. Describe the principles of clamping, drill jigs and computer aided jig design
MEU803C.6. Design fixtures for milling, boring, lathe, grinding, welding; identify fixtures and cutting tools for NC machine tools
MEU803C.7.Explain the principles of dies and moulds design

MEU 803 ELECTIVE – II
(D) LEAN MANUFACTURING

Teaching Scheme : 03 L + 00 T **Total 03** **Credit : 03**
Evaluation Scheme : 15 CT1 + 15 CT2 +10 TA+ 60 ESE **Total Marks :100**
ESE duration : 2 hrs 30 min.

Course Objectives:

I. Understand the basic lean manufacturing
II. Explain the concepts of primary tools of lean manufacturing
III. Describe Secondary tool of lean manufacturing
IV. Learn the Different approaches for lean manufacturing implementation
V. Understand lean manufacturing assessment

Introduction to lean manufacturing: history, Need, Benefits, Limitations and Applications of lean Manufacturing

Concepts in lean manufacturing: Overview of the Toyota Production System (TPS), Concept of value in lean, concept of waste in lean, Eight sources of waste their causes and remedies.

Elements of lean manufacturing: Primary tools of lean manufacturing such as 5S, Value Stream Mapping, Tool Productive Maintenance and work cell

Secondary tool of lean manufacturing: Just in time Single minute exchange of die, design of manufacturing and assembly, poke yoke, Kanban system, Visual management, Lean Vs Push Manufacturing.

Implementation of lean Manufacturing: Different approaches for lean manufacturing implementation, important factors in lean implementation, barriers and limitations in lean implementations.

Lean Manufacturing assessment: introduction to Lean audits, Employee involvement in the change process improvement of working culture by lean Manufacturing.

TEXT BOOKS :

1. Lean thinking , James Womack and Daniel Jones, Free press, Revised Edition, 2003

2. The Toyota Way of Fieldbook, Jeffery Liker and David Meier, McGraw-Hill, 2006
3. The Kaizen Blitz by Laraia, Moody and Hall , Weily ,1999

REFERENCE BOOKS :

1. Lean production Simplified , Pascal Dennies , Productivity Press, 2007

Course Outcomes: After completion of course, student will be able to:

MEU803.1 Explain the concept, history and application of lean manufacturing
MEU803.2 Apply the elements and secondary tools of lean manufacturing
MEU803.3 Implement proper approach of lean manufacturing to real life situation
MEU803.4 Apply the process of lean audit

MEU804 ELECTIVE- III
(A) AUTOMOBILE ENGINEERING

Teaching Scheme	**: 03L+00T**	**Total: 03**	**Credit: 03**
Evaluation Scheme	**: 15CT1 + 15CT2 + 10TA + 60 ESE**		**Total Marks: 100**
Duration of ESE	**: 2 hrs. 30 min.**		

Course Objectives:

I. Introduction to engineering analysis of the automobile and its sub-systems.
II. Application of engineering principles to automotive design.
III. Familiarization with modelling and analysis methods.
IV. Familiarization with the automotive industry and its terminology

Engine: Introduction, History, Classification of automobiles, Major components of automobile and its functions, Chassis Types, Subsystems of automobile.

Engine Part and Mounting: Functions and locations, Power for propulsion, Vertical and horizontal engine acceleration, Merits and demerits, Hill climbing, Engine parts-types, Construction and functions

Multiple Cylinder Engine: General considerations, Engine balance, Vibration, Firing order, Road performance curves, Engine maintenance and trouble shooting, Electronic engine Management

Fuel System: Types of Inlet manifold, Fuel pumps, fuel injectors for diesel engine, fuel filters, fuel gauges, Air filters, Basic principles & working of MPFI and CRDI, Auto emission and its control

Cooling system: Purpose, Types of cooling system, Water jacket, cooling water additives, Liquid water pump and radiators, By pass recirculation system, Closed System, Temperature indicator, Anti-freeze mixtures, Troubles and remedies of cooling system, Heating and air conditioning

Ignition System: Battery: construction, Types, Rating, Battery coil and magneto ignition system, Ignition timing and its effect on engine performance, Ignition advance mechanisms, Electronic ignition system. Intelligent ignition system in two and four wheelers

Electrical Setup:. Battery Capacity, Standard capacity rating, Battery life, battery testing, recharging of battery, starter motor drive - Bendix drive, Over running clutch drive, Solenoid switch

Transmission System: Clutch, Construction, Operation, Types, Requirements, Maintenance and trouble shooting, Gear Boxes, Sliding mesh, Constant mesh and synchromesh gear box, Double synchromesh type, over drives, Automatic transmission system, , CVT, Four wheel drive, Torque tube drive, Differential, Propeller shaft and universal joint rear axle assembly, steering and front axle, Function, Types of steering, Linkages, Steering gears, Steering gear ratio, Power steering

Wheels and Tyres: Alignment, Balancing, Camber, Castor, King pin inclination, Toe-in & Toe-out effects, Types of tyres, Tyre thread maintenance

Brakes: Mechanical, hydraulic brakes, disc brakes, Air brakes, and Vacuum brakes, Fault finding and maintenance of brakes, antiskid brake control system

Suspension System: Introduction**,** Need of suspension, Types, Maintenance and Trouble shooting

Text Book:

1. Automobile Engineering, K. K. Jain and R. B. Asthana, 2nd Edition, Tata McGraw Hill publishing Co. Ltd., New Delhi, 2005
2. Automotive Mechanics, Willam H. Crouse, Donald L. Anglin, 1st Edition, Tata McGraw Hill Publishing Co. New York, 2002

Reference Books:

1. Automotive Mechanics, Joseph Heitner, 2nd Edition, CBS Publisher, New Delhi, 2004
2. Automobile Engineering, G. B. S. Narang, 2nd Edition, Khanna Publication, New Delhi, 2006

Course Outcomes: After completion of course, student will be able to:

MEU804.1 Demonstrate the vehicle construction, chassis, lubrication system and cooling system inautomobile, 3-way catalytic converter.

MEU804.2 Describe the principle and working of Carburettors, CRDI, MPFI, electronic fuel injection system and Ignition system.

MEU804.3 Differentiate between clutch, gear box, rear axle drives, fluid flywheel, and torque converter.

MEU804.4 Identify the wheels, tyres, steering gear box, suspension system-telescopic, and leaf spring

MEU804.5 Appraise the recent trends in alternate fuels and automobile safety system.

MEU804 ELECTIVE- III
(B) MECHANICAL VIBRATIONS

Teaching Scheme : 03L+00T	**Total: 03**	**Credit: 03**
Evaluation Scheme : 15CT1 + 15CT2 + 10TA + 60 ESE		**Total Marks: 100**
Duration of ESE : 2 hrs. 30 min.		

Course Objectives:

I. To understand the need and importance of vibration analysis in mechanical design of machine parts that operate in vibratory conditions

II. To develop the ability to analyze the mathematical model of a linear vibratory system to determine its response

III. To develop the ability to determine vibratory responses of SDOF and MDOF systems to harmonic, periodic and non-periodic excitation

IV. Able to make free and forced vibrations (harmonic, periodic, non perodic) vibration analysis of single and multi degree of freedom linear systems

Fundamentals of Vibration:

Basic concepts, combination of springs, masses, Harmonic motion; harmonic analysis, Fourier series expansion, single degree system –undamped ,with viscous damping, with coulomb damping response to harmonic single degree freedom forced vibration with elastically coupled viscous dampers, frequency response

Transient Vibration of single Degree of freedom Systems: response to impulse, arbitrary excitation, Laplace formulation, shock isolation, numerical methods for irregular forcing

Two Degree of Freedom System: Free vibration of spring, coupled system, mass coupled system, Bending vibration of two degree of freedom system, forced vibration, vibration absorber, Vibration isolation

Introduction to Multi Degree of Freedom Systems: Normal mode of vibration, Lagrange's equation

Vibration of Continuous Systems: Systems governed by wave equations, vibration of strings, vibration of rods, Lateral vibration of beams, effect of rotary inertia and shear deformation, vibration of membranes

Vibration Absorber

Tuned absorber, determination of mass ratio. Tuned and damped absorber, unturned viscous damper

Experimental Methods in Vibration Analysis

Vibration instruments, vibration exciters, measuring devices, vibration tests, free and forced vibration tests, Examples of vibration tests

Text Books:

1. Mechanical Vibrations, Singiresu S. Rao, Fourth Edition 2007, Pearson Education
2. Mechanical Vibrations, G.K. Grover, Seventh Edition, 2003, New Chand & Brothers
3. Mechanical Vibrations,Er.J.S.Mehta, First edition, 2012, S. Chand

Reference Books:

1. Theory of Vibrations with Applications, Willium T. Thomson, Marie Dillon Dahleh, Chandramouli Padmanabhan Fifth Edition 2008 Pearson Education
2. Theory and Practice of Mechanical Vibrations, J.S. Rao, K. Gupta New Age International

Course Outcomes: After completion of course, student will be able to:

MEU804B.1 Developed the skills to obtain mathematical model of real life engineering systems

MEU804B.2 Construct the equations of motion for free-body diagrams

MEU804B.3 Solve for the motion and the natural frequency of (1) a freely vibrating single degree of freedom undamped motion and (2) a freely vibrating single degree of freedom damped motion.

MEU804B.4 Construct the governing differential equation and its solution for a vibrating mass subjected to an arbitrary force

MEU804B.5 Solve Vibration problems that contain multiple degrees of freedom

MEU804 ELECTIVE- III
(C) FINITE ELEMENT METHOD

Teaching Scheme: 03 L + 00 T **Total: 03** **Credit: 03**

Evaluation Scheme: 15 CT1 + 15 CT2 + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2 hrs. 30 min.

Course Objectives:

I. To develop a practical approach to Finite Element Method (FEM) as tool to solve engineering problems.
II. To introduce the FEM and its applications to common problems in engineering, especially structural and thermal areas.

Introduction: Basic concept, Historical background, engineering applications, general description, comparison with other methods, Need for weighted – integral forms, relevant mathematical concepts and formulae, displacement transformation matrix, stiffness matrix, weak formulation of boundary value problems, variational methods, Rayleigh –Ritz method and weighted residual approach

Finite Element Techniques: Model boundary value problem, finite element discretization, element shapes, sizes, and node locations, interpolation functions, shape functions, derivation of element equations, connectivity, boundary conditions, principal of potential energy, FEM solution, post-processing, Compatibility and completeness requirements, convergence criteria, higher order and isoparametric elements, natural coordinates, Langrange and Hermit olynomials

Applications to solid and structural mechanics problems: External and internal equilibrium equations, one-dimensional stress-strain relations, plane stress and strain problems, strain displacement relations, boundary conditions compatibility equations, analysis of trusses, frames and solids of revolution, computer programs.

Application to heat transfer problem: Variational approach, Galerkin approach, one-dimensional and two-dimensional steady state problems for conduction, convection and radiation

Application to fluid mechanics problems: In viscid incompressible flow, potential function and stream function formulation, incompressible viscous flow, stream function, velocity-pressure and stream function-vorticity formulation, solution of incompressible and compressible fluid film lubrication problems

Text Books:

1. An Introduction to Finite Element Method, J.N. Reddy, Tata McGraw Hill, New Delhi, 2nd Edition, 2005
2. Finite Element Analysis, P. Seshu, Prentice Hall India, New Delhi, First Edition, 2006

Reference Books:

1. Introduction to Finite Element Method, C S Desai, J F Abel, CBS Publishers, 2nd Edition, 2005
2. The Finite Element Method in Engineering, S. S. Rao, Elsevier India, Fourth Edition 2008

Course Outcomes: After completion of course, student will be able to:

MEU804C.1 Synthesise information and ideas for use in the evaluation process.
MEU804C.2 Develop governing equations of mechanical systems using domain knowledge and mathematical principles and apply principles of variation and integral forms of solution to formulate finite element problem.
MEU804C.3 Analyze and build FEA model for complex engineering problems.

MEU804C.4 Perceive the fundamental theory of the finite elements.

MEU804C.5 Develop skills to model the behaviour of structures under mechanical and thermo-mechanical loads.

MEU804 ELECTIVE- III
(D) COMPUTER INTEGRATED MANUFACTURING SYSTEMS

Teaching Scheme: 03 L + 00 T **Total : 03** **Credit : 03**
Evaluation Scheme: 15 CT1 + 15 CT2 + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2 hrs. 30 min.

Course Objectives:

I. To learn automation, CIMS and various manufacturing systems.
II. To learn about CNC, robotics and material handling processes.
III. To learn the fundamentals of part programming, , computer aided process Planning.

Automation: Types, Automation for mass manufacturing and assembly, Automation of continuous processing systems, Detroit type automation, Automated flow lines, Methods of work transport, Partial automation, Assembly system and line balancing
Computer Integrated Manufacturing System: Introduction , Integration and Rationalization, Sequence of Functions in CIM, Elements of CIM system, CIM wheel, Benefits of CIM, Applications of CIM system.
Introduction to Various Manufacturing Systems: Single Station Manufacturing Cells, Group Technology, Cellular Manufacturing, Flexible Manufacturing Systems, Manual Assembly Lines, Transfer Lines, Automated Assembly Systems.
Computer Numerical Control: Fundamentals of NC machines, Classification of Numerical Control Machine, Basic components of NC system, Problems in conventional NC, Computer numerical control, CNC system design, direct numerical Control system, Adaptive control system.
Fundamentals of Part Programming: NC words, Rapid Transverse Functions, Linear Interpolation Functions, Circular Interpolation Functions, Dwell Functions, Programming Formats, Writing a Part Program, Cutter Radius Compensation.
Robotics: Robot Terminology, Types of Robots, Robot Characteristics, Robot Controllers, End Effectors, Programming of Robot, Robot Application, Benefits of Robot.
Material Handling Systems: Overview of Material Handling Systems, Material Transport Systems like AGVS, Monorail and other Rail Guided Vehicles, Storage Systems.
Computer Aided Process Planning: Role of Process Planning, Approach of Process Planning, Process Planning System, Benefits of CAPP, Advantages of CAPP.

Text Books:

1. Computer Aided Design and Manufacturing , Groover, M. P. , Prentice-Hall of India ,
5th Edition ,2005.
2. Automation Production Systems and Computer Integrated Manufacturing, Groover, M.

P., Prentice-Hall of India, 2nd Edition.

Reference Books:
1. CAD/CAM, Zeid Ibrahim, Tata McGraw Hill,1st revised edition,2006
2. Robot System and Analysis, Shah S.K., Tata McGraw Hill ,1st edition, 2008

Course Outcomes: After completion of course, student will be able to:
MEU804.1 Classify automation, CIMS and various manufacturing systems.
MEU804.2 Identify CNC, robotics and material handling processes.
MEU804.3 Apply fundamentals of part programming , computer aided process Planning.

MEU805 INTERNAL COMBUSTION ENGINES LAB

Teaching Scheme: 02P **Total : 02** **Credit: 01**
Evaluation Scheme: 25 ICA + 25 ESE **Total marks: 50**
Duration of ESE: 3 hrs.

Course Objectives:
- I. To make students familiar with the design and operating characteristics of modern internal combustion engines
- II. To apply analytical techniques to the engineering problems and performance analysis of internal combustion engines
- III. To study the thermodynamics, combustion, heat transfer, friction and other factors affecting engine power, efficiency and emissions
- IV. To introduce students to the environmental and fuel economy challenges facing the internal combustion engine

It is representative list of practical. The instructor may choose experiments as per his/ her requirement (so as to cover entire content of the course MEU801 IC Engines) from the list or otherwise. Minimum **Six** experiments should be performed:

1. Trial on Single Cylinder Diesel engine.
2. Trial on Multi Cylinder Diesel engine
3. Trial on Single Cylinder Petrol engine.
4. Trial on Multi Cylinder Petrol engine
5. Trail on VCR Engine
6. Morse test on Diesel engine
7. Morse test on Petrol engine

ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A&B.

ESE: The end semester Exam for practical shall be based on performance in one of the experiments and may be followed by sample questions

Course Outcomes: After completion of course, student will be able to:
MEU805.1 Differentiate among different internal combustion engine designs and develop an understanding of real world engine design issues
MEU805.2 Recognize and understand reasons for differences among operating characteristics of different engine types and designs
MEU805.3 Given an engine design specification, predict performance and fuel economy trends with good accuracy
MEU805.4 Exposure to the engineering systems needed to set-up and run engines in controlled laboratory environments
MEU805.5 Develop skills to run engine dynamometer experiments
MEU805.6 Compare and contrast experimental results with theoretical trends, and to attribute observed discrepancies to either measurement error or modeling limitations
MEU805.7 Develop an ability to optimize future engine designs for specific sets of constraints (fuel economy, performance, emissions)

MEU806 MECHATRONICS LAB

Teaching Scheme: 02 P **Total : 02** **Credit: 01**
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks: 50**
Duration of ESE: 3 hrs.

Course Objectives:

I. Develop an understanding of the basic elements underlying mechatronic systems: analog electronics, digital electronics, sensors, actuators, microcontrollers, and embedded software.
II. Understand how to interface electromechanical systems to microcontrollers.
III. Gain hands-on experience with commonly used electronic test and measurement instrumentation.
IV. Improve written communication skills through laboratory and project reports.
V. Gain practical experience in applying knowledge gained in the course through a hands-on project.

It is representative list of practicals. The instructor may choose experiments as per his / her requirements (so as to cover entire content of the course MEU802 Mechatronics) from the list or otherwise. Minimum **Six** experiments should be performed:

1. Design and construction of Printed Circuit Board for confirmation of the sensor signal processing function.
2. Study the use of Proximity sensors to control the motion of objects using Mechatronics cube Assembly for conveyor system.
3. Performance of various elements of Mechatronics Cube Assembly for processing system
4. Performance of various elements of Mechatronics Cube Assembly for Automated Storage and Retrieval System.
5. Design of control algorithm to generate a “Traffic sequence” with appropriate timing.
6. PLC programming to sequentially moving parts on the conveyor system.

7. PLC programming to coordinate the functions in ASRS.-2 experiments.

ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A&B.

ESE: The end semester Exam for practical shall be based on performance in one of the experiments and may be followed by sample questions

Course Outcomes: After completion of course, student will be able to:

MEU8061. Analyse the velocity and direction of fluid power circuit with the help of simulation software.

MEU806 2. Demonstrate the fluid power circuits using PLC.

MEU806 3. Observe interface between stepper motor and 8051 micro controller.

MEU806 4. Simulate the basic electric, hydraulic and pneumatic system using simulation software.

MEU807ELECTIVE – III LAB.
(A) AUTOMOBILE ENGINEERING LAB

Teaching Scheme: 02 P **Total: 02** **Credit: 01**

Evaluation Scheme: 25 ICA +25 ESE **Total Marks: 50**

Duration of ESE: 3 hrs.

Course Objectives:

I. To make the student understand about the various components of petrol engine and diesel engine by dismantling and assembling the parts like carburetor, alternator, water pump etc and we have the multi cylinder diesel and petrol engines for easy learning.

II. To make the student understand about the various electrical components of an automobile and the wiring circuits and to test the starter motor, ignition system, batteries etc. Study on engine components. Fuel systems. Ignition systems - Transmission systems - Steering systems. Suspension and braking systems. Layout of electrical wiring - Light and heavy vehicles.

It is representative list of practical. The instructor may choose minimum **Six** experiments as per his/her requirement (so as to cover entire content of course MEU804 (1) Automobile Engineering from the list given below:

1. Study of lubricating system.
2. Circuit tracing of 4 wheeler carburetor
3. Study of wiring diagram of electrical system.
4. Fault finding of ignition system.
5. Setting of ignition timing and spark plug gap.
6. Disassembly & assembly of two types of gear boxes.
7. Study of brake systems.

8. Study of steering system & its adjustment.
9. Disassembly & assembly of two stroke engine.
10. Exhaust analysis of S.I. Engine studies and measurement.
11. Smoke measurement in Diesel exhaust.

ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A&B

ESE: The end semester Exam for practical shall be based on performance in one of the experiments and may be followed by sample questions

Course Outcomes: After completion of course, student will be able to:
MEU807A.1 Describe, explain and demonstrate the various aspects of automobile components and system which include engine components, fuel and ignition systems, transmission systems and steering systems, suspension and braking systems and electrical and electronics system.

MEU807ELECTIVE – III LAB.
(B) MECHANICAL VIBRATIONS LAB

Teaching Scheme: 02 P **Total: 02** **Credit: 01**
Evaluation Scheme: 25 ICA +25 ESE **Total Marks: 50**
Duration of ESE: 3 hrs.

Course Objectives:

I. To understand the need and importance of vibration analysis in mechanical design of machine parts that operate in vibratory conditions
II. To develop the ability to analyze the mathematical model of a linear vibratory system to determine its response
III. To develop the ability to determine vibratory responses of SDOF and MDOF systems to harmonic, periodic and non-periodic excitation
IV. Able to make free and forced vibrations (harmonic, periodic, non perodic) vibration analysis of single and multi degree of freedom linear systems

It is representative list of practical. The instructor may choose minimum **Six** experiments as per his/her requirement (so as to cover entire content of course MEU804 (2) Mechanical Vibrations) from the list given below

1. Verification of principle of gyroscope and gyroscopic couple, magnitude.
2. Study of any two gyro controlled instruments.
3. To study the dynamic balancing machine and to balance a rotor. (e. g. rotor of electric motor, flywheel, fan etc.)

4. To determine the natural frequency of damped vibration of single degree freedom system and to find its damping coefficient.
5. To verify natural frequency of torsional vibration of two rotor system and position of node.
6. To determine critical speed of single rotor system.
7. To determine resonance frequency of transverse vibration of beam.
8. To determine the frequency response curve under different damping conditions for single degree of freedom system of vibration.
9. To study shock absorbers and to plot transmissibility curve.

ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A&B

ESE: The end semester Exam for practical shall be based on performance in one of the experiments and may be followed by sample questions.

Course Outcomes: After completion of course, student will be able to:

MEU807B.1 Developed the skills to obtain mathematical model of real life engineering systems

MEU807B.2 Construct the equations of motion for free-body diagrams

MEU807B.3 Solve for the motion and the natural frequency of (1) a freely vibrating single degree of freedom undamped motion and (2) a freely vibrating single degree of freedom damped motion.

MEU807B.4 Construct the governing differential equation and its solution for a vibrating mass subjected to an arbitrary force

MEU807B.5 Solve Vibration problems that contain multiple degrees of freedom

MEU807ELECTIVE – III LAB.
(C) FINITE ELEMENT METHODS LAB

Teaching Scheme: 02P **Total : 02** **Credit: 01**

Evaluation Scheme: 25 ICA + 25 ESE **Total marks: 50**

Duration of ESE: 3 hrs.

Course Objectives:

I. To understand the Stress distribution computation for an element
II. To learn the Deflection in a cantilever / simply supported beam
III. To recognize the Temperature, Velocity & Pressure distribution in mechanical system components

It is representative list of practical. The instructor may choose minimum **Six** experiments as per his/her requirement (so as to cover entire content of course MEU804 (3) Finite Element Method) from the list given below:

The following assignments should be carried out using any of the FEM codes such as ANSYS / NASTRAN // FEMAP / MATLAB etc and a report thereof should be submitted.

1. Stress distribution computation for a cylindrical rod
2. Stress distribution in a flat plate
3. Deflection in a cantilever / simply supported beam
4. Temperature distribution in extended surfaces / fins
5. Velocity distribution in a flow channel
6. Pressure distribution in ducts

ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A&B.

ESE: The end semester Exam for practical shall be based on performance in one of the experiments and may be followed by sample questions.

Course Outcomes: After completion of course, student will be able to:
MEU807C.1 Analyze the Stress distribution computation for an element
MEU807C.2 Perform the Deflection in a cantilever / simply supported beam
MEU807C.3 Identify the Temperature, Velocity & Pressure distribution in mechanical system components
MEU807C.4 Draw inferences FEM analysis of element

MEU807ELECTIVE – III LAB.
(D) COMPUTER INTEGRATED MANUFACTURING SYSTEMS LAB

Teaching Scheme: 02P **Total : 02** **Credit: 01**
Evaluation Scheme: 25 ICA + 25 ESE **Total marks: 50**
Duration of ESE: 3 hrs.

Course Objectives:

I. Develop an understanding of the basic elements of CNC lathe or Milling machine
II. Understand the Robot structure and types of Robot & group technology
III. Learn the Robot programming for simple task like Pick-n-Place in assembly line using Robot programming language
IV. Gain practical experience in applying knowledge gained in the course through a hands-on project.

It is representative list of practical. The instructor may choose minimum **Six** experiments as per his/her requirement (so as to cover entire content of course MEU804 (4) Computer Integrated Manufacturing) from the list given below

1. Write a part program and perform on CNC lathe or Milling machine- 3 experiments.
2. Study of Robot structure and types of Robot.
3. Robot programming for simple task like Pick-n-Place in assembly line using Robot programming language- 3 experiments.
4. Study of any real world application of group technology.

5. Case study on CAPP.

ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A&B.

ESE: The end semester Exam for practical shall be based on performance in one of the experiments and may be followed by sample questions.

Course Outcomes: After completion of course, student will be able to:
MEU807D.1 Write a part program and perform on CNC lathe or Milling machine
MEU807D.2 Describe of Robot structure and types of Robot.
MEU807D.3 Perform Robot programming for simple task like Pick-n-Place in assembly line
MEU807D.4 Explore real world application of group technology.
MEU807D.5 Acquire skill to perform Case study on CAPP.

MEU808 PROJECT

Teaching Scheme: 06P **Total: 06** **Credits: 06**
Evaluation Scheme: 75 ICA +100ESE **Total Marks: 175**
Duration of ESE: 3 hrs.

Course Objectives:

I. To perform the test on a model also analyze and discuss the results to draw valid conclusions.
II. To encourage the student for publishing papers in peer reviewed journals/conference proceedings.
III. To reorganize the procedures with a concern for society, environment and ethics.
IV. To develop a prototypes/models, experimental set-up and software systems.
V. To improve the ability of presentation skill and communication techniques.

1. Project work decided in VII semester shall be continued.
2. Students should complete implementation of ideas given in synopsis, so that project work should be completed before end of semester.
3. Students shall submit the final project report in proper format as per guidelines given on the college website which shall include the work of both semesters.
4. For uniform and continuous evaluation, evaluation committee for each group shall be formed by Program Head in which guide must be a member. Internal marks should be awarded by committee at the end of semester based on continuous evaluation.
5. Final examination of project shall include demonstration, presentation of complete work and oral examination based on the project work.

Note:

ICA: The Internal Continuous Assessment shall be based on the active participation of the students in the Project work and knowledge / skill acquired. Oral examination shall be conducted on the Project report, by the panel of examiners consisting of Project Guide, Course Coordinator and Expert appointed by Program Head.

ESE: The End Semester Examination for Project shall consists of Demonstration if any, presentation and oral examinations based on the project report.

Course Outcomes: After completion of course, student will be able to:
MEU808.1. Identify methods and materials to carry out experiments/develop code.
MEU808.2. Reorganize the procedures with a concern for society, environment and ethics.
MEU808.3. Analyze and discuss the results to draw valid conclusions.
MEU808.4.Prepare a report as per recommended format and defend the work.
MEU808.5. Explore the possibility of publishing papers in peer reviewed journals/conference proceedings.
MEU808.6. Work in a group to develop the leadership/interpersonal skills for finishing task within timeframe.

MEU809 SELF STUDY-IV

Teaching Scheme: 00 P	**Total: 00**	**Credit: 02**
Evaluation Scheme: 25 TA		**Total Marks: 25**

Self Study-III is based on one class test each on the basis of 20% curriculum of the courses MEU801 IC Engines, MEU802 Mechatronics, MEU803 Elective II, MEU804 Elective III declared by the respective course coordinator at the beginning of the semester.

Govt. College of Engineering Amravati

(An Autonomous Institute of Govt. of Maharashtra)

Curriculum
for

V and VI Semesters.

of

B. Tech. (Mechanical Engineering)

Department of Mechanical Engineering

2012-2013

GOVERNMENT COLLEGE OF ENGINEERING, AMRAVATI
MECHANICAL ENGINEERING DEPARTMENT
SCHEME FOR B. Tech. (Mechanical Engineering) from academic year 2012-2013

Course Code	Name of the Course	Teaching Scheme (Hrs./week)				Evaluation scheme							Credits
		L	T	P	Total	Theory				Practical		Total	
						TA	CT1	CT2	ESE	ICA	ESE		
Semester – V													
MEU501	Machine Design – I	3	-	-	3	10	15	15	60	-	-	100	3
MEU502	Dynamics of Machines	3	-	-	3	10	15	15	60	-	-	100	3
MEU503	Machining Processes	3	-	-	3	10	15	15	60	-	-	100	3
MEU504	Metrology and Measurement system	4	-	-	4	10	15	15	60	-	-	100	4
MEU505	Hydraulic Machines	3	-	-	3	10	15	15	60	-	-	100	3
MEU506	Machine Design-I Lab.	-	-	2	2	-	-	-	-	25	-	25	1
MEU507	Dynamics of Machines Lab.	-	-	2	2	-	-	-	-	25	25	50	1
MEU508	Machining Processes Lab.	-	-	2	2	-	-	-	-	25	25	50	1
MEU509	Metrology & Measurement System Lab.	-	-	2	2	-	-	-	-	25	25	50	1
MEU510	Hydraulic Machine Lab	-	-	2	2	-	-	-	-	25	25	50	1
MEU511	Self study -I	-	-	-	-	25	-	-	-	-	-	25	2
		16	**0**	**10**	**26**	**75**	**75**	**75**	**300**	**125**	**100**	**750**	**23**
Semester – VI													
MEU601	Operation Research Management	3	-	-	3	10	15	15	60	-	-	100	3
MEU602	Machine Design-II	3	-	-	3	10	15	15	60	-	-	100	3
MEU603	Heat Transfer	3	-	-	3	10	15	15	60	-	-	100	3
MEU604	Control Systems Engineering	3	-	-	3	10	15	15	60	-	-	100	3
MEU605	Industrial Management and Quality Control	3	-	-	3	10	15	15	60	-	-	100	3
MEU606	Computational Lab.	-	-	2	2	-	-	-	-	25	25	50	1
MEU607	Machine Design – II Lab.	-	-	2	2	-	-	-	-	25	-	25	1
MEU608	Heat Transfer Lab.	-	-	2	2	-	-	-	-	25	25	50	1
MEU609	Control Systems Engineering Lab.	-	-	2	2	-	-	-	-	25	25	50	1
MEU610	Minor Project	-	-	2	2	-	-	-	-	25	25	50	2
MEU611	Self Study-II	-	-	-	-	25	-	-	-	-	-	25	2
MEU612	Industrial Lecture - I	1	-	-	1	-	-	-	-	-	-	-	-
		16	**0**	**10**	**26**	**75**	**75**	**75**	**300**	**125**	**100**	**750**	**23**

The ESE (Theory) duration for all courses shall be 2hrs 30 min except courses MEU101, MEU501 and MEU602 for which the ESE duration will be 3hrs.

ICA - Internal Continuous Assessment; ESE - End Semester Examination

Assessment of course MEU612 Industrial Lecture -I is scheduled in VII semester with course MEU711 Industrial Lecture – II

The course MEU511 Self Study-I is based on the basis of 20% curriculum of the courses MEU502, MEU503, MEU504 and MEU505 declared by the respective course coordinator at the beginning of the semester

The course MEU611 Self Study-II is based on the basis of 20% curriculum of the courses MEU601, MEU603, MEU604 and MEU605 declared by the respective course coordinator at the beginning of semester

One Faculty member shall be appointed as Course Coordinator for the course Self Study and his/ her teaching workload shall be considered as 01 hr per week

Course Code	Name of the Course	Teaching Scheme (Hrs./week)				Evaluation scheme							Credits
		L	T	P	Total	Theory				Practical		Total	
						TA	CT1	CT2	ESE	ICA	ESE		
Semester – VII													
MEU701	Refrigeration & Air Conditioning	3	-	-	3	10	15	15	60	-	-	100	3
MEU702	Mechatronics	3	-	-	3	10	15	15	60	-	-	100	3
MEU703	Elective-I	3	-	-	3	10	15	15	60	-	-	100	3
MEU704	Institute Level Elective	3	-	-	3	10	15	15	60	-	-	100	3
MEU705	Refrigeration and Air Conditioning Lab	-	-	2	2	-	-	-	-	25	25	50	1
MEU706	Mechatronics Lab.	-	-	2	2	-	-	-	-	25	25	50	1
MEU707	Elective-I Lab.	-	-	2	2	-	-	-	-	25	25	50	1
MEU708	Project Stage-I	-	-	4	4	-	-	-	-	50	-	50	2
MEU709	Seminar	-	-	2	2	-	-	-	-	50	-	50	1
MEU710	Industrial Training / Visit	-	-	-	-	-	-	-	-	50	-	50	2
MEU711	Industrial Lecture - II	1	-	-	1	-	-	-	-	25	-	25	1
MEU712	Self Study-III	-	-	-	-	-	-	-	-	25	-	25	2
		13	**0**	**12**	**25**	**40**	**60**	**60**	**240**	**275**	**75**	**750**	**23**
Semester – VIII													
MEU801	IC Engines	3	-	-	3	10	15		60	-	-	100	3
MEU802	CAD / CAM	3	-	-	3	10	15		60	-	-	100	3
MEU803	Elective-II	3	-	-	3	10	15		60	-	-	100	3
MEU804	Elective-III	3	-	-	3	10	15		60	-	-	100	3
MEU805	IC Engines Lab.	-	-	2	2	-	-		-	25	25	50	1
MEU806	CAD/CAM Lab.	-	-	2	2	-	-		-	25	25	50	1
MEU807	Elective-III Lab.	-	-	2	2	-	-		-	25	25	50	1
MEU808	Project	-	-	6	6	-	-		-	75	100	175	6
MEU809	Self Study-IV	-	-	-	-	-	-		-	25	-	25	2
		12	**0**	**12**	**24**	**40**	**60**		**240**	**175**	**175**	**750**	**23**

The ESE (Theory) duration for all courses shall be 2hrs 30 min except courses MEU101, MEU501 and MEU602 for which the ESE duration will be 3hrs.

ICA – Internal Continuous Assessment; ESE – End Semester Examination

Assessment of course MEU612 Industrial Lecture -I is scheduled in VII semester with course MEU711 Industrial Lecture - II

The course MEU712 Self Study-III is based on the basis of 20% curriculum of the courses MEU701, MEU702 and MEU703 declared by the respective course coordinator at the beginning of the semester

The course MEU809 Self Study-IV is based on the basis of 20% curriculum of the courses MEU801, MEU802, MEU803 and MEU804 declared by the respective course coordinator at the beginning of semester

One Faculty member shall be appointed as Course Coordinator for the course Self Study and his/ her teaching workload shall be considered as 01 hr per week

Students of this department will select any one Interdisciplinary Elective offered by other other departments. Interdisciplinary Elective shown below will be offered to the students of other departments

Sr. No.	MEU703 ELECTIVE-I	MEU704 INTERDISCIPLINARY ELECTIVE	MEU803 ELECTIVE-II	MEU804 ELECTIVE-III
1	New and Renewable Energy Sources	Quality System Engineering	Power Plant Engineering	Automobile Engineering
2	Tool Engineering	Human Resource Management	Production Management	Mechanical Vibrations
3	Experimental Stress Analysis	Entrepreneurship Development	Machine Tool Design	Finite Element Methods
4		Thermal Engineering		
5		Introduction to System Engineering		

MEU501 MACHINE DESIGN- I

Teaching Scheme: 03 L + 00 T Total: 03 Credits: 03
Evaluation Scheme: 15 CT1 + 15 CT2 + 10 TA + 60 ESE Total Marks: 100
Duration of ESE: 03.00 Hrs.

Course Objectives:

I. To develop an ability to apply knowledge of mathematics, science, and engineering
II. To develop an ability to design a system, component to meet desired needs within
III. realistic constraints.
IV. To develop an ability to identify, formulate, and solve engineering problems.
V. To develop an ability to use the techniques, skills, & engineering tools

Introduction: Steps of design, Design Principle, Design consideration for dynamic and static load, selection of materials, designation of material as per ISI, Various codes and standards.

Simple Stresses : Simple stresses, factor of safety, Hertz constant stress, thermal stresses, impact stress,torsional stress, bending in straight and curved beams and application to hooks, c-clamps, Biaxial stress, theories of failure.

Variable Stresses: Fatigue and Endurance limit, factors influencing fatigue, surface finish, stress concentration, Stress Intensity Factor, notch sensitivity, combined steady and variable stresses, Gerber Line, Sordbergs line.

Design of screw and bolted Joints: Forms and Threads, types of Fastening, standard dimensions stresses due to screwing up and external forces, stresses due to combination of screwing up and external force, bolts of uniform strength, bolted joints for eccentric loads.

Design of Riveted Joints: Method of riveting, types of rivets and fixed joints, caulking, fullering, failures, strength and efficiency of riveted joints, joints of boiler shell, eccentric loaded joint.

Welded Joints: Types of welding and joints, strength of transverse and parallel fillet welded section, axially loaded unsymmetrical welded section, eccentrically loaded joint.

Design of springs: Types of spring, stresses in helical springs, Wahl’s stress factor, bulking and surge, design of compression, tension, spiral helical and flat spiral springs, Introduction of leaf spring, material and construction, nipping, design of spring.

Design of Power Screw: Types of threads, torque required to raise loads, efficiency and helix angle, overhauling and self locking of screw, acme threads, stresses in power screw.

Design of Leaver: Types and Design Procedure.

Note: - Use of Design Data Book will be permitted during the examination.

Text Book:

1) Mechanical Engineering Design, Joseph E.Shigley and Charles R.Mischke, Tata McGraw Hill Publication, 6^{th} Edition,2005

2) Design of Machine Element, V.B.Bhandari, Tata McGraw Hill Publications, 4^{th} Edition, 1997

Reference Books:

1) Design of Machine Element, C.S.Sharma& Kamlesh Purohit, Prentice Hall of India Publications New Delhi, 4^{th} Edition,2003

2) Machine Design- AbasicApproach , Dr S.S.Wadhwa&S.S.Jolly, Dhanpatrai and Company, 1^{st} Edition ,2007

3) http://nptel.iitm.ac.in

Design Data Book:

1) Design Data Book for Mechanical Engineers, K.Mahadevanan&K.Balaveera Reddy, CBS Publishers & Distributor Delhi, 4^{th} Edition 2008

2)Design Data Book – B.D.Shiwalkar, Central Techno Publication Nagpur, 2^{nd} Edition 2007

Course Outcomes: After completion of course, students will be able to:

MEU501.1 Analyze the stress and strain on mechanical components; and understand, identify andquantify failure modes for mechanical parts

MEU501.2 Demonstrate knowledge on basic machine elements used in machine design

MEU501.3 Design machine elements to withstand the loads and deformations for a given application, while considering additional specifications.

MEU501.4 Solve a design problem successfully

MEU501.5 Proficient in the use of software for analysis and design

MEU502 DYNAMICS OF MACHINES

Teaching Scheme: 03 L + 00 T Total: 03 **Credits: 03**
Evaluation Scheme: 15 CT1 + 15 CT2 + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2hrs.30 min.

Course Objective:

I. To understand the force-motion relationship in components subjected to external forces and analysis of standard mechanisms.
II. To understand the effects of unbalances resulting from prescribed motions in mechanisms.
III. To understand the fundamentals of vibrations.
IV. To understand the principles in mechanisms used for governing of machines.
V. To understand static and dynamic balancing of highspeed rotary and reciprocating machines.

Static force analysis : Applied to plane motion mechanism (4 bar mechanism, single slider crank mechanism) virtual work method, static force analysis considering friction.

Inertia Force Analysis :D-Alembert’s Principle, dynamic analysis of slider-crank mechanism, velocity & acc. of piston, piston effort, crank effort, inertia of connecting rod. Dynamic analysis of slider crank mechanism.

Turning Moment: turning moment diagram for reciprocating engines, speed fluctuation, Power smoothening by flywheels

Governors:-Speed Control by Governors.

Gyroscopic Couple : Gyroscopic couples and its effect on a plane disc a naval ship ,aeroplane Gyroscopic stabilization, stability of automobile during turn (Four wheeler)

Vehicle Dynamics : Coefficient of adhesion, resistance to vehicle motion, relative drive effectiveness, braking of vehicles.

Vibration : Free vibrations:- Equilibrium method, energy method, and Rayleighs method, transverse vibration of uniformly loaded shaft & several loads attached to shaft. Damped vibrations and forced vibration, Dynamic magnifier, elastic suspension. Transmissibility, vibration isolation, Introduction to Vibration systems with more than one degree of freedom. Torsional vibration, single rotor systems, Two Rotor system, three rotor system, geared systems, Graphical method for multi rotor system, Whirling of shaft & critical speeds.

Balancing of Rotating Masses : Balancing of single revolving mass by single mass rotating in same plane, Balancing of single revolving mass by two masses rotating in 8 different planes, Balancing of several masses revolving in same plane, Balancing of several masses revolving in different planes, reference plane method.

Balancing of Reciprocating Masses: Primary and secondary unbalanced forces of reciprocating masses, Partial balancing of unbalanced primary force in an reciprocating engine, partial balancing of locomotives, effect of partial balancing of reciprocating parts of two cylinder locomotive – variation of tractive force, swaying couple and hammer blow, balancing of coupled locomotives, balancing of primary and secondary forces of multicylinder inline engine, balancing of radial engine, static and dynamic balancing machines

Text Books:

1. Theory of Machines, S.S.Rattan, Tata McGraw Hill Publishing Co Ltd., New Delhi, 2^{nd}Edition, 2005.
2. Theory of Machines & Mechanism, P.L.Ballaney , Khanna Publishers, New Delhi, 21^{st}Edition, 2005.

Reference Books:

1. The Theory of Machines, Thomas Bevan, CBS Publishers and Distributors, New Delhi,1st Edition, Reprint 2005.
2. Theory of Machines & Mechanism, J.E.Shigley, J. J.Uicker, McGraw Hill Publication–New Delhi, 2nd Edition.

3)http://nptel.iitm.ac.in

Course Outcomes: After Completion of Course, the students will able to

MEU502.1 Perform static and dynamics force analysis for machine components.

MEU502.2 Apply the knowledge of flywheel, governor and gyroscope for the field applications

MEU502.3 Analyze free and forced vibrations of machines, engines and structures.

MEU502.4 Perform static and dynamic balancing of high speed rotary and reciprocating machines.

MEU 503 MACHINING PROCESSES

Teaching Scheme: 03 L + 00 T Total: 03 Credits: 03

Evaluation Scheme: 15 CT1 + 15 CT2 + 10 TA + 60 ESE Total Marks: 100

Duration of ESE: 2hrs.30 min.

Course Objectives:

I. To identify the necessity and importance of machining processes.
II. To learn the fundamentals of metal cutting and cutting force analysis.
III. To understand the working principles and classifications of lathe, drilling, boring, broaching, reaming, milling, grinding, shaper, planer and slotter machine.
IV. To differentiate between these processes in terms of application, function, advantages, disadvantages, quality and productivity
V. To understand necessity, principle, advantages, disadvantage, limitations, applications of unconventional Machining Process

Theory of Metal cutting: Mechanics of Metal cutting, Cutting parameters, chip formation & types, Tool materials, Tool Geometry, Tool life, Tool wear types, Cutting forces and power consumption, Cutting fluid classification, Machining forces and merchants force circle diagram.

Lathe: Mechanical Construction, classification of lathe machine,specifications, Operations and accessories of centre lathe, introduction of capstan &turret lathe, introduction to Automatic screw machines.

Drilling: Introduction, Working principle, Classification general purpose, Mass production and special purpose drilling machines, drill tool geometry.

Boring: Gear producing machines, Introduction, classification & mechanical construction og gear producing machines. Horizontal, Vertical and jig Boring machine.

Broaching and Reaming: Introduction, Working principle, classification, mechanical construction.

Milling: Introduction, Working principle, Classification, Types of Milling Cutters, Dividing head, Compound and differential indexing, Climb & conventional milling, applications

Grinding: Introduction, Working principle, Classification, types of bonds & Abrasive, grinding wheel specification, selection of wheel, super finishing processes.

Shaper, Planer, Slotter: Introduction, Working principle, mechanical construction, classification

Unconventional Machining Processes

Mechanical Processes: - Ultrasonic Machining - principle and applications, process parameters, Abrasive and water abrasive jet machining.Thermal processes: - Election Beam Machining - Generation of beam, principle and applications, Laser Beam machining: Plasma-arc machining- Concept and generation of plasma, principle of PAM, applications. Electro Chemical Machining- Classification, fundamentals, Electro mechanical milling. Electric discharge Machining –EDM, wire EDM, Mechanism of material removal, process parameters, advantages and applications.

Text Books

1. Workshop Technology Vol II, H S Bawa, 2nd Edition, Tata Mc Graw Hill, 2008
2. Workshop TechnologyVol II, B S Raghuwanshi, 10th EditionDhanpat Rai & Sons, Delhi, 2009

References Books:

1. Processes and Materials of Manufacture, R A LindBerg, 5th Edition PHI Publication, 2001.
2. Manufacturing Science, A.Ghosh and Bhattacharya. 2nd Edition East West Publication, 2001
3. Production Technology, HMT, Tata McGraw Hill Education Private Limited, New Delhi. 2010
4. Workshop Technology Vol. – I, II & III, Chapman, 4th Edition, Standard Publishers Distributors, New Delhi, 2010
5. Elements of Workshop Technology, Vol II, S.K.Hajra Choudhary and S.K.Bose, 2nd Edition Asia Publishing House, Bombay, 2010
6. http://nptel.iitm.ac.in

Course Outcomes: After Completion of Course, the students will able to
MEU503.1 Able to understand working principles and classifications of lathe, drilling, boring, broaching, reaming, milling, grinding, shaper, planer and slotter machine.
MEU503.2 Able to understand advantages and limitations different machining processes.
MEU503.3 Able to differentiate between these processes in terms of application, function, advantages, disadvantages, quality and productivity
MEU503.4 Able to understand necessity, principle, advantages, disadvantage, limitations, applications of unconventional Machining Processes

MEU 504 METROLOGY AND MEASUREMENT SYSTEM

Teaching Scheme: 04 L + 00 T Total: 04 Credits: 04
Evaluation Scheme: 15 CT1 + 15 CT2 + 10 TA + 60 ESE Total Marks: 100
Duration of ESE: 2hrs.30 min.

Course Objectives

I. To learn basic principles of linear and angular measurement using precision non precision measuring instruments.
II. To understand the concept of tolerance and design of different limits gauges.
III. To understand the measurement of gear & screw thread elements.
IV. To learn different methods of force, torque, power, pressure and flow measurement

Elementary Metrology: - Definition of Metrology, Objectives of Metrology, Standardization and Standardizing organizations, International system of units, Methods of measurement.
Linear Measurement: - Introduction, Surface Plate, Angle Plate, V block, feeler gauges,Angle Gauges, , Principle of Vernier, Micrometers, Types of Micrometer, Slip Gauges, Introduction to CMM.
Angular Measurement:-Introduction, Bevel types Protractor, Sine Principle and Sine Bars,
Measurement of Spur Gears: Measurement ofRun out,Pitch, Profile, Backlash, Tooth Thickness.
Comparators- Characteristics, advantages, disadvantages, working of Mechanical, optical, electrical and Pneumatics Comparators.
Surface finish measurement- Introduction, RMS and CLA method, testing of surface finish.
Measurement of External Threads: Different errors in Screw Threads, Measurement of forms of Thread with Profile Projector, Pitch Measurement, Measurement of Thread diameter with Standard wire, Screw Thread Micrometer.
Instruments and gauges for testing straightness, flatness, squareness,parallelism.
Limits, Fits and Gauges**:-**Introduction, Concept of Tolerances, Interchangeability, Methods of Limit Systems - Hole Basis and Shaft Basis.
Generalized Measurement system:-Significance of measurement, generalized systems, Types of measuring instruments. General configuration and functional elements of measuring instruments, types of inputs, various methods of correction for interfering and modifying inputs.
General performance Characteristics and strain measurement : - Static characteristics, different types of errors, Types of strain gauges, strain gauge circuits
Pressure Measurements : Basic methods of pressure Measurement, High pressure measurement low pressure Measurement.
Force, Torque and power measurement- Various mechanical, hydraulic, pneumatic and electrical methods.
Flow measurement Construction- Venturi, orifice, Rota meter, Pressure probes- types and its working.

Temperature Measurements: - Standards, Various temperature measuring devices, Bimetallic strip, liquid in glass thermometer, pressure thermometers, thermo-couples, electrical resistance thermometers, Thermistors, radiation Thermometers

Liquid Level Measurements: - Various methods such as- single float, displacement or force transducers, capacitance variation type (for both conducting and non conducting type liquids).

Speed Measurements: - Various mechanical types of tachometers, electrical tachometers, stroboscope etc

Text Books:

1. Engineering Metrology, R.K. Jain, 4th Edition ,Khanna Publishers, New Delhi, , 2005
2. .Measurement Systems, ErenestO.Doebeling ,5th Edition, Tata Mc Graw Hill, New Delhi.

Reference Books:

1. Total Quality Management, L.Suganthi, A.A.Samuel, 2nd Edition,,Prentice Hall of India, New Delhi, 2005.
2. Inspection and Quality Control, National Productivity Council.
3. Quality Engineering Handbook, Thomas Pyzdek, Roger W. Berger, Tata McGraw Hill Publication, New Delhi, 1996.
4. Quality Handbook, J.M Juran, McGraw Hill Publication, New Delhi, 4th Edition, 2005.
5. Quality Control and TQM, P.L.Jain, Tata McGraw Hill Publishing Ltd, New Delhi, 6th Edition, 2001.
6. Practical Engg. Metrology- Sharp K.W.B. Pitman,London.
7. Engineering Metrology, I.C. Gupta , Khanna Publishers, New Delhi, 4th Edition, 2005.
8. . Instrumental Measurement & Analysis, NakraChoudhari Tata Mc Graw Hill.
9. . Experimental Methods for Engineers, J.P.Holman, Mc Graw Hill,New Delhi.
10. Mechanical Measurements, T. G. Bechwith, R.D.Marangoni, J.H.Lienhard –Pearson Education, Asia, Fifth Edition
11. Quality Control, Tata McGraw Hill Publishing Ltd, TTTI, Madras, 11th Edition, 2005.
12. Mechanical Measurements, T.G.Beckwith&N.L.Bulk - Addison Wesly Publishing Company, New Delhi, Sixth Edition
13. http://nptel.iitm.ac.in

Course Outcomes: After Completion of Course, the students will able to

MEU504.1 Apply the principles in measurements of various parameters using precisionmeasuring instrument.

MEU504.2 Understand the concept of tolerance and design of different limits gauges.

MEU504.3 Understand the measurement of gear & screw thread elements.

MEU504.4 Understand different methods of force, torque, power, pressure and flow measurement

MEU505 HYDRAULIC MACHINES

Teaching Scheme: 03 L + 00T Total: 03 Credits: 03
Evaluation Scheme: 15 CT1 + 15 CT2 + 10 TA + 60 ESE Total Marks: 100
Duration of ESE: 2hrs.30 min.

Course Objectives:

1. To study working principle and parameters of analysis for different hydro-machines.
2. To understand working and construction of reciprocating and centrifugal pumps.
3. To analyze the performance characteristics of different pumps and turbines.
4. To study various types of pumps and pumping system.
5. To know the basic of Computational Fluid Dynamics.

Principles of Fluid Machinery: Dynamic action of fluid force exerted by fluid jet on plane, curved, stationary and moving vanes. Velocity diagrams, work done by impact, pressure due to deviated flow.

General Theory of Hydrodynamic Machines: Euler's equation, degree of reaction, classification of machines according to degree of reaction. Efficiencies, volumetric efficiency, hydraulic efficiency, mechanical efficiency and overall efficiency.

Prime Movers :- Theory of impulse and reaction machines. Pelton, Francis and Kaplan turbines, their construction, analysis, characteristics and governing.Specific Speed, Types of Draft Tubes, Cavitations, and Performance Characteristics.

Centrifugal pumps: - Basic Theory, classification, construction, operation, characteristics, NPSH and cavitations in pumps. Slip Factor, Losses and Characteristics of a Centrifugal Pump.

Axial flow pump:-Basic theory, construction, operation, and characteristics. Other water lifting devices :-(a) Air lift pump (b) Jet Pump (c) Hydaulic Ram

Positive displacement Pumps: -Reciprocating Pumps: - Basic theory, types, construction, installation and characteristics

Computational Fluid Dynamics (CFD) : Basic Definition, Applications of CFD, Importance of Governing Equations and the physical meaning of the involved terms. Equation of continuity,

Hydrostatic systems, their function, components and application such as Hydraulic press, lift, crane and fluid drive for machine tools,Intensifier and accumulator.

Hydrokinetic systems: Fluid couplings and torque converter.

Text Books:

1.Hydraulics And Fluid Mechanics Including Hydraulics Machines**,** Dr. P.N.Modi , Dr. S.M. Seth, 14th Edition ,Standard Book House / Rajsons Publications pvt. ltd, Delhi, 2011.
2.Introduction to Fluid Mechanics and Fluid Machines, S.K. Som and G. Biswas, 2nd Ed ,Tata McGraw Hill Education Publishing Company Limited, 2007.

Reference Books:

1. Fluid mechanics and Hydraulic machines, Dr. R. K. Bansal, 9th Edition, Laxmi Publication, Delhi, 2005.

2. Fluid Mechanics and Hydraulics Machines by Dr. A.K. Arora, Standard Publisher, NewDelhi, Sixth Edition.
3. Fluid Power and Machines, Agrawal Tata Mc-Graw Hill
4. J D Anderson, Computational Fluid Dynamics, Basics and Applications– Mc HillInternational Publications
5. Fluid Mechanics, White, F. M., ,5th edition, McGraw-Hill, New York ,2003
6.http://nptel.iitm.ac.in

Course Outcomes: After completion of course, students will be able to:
MEU505.1 Explain the working of a hydro power plant, different hydro prime movers and pumps.
MEU502.2 Evaluate performance of different power generator and pumping system.
MEU502.3 Analyze and select hydro turbine / pump for a given application.
MEU502.4 Apply the proper pumping system as per requirement.
MEU502.5 Use Computational Fluid Dynamics in real fluid flow system.

MEU506 MACHINE DESIGN –I LAB

Teaching Scheme: 02 P **Total: 02** **Credit: 01**
Evaluation Scheme: 25 ICA **Total Marks: 25**

Course Objectives:

I. To develop an ability to apply knowledge of mathematics, science, and engineering
II. To develop an ability to design a system, component to meet desired needs within
realistic constraints
III. To develop an ability to identify, formulate, and solve engineering problems
IV. To develop an ability to use the techniques, skills, & engineering tools

It is representative list of practical. The instructor may choose minimum **Four** experiments as per his/her requirement (so as to cover entire content of course MEU501 Machine Design I) from the list given below

List of the Experiments:

1. Design of Screw Jack
2. Design of Knuckle Joint
3. Design of Bolted joint
4. Design of Riveted Joint
5. Design of helical spring
6. Design of Welded Joint and computer program based on above exercise.

ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A&B

Course Outcomes: After completion of course, students will be able to:
MEU506.1 Analyze the stress and strain on mechanical components; and understandidentify and quantify failure modes for mechanical parts
MEU506.2 Demonstrate knowledge on basic machine elements used in machine design; design machine elements to withstand the loads and deformations for a givenapplication, while considering additional specifications.
MEU506.3 Solve a design problem successfully
MEU506.4 Proficient in the use of software for analysis and design.

MEU507 DYNAMICS OF MACHINES LAB

Teaching Scheme: 02 P **Total: 02** **Credit: 01**
Evaluation Scheme: 25 ICA +25 ESE **Total Marks: 50**
Duration of ESE: 3 hrs.

Course Objective:

I. Perform static and dynamics force analysis for machine components.
II. To understand fundamentals of machine vibrations
III. To understand gyroscopic effect of two wheelers, four wheelers, and aircrafts.
IV. To Analyze free and forced vibrations of machines, engines and structures.
V. To Perform static and dynamic balancing of high speed rotary and reciprocating machines.

It is representative list of practical. The instructor may choose minimum **Six** experiments as per his/her requirement (so as to cover entire content of course MEU502 Dynamics of Machines) from the list given below

1. Graphical solution of problems On Static Force Analysis on half imperial size sheet.
2. Graphical solution of problems On Dynamic Force Analysis on half imperial size sheet, and compare it by analytical method.
3. To determine of mass moment of inertia of simple pendulum & compound pendulum.
4. To determine mass moment of inertia of rigid body using multifelar suspension method.
5. To determine the balancing mass for unbalanced rotary masses system for given set up.
6. To determine gyroscopic couple for gyroscopic apparatus for its spinning speed, verify the same with theoretical value.
7. To determine whirling speed of shaft of given diameter and length with specified end conditions.

8. To determine natural frequency of spring mass system , single rotor system.
9. To determine frequency of forced damped vibrating systems with one degree of freedom.
10. To determine frequency on free damped torsional vibration.
11. To verify Dunkerly's Formula in laboratory for given set up

ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A&B

ESE: The end semester Exam for practical shall be based on performance in one of the experiments and may be followed by sample questions

Course Outcomes: After Completion of Course, the students will able to
MEU507.1Demonstrate ability towards graphically estimating velocity and acceleration.
MEU507.2Exhibit skills towards application of principles of static and dynamics force analysis.
MEU507.3Knowledge attained will comply towards successfully addressing issues relating to gears, governors, cams and followers in real life engineering problems.
MEU507.4Understand free, forced damped vibrations
MEU507.5Measure Radius of Gyrations of simple and compound pendulum,

MEU 508 MACHINING PROCESSES LAB

Teaching Scheme: 02 P Total: 02 Credits: 01
Evaluation Scheme: 25 ICA + 25 ESE Total Marks: 50
Duration of ESE: 3 Hrs

Course Objectives:

I. To learn working of lathe, shaper, milling, drilling, grinding machine
II. To prepare one job on lathe covering taper turning and threading and one composite job on shaper, milling, drilling, grinding machine.

It is representative list of practical. The instructor may choose minimum **Three** experiments as per his/her requirement (so as to cover entire content of course MEU503 Machining Processes) from the list given below:

Demonstration of operations related to lathe, shaper, drilling & grinding m/cs.
One job on lathe covering taper turning and threading.

One composite job on shaper, milling, drilling, grinding machine.

ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A&B

ESE: The end semester Exam for practical shall be based on performance in one of the experiments and may be followed by sample questions

Course Outcomes: After Completion of Course, the students will able to

MEU508.1 Ability to understand working of lathe, shaper, milling, drilling, grinding machine

MEU508.2 Ability to prepare job on lathe covering taper turning and threading and one composite job on shaper, milling, drilling, grinding machine.

MEU508.3 Able to understand necessity, principle, advantages, disadvantage, limitations, applications of Machining Processes

MEU509 METROLOGY AND MEASUREMENT SYSTEM LAB

Teaching Scheme: 02 P Total: 02 Credit: 01

Evaluation Scheme: 25 ICA + 25ESE Total Marks: 50

Duration of ESE: 3 hrs.

Course Objectives:

I. To learn basic principles of linear and angular measurement using precision non-precision measuring instruments.
II. To understand the concept of tolerance and design of different limits gauges.
III. To understand the measurement of gear & screw thread elements.
IV. To learn different methods of force, torque, power, pressure and flow measurement

It is representative list of practical. The instructor may choose minimum **SIX** experiments as per his/her requirement (so as to cover entire content of course MEU504 Metrology and Measurement System) from the list given below:

A) Any Three of Following

1. Determination of Linear/Angular dimensions of a given specimen/part using Precision/Non-Precision measuring instruments
2. Precision Angular Measurement using Sine Bar/Sine Centre, Autocollimator /Angle Dekker.
3. Measurement of circularity/Roundness of a given specimen
4. Measurement of Screw Thread Element by Floating Carriage Micrometer.
5. Testing of Surfaces by using Optical Flat.
6. Measurement of various angles of single point cutting tool by using Profile Projector and Tool Maker's Microscope.
7. Dimensional measurement of a given product using CMM

B) Any Three of Following

1. Measurement of strain using strain gauges.
2. Performance of capacitance transducer as an angular displacement-measuring device.
3. Displacement Measurement by inductive Transducers.
4. Speed measurement by magnetic pick up or photo electric pick up tachometer.
5. Speed measurement by stroboscope
6. Liquid level measurement by capacitance method.
7. Temperature measurement by thermocouple, thermistor and RTD.
8. Pressure Measurement by strain gauge type transducer

ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A&B

ESE: The end semester Exam for practical shall be based on performance in one of the experiments and may be followed by sample questions

Course Outcomes: After Completion of Course, the students will able to
MEU509.1Apply the principles in measurements of various parameters using precision measuring instrument.
MEU509.2 Understand the concept of tolerance and design of different limits gauges.
MEU509.3Understand the measurement of gear & screw thread elements using Floating Carriage Micrometer
MEU509.4 Understand different methods of Angular displacement, Pressure, Speed, Liquid level, Temperature measurement

MEU510 HYDRAULIC MACHINES LAB

Teaching Scheme: 02 P **Total: 02** **Credit: 01**
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks: 50**
Duration of ESE: 3 hrs.

Course Objectives:

I. To demonstrate working of hydraulic turbines.
II. To demonstrate working of hydraulic pumps.
III. To study performance and operating characteristics of turbines.
IV. To study performance characteristics of pumps.

It is representative list of practical. The instructor may choose minimum **Six** experiments as per his/her requirement (so as to cover entire content of course MEU505 Hydraulic Machines) from the list given below

1 Trial of Pelton turbine.
2 Trial of Francis turbine.
3 Trial of Kaplan Turbine.
4 Trial of centrifugal pump.
5 Trial of reciprocating pump.
6 Trial of Axial flow pump
7 Study of multistage pump.
8 Trial of Hydraulic Ram.
9 Study of Hydrostatic components systems.
10 Study of Hydrostatic systems.

ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A&B

ESE: The end semester Exam for practical shall be based on performance in one of the experiments and may be followed by sample questions

Course Outcomes: After Completion of Course, the students will able to
MEU510.1 Develop procedure for standardization of experiments.
MEU510.2 Calibrate measuring device used in hydraulic system.
MEU510.3 Identify the different types of hydraulic turbines and pumps.
MEU510.4 Obtain performance characteristics of turbines and pumps.
MEU510.5 Demonstrate the hydraulic system.
MEU510.6 Test the performance of pumps and turbines.

MEU511 SELF STUDY-I

Teaching Scheme: 00 P **Total: 00** **Credit: 02**
Evaluation Scheme: 25 TA **Total Marks: 25**

Self Study-I is based on one class test each on the basis of 20% curriculum of the courses MEU502 Dynamics of Machines, MEU503 Machining Processes, MEU504 Metrology and Measurement system and MEU505 Hydraulic Machines declared by the respective course coordinator at the beginning of the semester

MEU601 OPERATION RESEARCH MANAGEMENT

Teaching Scheme: 03 L + 00 T Total: 03 Credits: 03

Evaluation Scheme: 15 CT1 + 15 CT2 + 10 TA + 60 ESE Total Marks: 100

Duration of ESE: 2hrs.30 min.

Course Objectives:

I. To illustrate the need of operational research models from the real world system
II. To learn the mathematical tools that are needed to solve optimization problem
III. To gain ability to apply the techniques of OR to solve real life problems in industry

Introduction: Characteristics, phases, limitations, and classification of O.R. Models.
Linear programming: formulation, Graphical method ,simplex methods: Minimization, Initialization and Iteration problems, introduction to duality.

Transportation Models: introduction, methods, formulation of transportation problems, methods for finding initial solution, Modi method.

Assignment Models: introduction, mathematical statement and solution methods of assignment problems, variations of assignment problems.

Network Models: - Network construction, PERT analysis, CPM analysis, cost analysis.

Waiting line models: introduction, classification, analysis of M/M/1and M/M/S models. Introduction to simulation, applications, generation of random numbers.

Sequencing Models: Processing of n jobs through 2 machines, n jobs through 3 machines,

Replacement Models: individual replacement policies.

Dynamic Programming: Introduction, characteristics, Examples involving discrete variables, continuous variables.

Inventory model: Deterministic models, Discount models.

Text Books:

1. Operation Research, H. A. Taha, PHI, 7th Edition.
2. Operations Research, Panneerselvan , PHI, 3nd Edition.

Reference Books:

1. Introduction to Operations Research, Billy E. Gillett, Tata McGraw Hill, 2nd Edition
2. Operation Research , Natarajan, Balasubramani, and Tamilarasi, Pearson Education, 3rd Edition,2008
3. System Simulation with Digital Computer, Narsingh Deo, PHI.

4.http://nptel.iitm.ac.in

Course Outcomes: After completion of course, students will be able to:

MEU604.1 Identify and develop operational research models from the real world system
MEU604.2 Understand the mathematical tools that are needed to solve optimizationproblem
MEU604.3 Able to apply the techniques of OR to solve real life problems in industry

MEU602 MACHINE DESIGN- II

Teaching Scheme: 03 L + 00 T Total: 03 Credits: 03
Evaluation Scheme: 15 CT1 + 15 CT2 + 10 TA + 60 ESE Total Marks: 100
Duration of ESE: 03.00Hrs

Course Objectives:

I. To develop an ability to apply knowledge of mathematics, science, and engineering
II. To develop an ability to design a system, component to meet desired needs withinrealistic constraints.
III. To develop an ability to identify, formulate, and solve engineering problems.
IV. To develop an ability to use the techniques, skills, & engineering tools

Design of Shaft: Material, Design on the basis of strength considering shaft subjected to twisting moment only, bending moment, combined twisting and bending moment, axial load in addition to twisting and bending, Design on the basis rigidity.

Design of Key: Types, strength of keys.

Design of Coupling: Types, requirement of good couplings, design of sleeve coupling, clamp or compression coupling, rigid flange coupling, and flexible flange coupling.

Antifriction Bearing: Types of bearing, construction, designations, standard load rating by AFBMA for static and dynamic loads, life of bearings, selection of bearing, lubrication, mounting and enclosure.

Journal Bearing: Types of Lubrication, stale lubrication, Thick film lubrication, pressure distribution, minimum film thickness, relations of variable-viscosity, coefficient of friction,speed,pressure,length and diameter, bearing modulus, viscosity-Temperature chart,Sommerfield number, selection of lubricant, design procedure and numerical.

Design of flexible machine element: Flat belt types, material and construction of belt, types of drives, slip, creep, Design **of V Belts and Rope drive- Construction** and types, design of V and Rope drive. **Chain Drive** Classification, power, no of teeth on pockets, principal dimensions, election and design of chain. **Wire Rope** Design Procedure.

Design of Gears: Classification, law of gearing, forms and system of teeth, interference, beam strength of teeth, dynamic tooth load, wear tooth load, tooth failure a) Spur gear b) Helical gear : Classification face width, formative teeth number, strength of gear Design of gear c) Bevel gear : Classification, pitch angles, strength of gear, Design of gear d)Worm gear : Types, efficiency of gear, Design of gear.

Design of Clutch- Design of single plate, multiplate clutch

Design of Brake: Design of band brake and shoe brake.

Introduction to design of IC Engine Component.

Note: 1. Use of design data book will be permitted during the examination.

Text Book:
1) Mechanical Engineering Design, Joseph E. Shigley and Charles R. Mischke , Tata McGraw Hill Publications, 6th edition Reprint ,2005
2) Design of Machine Elements, V .B Bhandari, Tata McGraw Hill Publications, 2nd Edition 2007.

Reference Book:

1) Design Of Machine Elements, C.S Sharma & Kamlesh Purohit, Prentice Hall of Indiapublications, New-Delhi, Eastern Economy 3rd Edition, 2003.
2) Machine Design- A Basic Approach, Dr. S.S. Wadhwa and S.S. Jolly, Dhanpat Rai and Company, Delhi , 1stt Edition 2007
3) http://nptel.iitm.ac.in

Design Data Book:
1)Design data hand book for mechanical Engineers, K. Mahadevanan K. Balaveera Reddy, CBS Publishers, Delhi,4th Edition,2009
2) Design Data for Machine Element, B.D.Shiwalkar, Central Techno Publication,2nd Edition,2006

Course Outcomes: After completion of course, students will be able to:
MEU602.1 Analyze the stress and strain on mechanical components; and understand, identify andquantify failure modes for mechanical parts
MEU602.2 Demonstrate knowledge on basic machine elements used in machine design; design machine elements to withstand the loads and deformations for a given application, while considering additional specifications.
MEU602.3 Solve a design problem successfully

MEU602.4 Proficient in the use of software for analysis and design.

MEU603 HEAT TRANSFER

Teaching Scheme: 03 L + 00 T Total : 03 Credits: 03
Evaluation Scheme: 15 CT1 + 15 CT2 + 10 TA + 60 ESE Total Marks: 100
Duration of ESE: 2hrs.30 min.

Course Objectives:

I. To learn basic modes and laws of heat transfer.
II. To learn network analogy for solving composite structure heat transfer problems.
III. To learn problem solving techniques for natural convection, forced convection, two phase systems and radiation.
IV. To solve problems on combined modes in heat transfer.
V. To study and analyze heat exchanger performance

Introduction: heat transfer in engineering, modes of heat transfer, basic laws of heat transfer and their basic equations. Conduction- thermal conductivity and thermal diffusivity effect of phase & temperature on thermal conductivity, one dimensional steady state heat conduction through slab, cylinder & sphere-simple and composite. Combined conduction convection, overall heat transfer coefficient. General heat conduction differential equation. One dimensional steady state conduction with internal heat generation for infinite slab, wire & cylinder. Introduction Two dimensional heat transfer

Insulations, critical radius of insulation, Economic thickness of insulation, Conduction through extended surfaces, analysis of a uniform C.S. fin, efficiency, fin effectiveness, Biot number. Introduction to unsteady state heat conduction, Newton’s law of cooling, lumped heat capacity analysis, Heisler chart

Radiation- general concepts and definitions, black body & grey body concept. Laws of addition- Plank’s, Stefan-Boltzman’s radiation. Concept of shape factor, emissivity factor and radiation heat transfer equation. Radiation errors in temperature, measurement, radiation shield

Forced convection- heat convection, forced and natural convection, boundary layer theory, hydrodynamic & thermal boundary layers, boundary layer thickness. Laminar & turbulent flow over flat plate and through pipes & tubes Dimensionless number and their physical significance Reynold, Prandtl, Nusselt, Grashoff number, empirical correlations for forced convection for flow over flat plate, flow over cylinder and sphere through pipes & tubes & their applications in problem solving.

Free convection- velocity and thermal boundary layers for vertical plate, free convection over vertical cylinder and horizontal plate/cylinder. Boiling and condensation.

Heat exchanger - applications, classifications, overall heat transfer coefficient, fouling. L.M.T.D. & E.N.T.U. methods, temperature profiles, selection of heat exchangers. Introduction to working of heat pipe with and without wick

TextBooks:

1) Heat Transfer by J.P. Holman, Tata McGraw Hill Publication, 9th ed. 2002.
2) Heat Transfer by S.P. Sukhatme, Tata McGraw Hill Publication, 1994.

Reference Book:

1) Heat Transfer data book Convective heat & mass transfer by Kays and Crawford, Tata McGraw Hill Publication.1998
2) Computer aided heat transfer analysis by Adams J.A. & Roger D.E Tata McGraw Hill Publication, 1997.
3) Heat pipe theory application Springer link Publication, by S. W. Chi, 1998.
4)Heat Transfer by P.K. Nag, Tata McGraw Hill Publication, 2005.
5) Heat and Mass Transfer Data Book Book by C P Kothandaraman, S Subramanyam, New Age International, 1994
6) http://nptel.iitm.ac.in

Course Outcomes: After completion of course, students will be able to:
MEU603.1Identify the basic modes of heat transfer.
MEU603.2Compute temperature distribution in steady-state and unsteady-state heat conduction.
MEU603.3Identify and analyse heat transfer through extended surfaces.
MEU603.4Interpret and analyze forced and free convection heat transfer.
MEU603.5Identify the concept and analyze radiation heat transfer.
MEU603.6Design heat exchangers using LMTD and NTU methods

MEU 604 CONTROL SYSTEMS ENGINEERING

Teaching Scheme: 03 L +00T Total = 03 **Credit : 03**
Evaluation Scheme: 15 CT1 + 15 CT2 + 10 TA + 60 ESE **Total Marks : 100**
Duration of ESE: 2hrs.30 min.

Course Objectives:

I. To teach the fundamental concepts of control systems & mathematical modeling of system
II. To study the concept of time response and frequency response of the system
III. To teach the basics of stability analysis of the system

Introduction:

System concept, open and closed loop systems, Mathematical models of physical systems, transfer functions. Block diagrams reduction and signal flow graphs.

Basic control actions and Industrial controllers: Classification of industrial automatic controllers, control actions, proportional controllers, obtaining derivative and integral control action, effects of integral and derivative control action on systems performance. Industrial Control examples: electro hydraulic valves, hydraulic servomotors, electro-pneumatic valves, pneumatic actuators.

Transient Response Analysis: Standard test signals, steady state response of first and second order systems for step, ramp and impulse input, transient response specifications, steady state error and error constants.

Concept of stability Necessary condition for stability, Routh's stability criterion, Root locus concept, construction of Root loci, systems with transportation lag.

Compensation: Introduction to lead and lag compensation

Frequency Response methods: Introduction, Relationship between time & frequency response, concept of polar plot and Bode diagrams.

Study of important automatic speed control systems in machine tools, Prime movers etc. Analysis of performance characteristics. Modeling of Mechanical system elements, such as motion, friction, gear trains etc.

Text Books

1. Modern Control Systems,- by Richard C. Dorf, Robert H Bishop, 11th Edition, Pearson, 2007.
2. Modern Control Engineering, - by Katsuhiko Ogata, PHI, 5th Edition, 2010.

Reference Books

1. Automatic Control Systems, - by Benjamin C. Kuo and Farid Golnaraghi, 9th Edition, John Wiley & Sons, 2009
2. Control Systems Engineering, - by I. J. Nagrath and M. Gopal, 5th Edition, Anshan Pub., 2009.
3. http://nptel.iitm.ac.in

Course Outcomes: After completion of course, students will be able to:

MEU604.1 Ability to apply knowledge of mathematics, science, and engineering

MEU604.2 Ability to design and conduct experiments, as well as to analyze and interpret data

MEU604.3 Ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

MEU604.4 Gaining knowledge of mathematics through differential and integral calculus, and basic science, computer science, and engineering sciences, MEU604.5 Analysis and designing of complex electrical and electronic devices, software, and systems containing hardware and software components, as appropriate to electrical engineering

MEU605 INDUSTRIAL MANAGEMENT & QUALITY CONTROL

Teaching Scheme: 03 L + 00 T   Total: 03   Credits: 03

Evaluation Scheme: 15 CT1 + 15 CT2 + 10 TA + 60 ESE   Total Marks: 100

Duration of ESE: 2hrs.30 min.

Course Objectives:

I. To impart fundamental knowledge and skill sets required in the IndustrialManagement and Engineering profession, which include the ability to apply basic knowledge of mathematics, probability and statistics, and the domain knowledge of Industrial Management and Engineering.

II. To produce graduates with the ability to adopt a system approach to design, develop,implement and innovate integrated systems that include people, materials, information, equipment and energy.

III. To enable students to understand the interactions between engineering, business, technological and environmental spheres in the modern society.

IV. To enable students to understand their role as engineers and their impact to society at large

Introduction:

Concept, principles and techniques of management, evolution of management thoughts, scientific management, modern management, principles of management, management and administration, functions of management, various areas of management. Organization structure and relationship.

Marketing Management:

Different types of market research, various marketing strategies, new product development, product life cycle,and advertising media.

Financial Management:

Need for finance, elements of cost, waste and scrap, financial ratios, profit and loss statements, balance sheet.

Personnel Management:

Functions of Personnel Management, human resources planning, recruitment and training, workers participation in management, industrial safety.

Materials Management , Estimating & Costing:

Classes of materials, purchasing methods and procedure, inventory control, stores, EOQ, ABC analysis. Objectives of estimating and costing, elements of cost,

Quality function in Industry: - Introduction, dimensions of product quality, Three aspect of quality, Evolution of Quality:, Quality costs, Customer-Orientation: Internal & External Customer Concept , seven basic quality control tools.

Statistical Quality Control: - Process Capability, Measuring process capability, Control Charts, types of control charts, Variables charts : (X bar and R- charts), Attribute charts : (p, c, u charts) , Construction and analysis of above mentioned charts.

Sampling Inspection: - Introduction to Sampling Inspection, Types of sampling plan,: (Single sampling, Double sampling and Sequential Sampling Plan).

Operating Characteristics (OC) Curve: - Introduction,Parameters of OC Curves - (Producer'sRisk, Consumer's Risk, Acceptance Quality Level (AQL) etc, Zone of Acceptance,Rejection and Indecision

Text Books:

1.Essentials of Management,, Koontz, Harold, McGraw Hill Education India Ltd. New Delhi , 2009 Edition.

2.Purchasing and Materials Management ,Gopalkrishnan, McGraw Hill Education India Ltd. New Delhi , 2010 Edition.

3.Statistical Quality Control, E.L.Grant, R.S.Leavenworth, Tata McGraw HillPublishing Ltd, New Delhi, 6th Edition, 2005.

Reference Books:

1. Total Quality Management, L.Suganthi, A.A.Samuel, Prentice Hall of India, New Delhi, 2nd Edition, 2005.

2. Quality Engineering Handbook, Thomas Pyzdek, Roger W. Berger, Tata McGraw Hill Publication, New Delhi, 1996.

3. Quality Handbook, J.M Juran, McGraw Hill Publication, New Delhi, 4th Edition, 2005.

4. Quality Control and TQM, P.L.Jain, Tata McGraw Hill Publishing Ltd, New Delhi, 6th Edition, 2001.

5.Quality Control, Tata McGraw Hill Publishing Ltd, TTTI, Madras, 11th Edition, 2005

6.http://nptel.iitm.ac.in

Course outcomes: After the course, the students are expected to be able to:

MUE605.1 Design and conduct experiments, analyze, interpret data and synthesize valid conclusions.

MEU605.2 Design a system, component, or process, and synthesize solutions to achieve desired needs

MEU605.3 Use the techniques, skills, and modern engineering tools necessary for engineering practice with appropriate considerations for public health and safety, cultural, societal, and environmental constraints

MEU605.4 Function effectively within multi-disciplinary teams and understand the fundamentalprecepts of effective project management.

MEU605.5 Design and perform experiments to determine critical areas of product development and analyze the results and form conclusions for quality improvement.

MEU605.6 Use statistical process control techniques (SPC) recognized throughout industries to ensure the quality level of products

MEU606 COMPUTATIONAL LAB

Teaching Scheme: 02 P Total: 02 Credit: 01

Evaluation Scheme: 25 ICA + 25 ESE Total Marks: 50

Duration of ESE: 3 hrs.

Course Objectives:

I. This course aims to develop a practical approach to mathematical problem solving.

II. The course will introduce to many commonly used tools and techniques in numerical work. Due emphasis will be placed on converting algorithms and techniques to working computer codes. Carefully designed examples will help in understanding the nuances of the numerical techniques and computer applications of the same.

III. Solving through programming. It aims to train the student to the basic concepts of the programming language.

IV. This course involves a lab component which is designed to give the student hands on experience with the concepts

At least Six tasks from any of the following, using MATLAB/SciLab/ SimulationX or any equivalent software package or programming language.

1) Solution of linear simultaneous equations
2) Solution of non-liner equations
3) Solution of differential equations
4) Curve fitting problems
5) Plots of potential flow
6) Integration of velocity profile to determine displacement and momentum thickness
7) Determination of adiabatic flame temperature
8) Determination of nature of nozzle flow
9) Design of spring

10) Design of power screw
11) Simulation of waiting line models
12) Simulation of Inventory models

ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A&B

ESE: The end semester Exam for practical shall be based on performance in one of the experiments and may be followed by sample questions

Course outcomes: After the course, the students are expected to be able to
MEU606.1 Identify situations where computational methods and computers would be useful.
MEU606.2 Given a computational problem, identify and abstractthe programming task involved.
MEU606.3 Approach the programming tasks using techniques learned
MEU606.4 Choose the right data representation formats based on the requirements of theproblem.
MEU606.5 Use the comparisons and limitations of the various programming constructs and choose theright one for the task in hand.
MEU606.6 Write the program on a computer, edit, compile, debug, correct, recompile and run it.
MEU606.7Identify tasks in which the numerical techniques learned are applicable and apply them to write programs, and hence use computers effectively to solve the task.

MEU607 MACHINE DESIGN –II LAB

Teaching Scheme: 02 P **Total: 02** **Credit: 01**
Evaluation Scheme: 25 ICA **Total Marks: 25**

Course Objectives:

I. To develop an ability to apply knowledge of mathematics, science, and engineering
II. To develop an ability to design a system, component to meet desired needs withinrealistic constraints.
III. To develop an ability to identify, formulate, and solve engineering problems.
IV. To develop an ability to use the techniques, skills, & engineering tools

It is representative list of practical. The instructor may choose minimum **Six** experiments as per his/her requirement (so as to cover entire content of course MEU602 Machine Design II) from the list given below

List of the Experiments:

1) Design of shaft

2) Design of bushed pin type flexible coupling.
3) Design of I.C. Engine parts.
4) Design of Steel wire rope of lift
5) Design of Chain Drive.
6) Design of Belt Drive
7) Design of Antifriction Bearing
8) Design of Journal Bearing

Note: Team Work shall consist of drawing sheet based on above exercise and design report.

ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A&B

Course Outcomes: After completion of course, students will be able to:

MEU607.1 Analyze the stress and strain on mechanical components; and understand, identify andquantify failure modes for mechanical parts
MEU607.2 Demonstrate knowledge on basic machine elements used in machine design; design machine elements to withstand the loads and deformations for a given application, while considering additional specifications.
MEU607.3 Solve a design problem successfully
MEU607.4 Proficient in the use of software for analysis and design.

MEU608 HEAT TRANSFER LAB

Teaching Scheme: 02 P **Total: 02** **Credit: 01**
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks: 25**
Duration of ESE: 3 hrs.

Course Objectives:

I. To learn basic modes and laws of heat transfer.
II. To learn network analogy for solving composite structure heat transfer problems.
III. To learn problem solving techniques for natural convection, forced convection, two phase systems and radiation.
IV. To solve problems on combined modes in heat transfer.
V. To study and analyze heat exchanger performance

It is representative list of practical. The instructor may choose minimum **Six** experiments as per his/her requirement (so as to cover entire content of course MEU603 Heat Transfer) from the list given below

LIST OF PRACTICALS

1. Determination of thermal conductivity of a metal bar.
2. Determination of thermal conductivity of insulating powder.
3. Determination of heat transfer through composite wall.
4. Determination of fin efficiency.
5. Verification of Stefan-Boltzman's law.

6 Determination of emissivity of grey body.

7. Determination of heat transfer coefficient for forced convection.
8. Determination of heat transfer coefficient for natural convection.
9. Trial on double pipe heat exchanger.
10. Determination of efficiency of cross flow heat exchanger.
11. To determine temperature distribution and efficiency of heat pipe

Note:

ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A&B

ESE: The end semester Exam for practical shall be based on performance in one of the experiments and may be followed by sample questions

Course Outcomes: After completion of course, students will be able to:

MEU608.1 Estimate the thermal conductivity of insulating powder and metal bar
MEU608. 2 Estimate the effective thermal resistance in composite slabs.
MEU608.3 Estimate heat transfer coefficient in forced convection and in natural convection and correlate with theoretical values.
MEU608.4 Determine surface emissivity of a test plate

MEU 609 CONTROL SYSTEMS ENGINEERING LAB

Teaching Scheme: 02 P **Total: 02** **Credit: 01**

Evaluation Scheme: 25 ICA + 25 ESE **Total Marks: 50**

Duration of ESE: 3 hrs.

Course Objectives

I. To teach the fundamental concepts of control systems & mathematical modeling of system

II. To study the concept of time response and frequency response of the system

III. To teach the basics of stability analysis of the system

It is representative list of practical. The instructor may choose minimum Six experiments from any of the following list using MATLAB/SciLab or any equivalent software package as per his/her requirement (so as to cover entire content of course MEU604 Control System Engineering) from the list given below

1) Partial fraction expansion
2) Transformation of Mathematical models
3) Transient response Analysis (Two cases)
4) Root-Locus plots
5) Bode diagram
6) An Industrial visit covering control systems applications
7) Analysis of performance characteristics of speed control system
8) Electro hydraulic and electro-pneumatic valves.

Note:
ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A&B
ESE: The end semester Exam for practical shall be based on performance in one of the experiments and may be followed by sample questions

Course Outcomes: After completion of course, students will be able to:

MEU609.1 Ability to apply knowledge of mathematics, science, and engineering
MEU609.2 Ability to design and conduct experiments, as well as to analyze and interpret data
MEU609.3 Ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
MEU609.4 Knowledge of mathematics through differential and integral calculus, and basic science, computer science, and engineering sciences, necessary to analyze and design complex electrical and electronic devices, software, and systems containing hardware and software components, as appropriate to electrical engineering

MEU610 MINOR PROJECT

Teaching Scheme: 02 P **Total: 02** **Credit: 02**
Evaluation Scheme: 25 ICA +25 ESE **Total Marks: 50**
Duration of ESE: 3 hrs.

Course Objectives:

I. To prepare the students to examine any design or process or phenomenon.
II. To encourage the process of independent thinking and working.
III. To develop for solving the conceive problem by designing and analyzing.
IV. To build the ability of working in a team for the betterment of the society.

Minor project includes topics such as,
1) Design,
2) Fabrication,
3) Analysis,
4) Simulations,
5) Field study
6) Market survey and
7) Case study etc.
The guide would be allotted by the department to the batch of 15 students. However the topic may be given to the individual student or a group of not more than three students. Students shall prepare and submit the report in consultation with the guide in three copies based on the work done. Committee of two faculties be set up to review the report and attend the presentation of the students. Marks would be given by the committee based on the quality of the work, report and presentation.

Note:

ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A&B

ESE: The end semester Exam for practical shall be based on performance in one of the experiments and may be followed by sample questions

Course Outcomes: After completion of course, students will be able to:

MEU610.1 Integrate the fundamentals knowledge of subjects to search the related literature and devise solution.

MEU610.2 Conceive a problem statement either from rigorous literature survey or from the requirements raised from need analysis.

MEU610.3 Generate and implement innovative ideas for social benefit.

MEU610.4 Design, implement and test the prototype/algorithm in order to solve the conceived problem.

MEU610.5 Write comprehensive report on mini project work.

MEU610.6 Work in a group to develop the leadership/interpersonal skills for finishing task within timeframe.

MEU611 SELF STUDY-II

Teaching Scheme: 00 P **Total: 00** **Credit: 02**
Evaluation Scheme: 25 TA **Total Marks: 25**

Self Study-I is based on one class test each on the basis of 20% curriculum of the courses MEU601 Operation Research Management, MEU603 Heat Transfer, MEU604 Control

System Engineering, MEU605 Industrial Management and Quality Control declared by the respective course coordinator at the beginning of the semester

MEU612 INDUSTRIAL LECTURE I

Teaching Scheme:01T **Total: 01** **Credit: 00**

The industrial Lectures of the experts from nearby industries will be organized on the topics such as Design, Production Engineering, Manufacturing Process, Quality Management, Thermal Engineering, Maintenance, Heat Transfer etc.

Note: Assessment of course MEU612 Industrial Lecture –I is scheduled in VII semester with course MEU711 Industrial Lecture – II

Govt. College of Engineering Amravati

(An Autonomous Institute of Govt. of Maharashtra)

Curriculum

for

III and IV Semesters

of

B. Tech. (Mechanical Engineering)

Department of Mechanical Engineering

2011-12

GOVERNMENT COLLEGE OF ENGINEERING, AMRAVATI

MECHANICAL ENGINEERING DEPARTMENT

SCHEME FOR B. Tech. (Mechanical Engineering) from academic year 2011-2012

Course Code	Name of the Course	Teaching Scheme (Hrs./week)				Evaluation scheme							Credits
						Theory				Practical			
		L	T	P	Total	TA	CT1	CT2	ESE	ICA	ESE	Total	
Semester – III													
SHU301	Engineering Mathematics-III	3	-	-	3	10	15	15	60	-	-	100	3
CEU303	Strength of Materials	4	-	-	4	10	15	15	60	-	-	100	4
EEU311	Electrical Drives and Control	4	-	-	4	10	15	15	60	-	-	100	4
MEU301	Material Science and Engineering	3	-	-	3	10	15	15	60	-	-	100	3
MEU302	Engineering Thermodynamics	4	-	-	4	10	15	15	60	-	-	100	4
CEU307	Strength of Materials Lab.	-	-	2	2	-	-	-	-	25	25	50	1
EEU312	Electrical Drives & Control Lab.	-	-	2	2	-	-	-	-	25	25	50	1
MEU303	Material Science and Engineering Lab	-	-	2	2	-	-	-	-	25	25	50	1
SHU301	General Proficiency-II	1	-	2	3	-	-	-	-	25	25	50	2
		19	**0**	**8**	**27**	**50**	**75**	**75**	**300**	**100**	**100**	**700**	**23**
Semester – IV													
MEU401	Fluid Mechanics	4	-	-	4	10	15	15	60	-	-	100	4
MEU402	Kinematics of Machines	3	1	-	4	10	15	15	60	-	-	100	4
MEU403	Thermal Engineering & Energy Conversion	4	-	-	4	10	15	15	60	-	-	100	4
MEU404	Manufacturing Processes	4	-	-	4	10	15	15	60	-	-	100	4
MEU405	Machine Drawing	2	-	-	2	4	8	8	30	-	-	50	2
MEU406	Fluid Mechanics Lab.	-	-	2	2	-	-	-	-	25	25	50	1
MEU407	Kinematics of Machines Lab.	-	-	2	2	-	-	-	-	25	25	50	1
MEU408	Manufacturing Processes Lab.	-	-	2	2	-	-	-	-	25	25	50	1
MEU409	Computer Aided Drafting Lab.	-	-	4	4	-	-	-	-	50	50	100	2
		17	**1**	**10**	**28**	**44**	**68**	**68**	**270**	**125**	**125**	**700**	**23**

Course Code	Name of the Course	Teaching Scheme (Hrs./week)				Evaluation scheme							Credits
						Theory				Practical			
		L	T	P	Total	TA	CT1	CT2	ESE	ICA	ESE	Total	
Semester – V													
MEU501	Machine Design – I	3	-	-	3	10	15	15	60	-	-	100	3
MEU502	Dynamics of Machines	3	-	-	3	10	15	15	60	-	-	100	3
MEU503	Machining Processes	3	-	-	3	10	15	15	60	-	-	100	3
MEU504	Metrology and Measurement system	4	-	-	4	10	15	15	60	-	-	100	4
MEU505	Operation Research Management	3	-	-	3	10	15	15	60	-	-	100	3
MEU506	Machine Design-1 Lab.	-	-	2	2	-	-	-	-	25	-	25	1
MEU507	Dynamics of Machines Lab.	-	-	2	2	-	-	-	-	25	25	50	1
MEU508	Machining Processes Lab.	-	-	2	2	-	-	-	-	25	25	50	1
MEU509	Metrology Measurement Systems Lab.	-	-	2	2	-	-	-	-	25	25	50	1
MEU510	Computational lab.	-	-	2	2	-	-	-	-	25	25	50	1
MEU511	Self study -I	-	-	-	-	-	-	-	-	25	-	25	2
		16	**0**	**10**	**26**	**50**	**75**	**75**	**300**	**150**	**100**	**750**	**23**
Semester – VI													
MEU601	Hydraulic Machines	3	-	-	3	10	15	15	60	-	-	100	3
MEU602	Machine Design-II	3	-	-	3	10	15	15	60	-	-	100	3
MEU603	Heat Transfer	3	-	-	3	10	15	15	60	-	-	100	3
MEU604	Control Systems Engineering	3	-	-	3	10	15	15	60	-	-	100	3
MEU605	Industrial Management and Quality Control	3	-	-	3	10	15	15	60	-	-	100	3
MEU606	Hydraulic Machines Lab.	-	-	2	2	-	-	-	-	25	25	50	1
MEU607	Machine Design – II Lab.	-	-	2	2	-	-	-	-	25	-	25	1
MEU608	Heat Transfer Lab.	-	-	2	2	-	-	-	-	25	25	50	1
MEU609	Control Systems Engineering Lab.	-	-	2	2	-	-	-	-	25	25	50	1
MEU610	Minor Project	-	-	2	2	-	-	-	-	25	25	50	2
MEU611	Self Study-II	-	-	-	-	-	-	-	-	25	-	25	2
MEU612	Industrial Lecture - I	1	-	-	1	-	-	-	-	-	-	-	-
		16	**0**	**10**	**26**	**50**	**75**	**75**	**300**	**150**	**100**	**750**	**23**

The ESE (Theory) duration for all courses shall be 2hrs 30 min except courses MEU101, MEU501 and MEU602 for which the ESE duration will be 3hrs.
ICA - Internal Continuous Assessment; ESE - End Semester Examination
Assessment of course MEU612 Industrial Lecture -I is scheduled in VII semester with course MEU711 Industrial Lecture - II
The course MEU511 Self Study-I is based on the basis of 20% curriculum of the courses MEU502, MEU503, MEU504 and MEU505 declared by the respective course coordinator at the beginning of the semester
The course MEU611 Self Study-II is based on the basis of 20% curriculum of the courses MEU601, MEU603, MEU604 and MEU605 declared by the respective course coordinator at the beginning of semester
One Faculty member shall be appointed as Course Coordinator for the course Self Study and his/ her teaching workload shall be considered as 01 hr per week

Course Code	Name of the Course	Teaching Scheme (Hrs./week)				Evaluation scheme							Credits
						Theory				Practical		Total	
		L	T	P	Total	TA	CT1	CT2	ESE	ICA	ESE		
						Semester – VII							
MEU701	Refrigeration & Air Conditioning	3	-	-	3	10	15	15	60	-	-	100	3
MEU702	Mechatronics	3	-	-	3	10	15	15	60	-	-	100	3
MEU703	Elective-I	3	-	-	3	10	15	15	60	-	-	100	3
MEU704	Institute Level Elective	3	-	-	3	10	15	15	60	-	-	100	3
MEU705	Refrigeration and Air Conditioning Lab	-	-	2	2	-	-	-	-	25	25	50	1
MEU706	Mechatronics Lab.	-	-	2	2	-	-	-	-	25	25	50	1
MEU707	Elective-I Lab.	-	-	2	2	-	-	-	-	25	25	50	1
MEU708	Project Stage-I	-	-	4	4	-	-	-	-	50	-	50	2
MEU709	Seminar	-	-	2	2	-	-	-	-	50	-	50	1
MEU710	Industrial Training / Visit	-	-	-	-	-	-	-	-	50	-	50	2
MEU711	Industrial Lecture - II	1	-	-	1	-	-	-	-	25	-	25	1
MEU712	Self Study-III	-	-	-	-	-	-	-	-	25	-	25	2
		13	**0**	**12**	**25**	**40**	**60**	**60**	**240**	**275**	**75**	**750**	**23**
						Semester – VIII							
MEU801	IC Engines	3	-	-	3	10	15		60	-	-	100	3
MEU802	CAD / CAM	3	-	-	3	10	15		60	-	-	100	3
MEU803	Elective-II	3	-	-	3	10	15		60	-	-	100	3
MEU804	Elective-III	3	-	-	3	10	15		60	-	-	100	3
MEU805	IC Engines Lab.	-	-	2	2	-	-		-	25	25	50	1
MEU806	CAD/CAM Lab.	-	-	2	2	-	-		-	25	25	50	1
MEU807	Elective-III Lab.	-	-	2	2	-	-		-	25	25	50	1
MEU808	Project	-	-	6	6	-	-		-	75	100	175	6
MEU809	Self Study-IV	-	-	-	-	-	-		-	25	-	25	2
		12	**0**	**12**	**24**	**40**	**60**		**240**	**175**	**175**	**750**	**23**

The ESE (Theory) duration for all courses shall be 2hrs 30 min except courses MEU101, MEU501 and MEU602 for which the ESE duration will be 3hrs.

ICA – Internal Continuous Assessment; ESE – End Semester Examination

Assessment of course MEU612 Industrial Lecture -I is scheduled in VII semester with course MEU711 Industrial Lecture - II

The course MEU712 Self Study-III is based on the basis of 20% curriculum of the courses MEU701, MEU702 and MEU703 declared by the respective course coordinator at the beginning of the semester

The course MEU809 Self Study-IV is based on the basis of 20% curriculum of the courses MEU801, MEU802, MEU803 and MEU804 declared by the respective course coordinator at the beginning of semester

One Faculty member shall be appointed as Course Coordinator for the course Self Study and his/ her teaching workload shall be considered as 01 hr per week

Students of this department will select any one Interdisciplinary Elective offered by other other departments. Interdisciplinary Elective shown below will be offered to the students of other departments

Sr. No.	**MEU703 ELECTIVE-I**	**MEU704 INTERDISCIPLINARY ELECTIVE**	**MEU803 ELECTIVE-II**	**MEU804 ELECTIVE-III**
1	New and Renewable Energy Sources	Quality System Engineering	Power Plant Engineering	Automobile Engineering
2	Tool Engineering	Human Resource Management	Production Management	Mechanical Vibrations
3	Experimental Stress Analysis	Entrepreneurship Development	Machine Tool Design	Finite Element Methods
4		Thermal Engineering	Lean Manufacturing	

SHU301 ENGINEERING MATHEMATICS-III

Teaching Scheme 03 L + 00 T Total :03 Credit: 03

Marking scheme: 15CT1 + 15CT2 + 10TA + 60 ESE Total Marks: 100

Duration of ESE: 2Hrs.30min

Course objectives:

I. To solve linear, partial differential equations with constant coefficient.
II. To analyze methods of separation of variables & apply it to solve thermal equations for different states.
III. To enhance thinking power with statistics methods.
IV. To develop numerical methods aided by technology to solve algebraic, transcendental, and differential equations, and to calculate derivatives and integrals

Linear Differential Equations with constant coefficients:

General solution to L.D.E. of nth order with constant coefficients, rules for finding C.F., General method for finding P.I., P.I. of some standard functions, Method of Variation of Parameters, Cauchy's and Legendre's L.D.E., applications of L. D. E. to deflection of beam, bending moments.

Partial Differential Equations:

Complete solution of PDE, Linear and non-linear PDE of types (i) f(p, q)= 0, (ii)f(p, q, z)= 0, (iii)f(p, q, x, y)= 0,(iv)f(p, q, x, y, z)= 0 i.e. Lagrange's form Pp+Qq=R and Clairaut's form z = px + qy + f(p, q), (v) Equations reducible to above forms. Complete solution of PDE of first and second order by method of separation of variables.

Laplace Transform:

Definition, standard formulae and properties of LT., Inverse Laplace Transform, Convolution Property.

Numerical Methods:

Solution of system of linear equations by Crout's method, Gauss Siedal method.

Numerical solution of ordinary differential equations: Taylor's series method, Modified Euler's method, Runge Kutta method.

Statistics:

Correlation: coefficient of Correlation, lines of regression, Curve fitting by least square method. Probability distribution: Binomial, Poisson and Normal.

Text Books:

1. Text Book of Applied Mathematics, P. N. Wartikar and J.N.Wartikar, Pune Vidyarthi Griha, Pune, 2001.

2. Higher Engineering Mathematics, B. S. Grewal, Khanna Publication, 40th edition, New Delhi, 2007.

Reference Books:

1. Advanced Engineering Mathematics, Kreyzig, John Wiley & Sons, 9th edition, 1995.
2. Advanced Engineering Mathematics, John Bird, 5th edition, Elsevier Publication 2007.
3. Higher Engineering Mathematics, C. R. Wiley, 8th edition, John Wiley and Sons, 1999

Course Outcomes: After completion of the course students will be able to:
SHU301.1 Solve linear PDEs by analyzing the behaviour of solutions.
SHU301.2 Apply the knowledge of linear PDE in heat flow equations and Laplace equations.
SHU301..3 Analyze various relations through correlation & regression methods.
SHU301.4 Apply numerical methods in modern scientific computing.

CEU303 STRENGTH OF MATERIALS

Teaching Scheme : 03 L + 01 T   Total : 04   Credits: 04

Evaluation Scheme: 15 CT1 + 15 CT2 + 10 TA + 60 ESE   Total Marks: 100

Duration of ESE: 2hrs.30 min.

Course objectives:

I. To establish the fundamental concepts of stresses, strains and deformation response of elastic solids under external loading conditions.
II. To understand shear force and bending moment diagrams for various loading conditions.
III. To understand principal stresses and strains analytical and graphically.
IV. To build the necessary theoretical background for structural analysis involving torsion and strain energy.
V. To develop the analytical skill for use of the theories of failure and enable to apply the same systematically.
VI. To make students relate the knowledge for design of different machine elements.

Mechanical properties: Concept of direct, bearing and shear stresses and strains, stress strain relations, Biaxial and triaxial loading, elastic constants and their relationship, stress-strain diagrams and their characteristics for mild steel, TOR steel and concrete, Generalized Hook's law, factor of safety.

Uniaxial stresses and strains: Stresses and strains in compound bars in uniaxial tension and compression, temperature stresses in simple restrained bars and compound bars of two metals only.

Shear force & bending moment diagrams: Beams, loading and support conditions, bending moment, shear force and axial load diagrams for all types of loadings for simply supported beams, cantilevers and beams with overhangs, relation between shear forces, bending moment and loading intensity.

Stresses in beams (Bending, Shear):

i) Bending: Theory of simple bending, section modulus, moment of resistance, bending stresses in solid, hollow and built up section.

ii) Shear: Distribution of shear stresses on beam cross sections,

iii) Strain energy under uniaxial tension and compression, impact loads and instantaneous stresses.

Torsion: Theory of torsion & assumptions, derivation of torsion equation, polar modulus, stresses in solid & hollow circular shaft

Principal stresses: Biaxial stress system, principal stresses, principal planes, Mohr's circle of stresses, principal strains.

Thin and Thick cylinders and thin spherical shells subjected to internal pressures.

Combined direct & bending stresses: Combined direct and bending stresses, applications to short columns with eccentric loads.

Slope & deflection of beams: Slope & deflection in statically determinate beams subjected to point loads, uniformly distributed loads, moments by Macaulay's method, Moment Area method and Conjugate Beam method.

Columns: Theory of long columns, Euler, Rankin formula

Introduction to fatigue

Text Books:

1. Engineering Mechanics of Solids, E.P. Popov, 2nd Edition, Prentice Hall of India, 1998
2. Mechanics of Materials, by Beer, Johnston and DeWolf, 3rd Edition, Tata McGraw Hill Publication, New Delhi, 2002.

Reference Books :

1. Mechanics of Materials, Gere and Timoshenko, 2nd Edition, CBS publishers, 2002.
2. Mechanical of Solids in Introduction, Laudner T. J. and Archer R. R., McGrawHill International Edition, 1994.
3. Theory and Problems of Strength of Materials, William A. Nash, 3rd Edition, Schaum's Outline Series, McGraw Hill International Editions, 1994.

Course Outcomes: After completion of the course students will be able to:

CEU303.1 Analyze and design structural members subjected to composite loading using fundamental concepts of stress, strain, elastic behavior

CEU303.2 Identify, formulate and solve the cases related to static design in engineering applications

CEU303.3 solve the problems of simple, combined bending and torsion in shafts

CEU303.4 Draw the principal stress and strain problems graphically

CEU303.5 Apply the appropriate theory of failure to analyze machine components

EEU311 ELECTRICAL DRIVES AND CONTROL

Teaching Scheme : 04 L Total : 04 Credit : 04

Evaluation Scheme : 15 CT1 + 15 CT2 + 10 TA + 60 ESE Total Marks :100

Duration of ESE: 2 hrs. 30 min

Course objectives:

I. To understand the working principle of power transistors, power MOSFET, SCR.

II. To understand basic construction, its principle, characteristics, power flow diagram, starters speed control methodology.

III. To understand basic types of single phase and 3-phase motors, their working principles and its applications

IV. To understand the construction, characteristics of a semi conducting devices

Concept of General Electric Drives: Classification and comparison of electric drive system, cooling and heating of electric motors, Theory and working principle of power transistors, power MOSFET, SCR.

Basic Characteristics of DC Motors: Torque equation, modified speed–torque characteristics, starting and braking of electric DC motors, comparison of mechanical and electric braking methods, conventional speed control methods.

Classification of AC Motors: Construction, types, characteristics of 3-phase IM, torque equation, applications, staring and braking of 3-phase IM, conventional speed control methods.

Thyristorised stator voltage control of 3-phase IM, (V/F) control, slip–power recovery scheme, thyristorised armature voltage control of DC motors using phase control and thyristorised chopper.

Introduction, principle, construction and working of DC servomotors, stepper motors, brushless DC motors, classification of 1-phase IM, construction, principle, working and applications, principle and working of Universal motor, linear IM

Industrial Applications: Classes of duty, selection of an electric drive for particular applications such as steel mill, paper mill, cement, textile mill, electric traction, coal mining, etc.

Text Books:

1. Electric machines, I. J. Nagrath and D. P. Kothari, 2nd Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2008.
2. Electrical Technology (AC and DC drives) Vol-II and Vol-III B. L. Thereja, 4th Edition, Dhanpat Rai and Sons, 2002.

Reference Books:

1. Electric Motor Drives-modeling, analysis and control, R. Krishnan, 1st Edition, Pearson Edu, 2006.
2. Utilization of Electrical Power, R.K. Rajput, 5th Edition, Laxmi publications, 2007

Course Outcomes: After completion of the course students will be able to:

EEU311.1 Select electrical drive for industries

EEU311.2 Identify types of DC motor and 3 phase induction motor

EEU311.3 Evaluate the performance characteristics of DC motor and 3 phase induction motor

EEU311.4 Select special motors

EEU311.5 Apply starting braking and speed control methods

MEU301 MATERIAL SCIENCE AND ENGINEERING

Teaching Scheme : 03L **Total : 03** **Credit : 03**

Evaluation Scheme : 15 CT1 + 15 CT2 + 10 TA + 60 ESE **Total Marks: 100**

Duration of ESE: 2 hrs. 30 min

Course objectives:

I. Understand the basic structure of metals and alloys

II. Understand the relationship between structure and property of metals and alloys

III. Learn about structure, property and applications of industrially useful metals and alloys

IV. Develop the ability to suitably alter the properties of metals and alloys by application of heat treatments and other processes

Solid Crystalline Structure: Metal structure and crystallization, Nucleation and growth in metals and alloys, single and polycrystalline materials, classification of crystals, FCC, BCC, HCP lattice, lattice structure, unit cell, packing density and co-ordination number, Crystallographic directions and planes.

Theory of Alloys and Alloy Diagrams: Alloys, solid solutions, intermetallic compounds, binary diagrams, its construction, eutectic, peritectic, eutectoid reactions, Lever rule.

Construction and study of Iron-Carbon equilibrium diagram,

Plain carbon steels: Microstructure and properties, effect of impurities and grain size on the properties of p.c. steels.

Alloy Steels: Effect of alloying elements on the structure and properties of steels, classification of alloying elements, effect on constitution of steels, effect on transformation of steels, low and high alloy engineering steels.

High Speed Steels: Their heat treatment and applications, ferritic, austenitic, martensitic.

Stainless Steels: Properties and applications, weld decay in stainless steels.

Cast Irons: Constitution and properties of white, grey, nodular and malleable cast irons, their applications, alloy cast irons.

Non-Ferrous Materials: Brasses and bronzes, types, properties, applications, alloys of aluminum, lead, tin, zinc their applications. Bearing metal, season cracking, and precipitation hardening.

Principles of Heat Treatment: Annealing, normalizing, tempering, Iso-thermal transformation diagrams (S-curves), superimposition of S-curve on continuous cooling diagram, characteristics of pearlite, bainite, martensite transformation on continuous cooling. hardenability, quenching media, severity of quench, austempering, martempering, patenting, retained austenite, sub-zero treatment.

Methods of surface hardening: Carburizing, nitriding, cyaniding, flame hardening, induction hardening.

Mechanical working of metals: Deformation of metals, slip, twinning, critical resolved shear stress, deformation in single and polycrystalline materials, stress-stain curve, Luder bands, recovery, re-crystallization, grain growth, hot and cold working-advantages, disadvantages. fracture, creep, fatigue failures. Strengthening mechanisms e.g. strain hardening, age hardening, precipitation hardening.

Welding Metallurgy: Weldabilty, metallurgical effects of welding, residual stresses, heat affected zone, microstructure changes during welding, grain size, cracking, and corrosion characteristics of welds.

Powder Metallurgy: Manufacture of metal powders, single die, double die compaction, sintering, manufacture of porous bearings and cemented carbide tip tools, advantages, limitations, application of powder metallurgy.

Text Books

1. Introduction to Material Science and Engineering, W.F. Smith, 4th Edition, Mc-Graw Hill International London, 2006.
2. Material Science and Engineering, V. Raghavan, 5th Edition, PHI. 2005
3. Introduction to Physical Metallurgy, S. Avner, 5th Edition ,Tata Mc-Graw Hill, New Delhi, 2006

Reference books

1. Mechanical Metallurgy, G.E. Dieter, 3rd Edition, Mc-Graw Hill International, London, 1999.
2. Physical Metallurgy for Engineers, 4th Edition, Clarke and Varney,. 2004.
3. Powder Metallurgy, A.K. Sinha 1st Edition., 1991.
4. Engineering Physical Metallurgy, Y. Lakhtin, 2nd Edition, Mir Publications, 1999.

Course Outcomes: After completion of the course students will be able to:
MEU 301.1 Understand the basic structure of metals and alloys
MEU 301.2 Understand the relationship between structure and property in metals and alloys
MEU 301.3 Understand structure, property and applications of industrially useful metals and alloys
MEU 301.4 Develop the ability to suitably alter the properties of metals and alloys by application of heat treatments and other processes

MEU302 ENGINEERING THERMODYNAMICS

Teaching Scheme : 04L **Total : 04** **Credit: 04**
Evaluation Scheme: 15 CT1 + 15 CT2 + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2 hrs. 30 min

Course Objectives:

I. To train the students on the basics and applications of energy in Mechanical Engineering and energy conservation
II. To be able to use the first law of thermodynamics to estimate the potential of thermo-mechanical energy conversion in engineering devices

III. To be able to chart thermodynamic processes on appropriate thermodynamic diagrams, such as a temperature-entropy or pressure-volume diagram
IV. To explain the influence of temperature limits on performance of cycles
V. To understand the nature and role of the following thermodynamic properties of matter: internal energy, enthalpy, entropy, temperature, pressure and specific volume
VI. To understand implications of the second law of thermodynamics and limitations placed by the second law on the performance of thermodynamic systems
VII. To be able to differentiate forms of energy on the basis of quality
VIII. To be able to quantify the entropy generation and exergy of a system
IX. To analyze gas power and vapor power cycles on the basis of first law of thermodynamics

Basic concepts and properties: introduction, thermodynamic system, control volume, macroscopic and microscopic approaches, properties of a system, continuum, state and equilibrium, processes and cycles, quasi-static process, point and path functions, steady flow process, temperature and the zeroth law of thermodynamics, properties such as specific volume pressure, temperature, ideal gas & ideal gas temperature, temperature scales.

Energy, Energy Transfer & Analysis: forms of energy, energy transfer by heat, energy transfer by work, electrical & mechanical forms of work, pdV work, work-a path function, heat transfer- a path function, comparison of heat and work.

Properties of Pure Substances: Phase change process of a pure substance: specific heats, sensible heat and latent heat, triple point, critical point, superheat and total heat of steam, p-v & p-T diagram of a pure substance, p-v-t Surface, T-s and H-s diagram of a pure substance, quality or dryness fraction, steam tables.

Properties of Ideal Gas: Difference between gases and vapors, ideal gases, gas laws, gas constant, universal gas constant, Specific heats, internal energy and enthalpy of an ideal gas, entropy change of an ideal gas, reversible adiabatic and isothermal process, poly-tropic process, Equations of state.

First law of thermodynamics: law of conservation of energy, first law applied to closed system undergoing a cycle, joule experiment, energy-a property of system, energy balance, energy transfer of a system and mechanisms of energy transfer, internal energy: a function of temperature, energy and environment,.

First law applied to flow processes: steady-state steady flow process, mass balance and energy balance in steady flow process, steady flow energy equation and its application to nozzles and diffusers, throttling valve, turbines and compressors, pumps, heat exchangers etc. Work done and heat transfer during steady flow processes.

Second law of thermodynamics: limitations of first law, qualitative difference between Heat and Work, cyclic heat engines, reservoirs, Kelvin-Plank and Clausius statements of second law, refrigerators and heat pumps, equivalence of Kelvin – Planck and Clausius statements, reversibility and irreversibility, causes of irreversibility, conditions for reversibility, Carnot Cycle, reversed heat engine, Carnot’s Theorem, absolute temperature scale, efficiency of the reversible heat engine, types of irreversibility.

Entropy: Clausius Theorem, the property of entropy, inequality of Clausius, entropy: a property of system, entropy change for ideal gases, entropy change of a system during irreversible process, entropy principle and its applications, entropy transfer with heat flow, entropy generation, first and second laws combined, reversible adiabatic work in a steady flow system. Availability and irreversibility: available energy, available energy referred to cycle, quality of energy, maximum work in a reversible process, reversible work in an open system exchanging heat only with the surroundings, useful work, dead state, availability (exergy), availability in a steady flow system, irreversibility and effectiveness, decrease in available energy with heat transfer through a finite temperature differences, exergy balance, second law efficiency, T-ds equations,

Power cycles: gas power cycles: Otto cycle, Diesel cycle, Semi-Diesel, Sterling cycles, their efficiency and mean effective pressure calculations.

Vapor power cycles: properties of steam, specific volume and entropy of steam, dryness fraction of steam, throttling of steam, determination of dryness fraction, steam tables and their use, t-s and h-s diagram, Rankine and Modified Rankine cycle, work done and efficiency, specific steam consumption, comparison of Rankine and C arnot cycle, representation on p-v, t-s and h-s diagram.

Text Books:

1. Thermodynamics: An Engineering Approach, Yunus Cengel and Michael Boles, 4^{th} Edition, McGraw Hill, 2002
2. Engineering Thermodynamics, P. K. Nag, 4^{th} Edition, McGraw Hill, 2008

Reference books:

1. Fundamentals of Thermodynamics, Richard Sonntag, Claus Borgnakk, 7^{th} Edition, John Wiley and Sons, 2009
2. Fundamentals of Engineering Thermodynamics, Michael J. Moran, Howard Shapiro, 6^{th} Edition John Wiley & Sons, 2008

Course Outcomes: After completion of the course students will be able to:

MEU302.1 Understand the fundamentals of first and second laws of thermodynamics and their application to a wide range of systems

MEU302.2 Analyze the work and heat interactions associated with a prescribed process path, and to perform a first law analysis of a flow system

MEU302.3 Demonstrate limitations of the first law, study second law and its applications to energy conversion devices

MEU302.4 Evaluate entropy changes in a wide range of processes and determine the reversibility or irreversibility of a process from such calculations

MEU302.5 Calculate the efficiencies of heat engines and other engineering

CEU307 STRENGTH OF MATERIALS-LAB

Teaching Scheme: 02 P **Total : 02** **Credit: 01**

Evaluation Scheme: Internal = 25 ICA + 25 ESE **Total Marks: 50**

Duration of ESE: 3 hrs.

Course objectives:

I. Learn to perform the tension, compression and bend test on different specimens and observe the nature of failure

II. Learn to perform the shear test on metals using Izod impact test apparatus

III. Learn to perform the hardness test and torsion test on metals

IV. Understand buckling of columns and factors affecting strength of columns.

It is a representative list of practical. The instructor may choose experiments as per his/her requirements (so as to cover entire contents of the course CEU303) from the list or otherwise. Minimum eight experiments should be performed from part A, while part B is compulsory.

List of Experiments:

Part A:

1. To perform tension test on mild steel and compare the results obtained with standard IS values and comment
2. To perform tension test on TOR steel also perform bend test. Compare the results obtained with standard IS values and comment. Refer I.S. 1608.
3. To perform compression test on metals. Observe the nature of failure and determine the compressive stress. Refer I.S.1708 for test procedure.
4. To perform compression test on Wood (parallel and perpendicular to grains). Observe the nature of failure and determine the compressive stress. Refer I.S.1708 for test procedure. Comment on results.
5. To perform shear test on metals. Study single & double shear action. Interpret failure pattern and calculate shear strength in single & double shear. Refer I.S 5242-9779.
6. To perform impact test on metals. Determine the shock absorbing capacity of the material using Izod impact test apparatus. Compare the impact resisting qualities of different metals. Refer IS: 1598 and IS: 1757 – 1973.
7. To perform hardness test on different metals and compare hardness number for different metals. Refer IS 1500.
8. To perform torsion test on metals. Interpret the graph of torque and angle of twist and determine shear strength and modulus of rigidity of the specimen. Refer I.S. 1717.
9. To find deflection of beams, bending stresses and their relation for simply supported beam. Also find Young’s modulus.
10. Determine modulus of rupture of wooden beam. Observe the parameters that affect modulus of rupture.
11. Observe types of columns, their deflection behaviors. Understand buckling of columns and factors affecting strength of columns. Find buckling load of given set of columns with different end conditions.

12. Observe deflection and working of different types of springs. Determine modulus of rigidity of spring material and stiffness of spring.

Part B:

At least four problems from four different topics to be solved using either programming or spreadsheet or solvers or any software.

Note :

ICA - The Internal Continuous Assessment shall be based on practical record and knowledge / skill acquired. The performance shall be assessed experiment wise using continuous assessment formats A & B.

ESE – The End Semester Exam for Practical shall be based on performance in one of the experiment and may be followed by sample questions.

Course outcomes: After completion of the laboratory course, students will be able to:

CEU307.1 Perform tension test tension, compression and bend test on different specimens and observe the nature of failure

CEU307.2 Compare the results obtained with standard IS values and comment

CEU307.3 Observe the nature of failure and determine the compressive stress

CEU307.4 Interpret failure pattern and calculate shear strength in single & double shear

CEU307.5 Compare the impact resisting qualities of different metals

CEU307.6 Interpret the graph of torque and angle of twist and determine shear strength and modulus of rigidity of the specimen

CEU307.7 Analyze the deflections of beam, column & evaluate the modulus of rupture, buckling load, etc.

EEU312 ELECTRICAL DRIVES AND CONTROL LAB

Teaching Scheme : 02 P Total : 02 Credit: 01

Evaluation Scheme: 25 ICA + 25 ESE Total Marks: 50

Duration of ESE: 3 hrs.

Course objectives:

I. Understand the various controls of D.C. motor & 3-phase induction motor
II. Aquire skill to use the braking methods for D.C motor
III. Understand the methodology of single-phase induction motor & 3-phase induction motor
IV. Learn the different sources of heating in the motors

It is representative list of practical. The instructor may choose minimum Six experiments as per his/her requirement (so as to cover entire content of course EEU311) from the list given below

List of the Experiments:

1. To perform speed control of d. c. shunt motor.
2. Speed control of 3-phase induction motor by changing rotor resistance.
3. To perform load test on D.C. series motor.
4. Rheostatic speed braking of D.C. shunt motor.
5. To study single-phase induction motor.
6. To identify different parts and understand working of starters used for 3-phase I.M.
7. Study of D.C. motor starters.
8. To study different types of heating.
9. To study power MOSFET

Note:
ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A&B
ESE: The end semester Exam for practical shall be based on performance in one of the experiments and may be followed by sample questions

Course outcomes: After completion of the laboratory course, students will be able to:
EEU 312.1 Perform braking methods
EEU 312.2 Demonstrate speed control methods
EEU 312.3 Draw various characteristics of dc motor and induction motor
EEU 312.4 Identify the starter operation

MEU303 MATERIAL SCIENCE AND ENGINEERING LAB

Teaching Scheme: 02 P Total : 02 Credit: 01
Evaluation Scheme: 25 ICA + 25 ESE = 50 Total Marks: 50
Duration of ESE: 3 hrs.

Course objectives:
I. Reinforce the concepts learnt in the theory classes of Material Science and Engineering (MEU 301)
II. Learn the specimen preparation for optical microscopy and by using optical microscope, study microstructures of various metals and alloys which are used in industries for various applications
III. Be conversant with the various equipments/ instruments/machines which are used to study structures and properties of metals and alloys
IV. Relate the structure and properties of various metals and alloys

Note: It is representative list of experiments. The instructor may choose minimum eight experiments as per his/her requirement (so as to cover entire content of course MEU301) from the list given below.
List of Experiments:
1. Study of metallurgical microscope.
2. Preparation of specimen for micro-examination.

3. Molding of specimen for micro-examination.
4. Study of microstructure of annealed and normalized steels.
5. To carry out hardening and tempering of steel.
6. To study Jominy end quench test for harden ability.
7. Hardness Testing using Rockwell Hardness Tester.
8. To study microstructures of various cast irons.
9. To study microstructures of various non –ferrous metals and alloys.
10. To study and perform impact test.
11. Hardness Testing using Brinell Hardness Tester
12. Study of Image analyzer
13. Study of scanning electron microscopy
14. Study of Transmission electron microscopy

Note:

ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired.

ESE: The end semester Exam for practical shall be based on performance in one of the experiments and may be followed by sample questions

Course outcomes:

After completion of the laboratory course, students will be able to-

303.1 Prepare the specimen for optical microscopy and by using optical microscope,

303.2 study microstructures of various metals and alloys

303.3 use various equipments/ instruments/machines which are used to study structures and properties of metals and alloys

303.4 Relate the structure and properties of various metals and alloys

SHU301 GENERAL PROFICENCY – II

Teaching Scheme: 01L+02 P Total : 03 Credit : 02

Evaluation Scheme: 25 ICA + 25 ESE =Total 50 Total Marks: 50

Duration of ESE: 3 hrs.

Course objectives:

I. To Build the Basics of Presentation and Managerial Skills
II. To Provide Understanding of General and Specific Communication Skills for Presentation
III. To Sensitize about Various Models of Presentation
IV. To Develop Effective Time Management Skills
V. To be able to Learn Stress Management Techniques
VI. To Develop Team Work Capabilities

Presentation Skill:

Communication Boosters – Aura Words, Pronunciation, Body Language – Voice, Posture and Gesture, Eye Contact, Dress Codes
Function of Culture Code in Presentation – Planning, Preparing and Delivering a Presentation, Etiquettes, Clarity and Aliveness of Delivery
General Communication Skill for Presentation – Content Matching and Language Matching for Specific Audience, Tone, Hummer Poise- Listener/Speaker Sensitivity
Specific Communication Skill for Presentation – Ice Breaker, Small Talk Dialogue, Debate, Turn Taking, Effective and Defensive Handling of Question.
Models of Presentation – Public Speaking, Academic and Professional Presentation, Group Discussion, Personal Interview, Technical Report Writing (IEEE Standards)

Managerial Skill:
Time Management - Advantages, Time Wasters – Procrastination, Time Management Tips and Strategies
Stress Management- Stress and its Disadvantages, Stress Coping Ability and Stress Inoculation Training, Management of Various Types of Fear, Depression and Anger
Conflict Management -Types of Conflict, Conflict Stimulation and Conflict Resolution Technique for Conflict for Effective Conflict Management, Effective Ways of Dealing with People, Significance of Body Language in Communication and Assertiveness Training
Interpersonal Skills - Concept of Team, Advantages of Team Work, Promotion of Team Spirit, Team Building Techniques, Nurturing Leadership Qualities, Negotiation Skills

Topics for Assignments/Practical:
Minimum Eight Assignments / Practical Based on above Topics. The Representative List is Given Below
1. Collection of New Words Concerning Various Technical And Professional Subjects
2. Listening to Audio Cassette or Lecture or Watching Video Cassette (Based on the Topics of Managerial Skill) followed by Speech/Seminar by Students
3. Listening to Audio Cassette or Lecture or Watching Video Cassette (Based on the Topics of Managerial Skill) Followed by Group Discussion of Students
4. Collecting the Information Related to the Topics of Managerial Skill Using Internet, Books, Magazines etc. and its Power Point Presentation or Seminar/Lecture
5. Power Point Presentation on Topic Related to any Subject of Programme
6. Preparing a Technical Paper in IEEE Format
7. Management Games
8. Personal Interview
9. Extempore Elocution, Debate

Text Books:

1. Professional Communication Skills, Alok Jain, Pravin S.R. Bhatia, A.M. Sheikh, 3rd Edition, S. Chand And Company, New Delhi,2005
2. Personality Development, E.B. Hurlock, 5th Edition, Tata McGraw Hill, New Delhi 2006

Reference Books:

1. Power Of Positive Thinking, D. J. Mile, 2nd Edition, Rohan Book Company, Delhi, 2004
2. All About Self Motivation, Pravesh Kumar, 3rd Edition, Goodwill Publishing House, New Delhi,2005
3. Body Language: How to Read Others Thoughts by their Gestures, Pease, Allan, 3rd Edition, Sudha Publications. New Delhi, 1998
4. Multiple Intelligences: The Theory in Practice: A Reader, Howard Gardner, 1st Edition, Basic Books, New York, 1993
5. Six Thinking Hats, De Bono Edward, 2nd Edition, Penguin Books, New York, 2000

Course Outcomes: After Completion of the Course, the Students Should be Able to:
MEU303.1 Display Competence in Oral, Written and Visual Communication
MEU303.2 Develop Effective Communication Strategies for Diverse Audiences
MEU303.3 Develop Excellent Public Speaking Skills
MEU303.4 Use Effective Time Management Skills for Career Planning
MEU303.5 Develop Strong Interpersonal Skills for Team Building
MEU303.6 Bring Assertiveness in Leadership Qualities

MEU 401 FLUID MECHANICS

Teaching Scheme : 04 L Total : 04 **Credit : 04**
Evaluation Scheme: 15 CT1 + 15 CT2 + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2 hrs. 30min

Course Objectives:

I. To understand the basic fundamental of fluid mechanics and its properties.
II. To analyze the various types of fluid flow problems in the dynamic situation.
III. To demonstrate the fluid properties, fundamentals of fluid statics and fluid flow.
IV. To interpret the concepts of flow measurements and flow through pipes.
V. To develop the relative equation from the available parameter for research work.

General Properties of fluids and Fluid Statics: Viscous fluids, Newtonian and non-Newtonian, their stress strain relationship (general description only), pressure at a point in fluid, variation of pressure with depth, fluid application to manometer, transmission of pressure in a fluid, thrust on plane surface, centre of pressure horizontal and vertical plane surfaces, forces on immersed bodies, vapour pressure, cavitation.

Fluid kinematics: Types of flow-steady & unsteady, uniform & non-uniform, laminar & turbulent, one, two & three dimensional, rotational & irrotational, compressible and incompressible, Reynold's experiment and Reynolds number, Euler's approach of describing fluid motion- Velocity and acceleration, Stream line, Streak line, Path line, Stream tube, Stream function, Velocity potential, Flow net- uses, limitations & methods of drawing, Discharge, Continuity equation of fluid flow

Fluid Dynamics: Euler's equation of motion, Bernoulli's equation, assumption and limitations, kinetic energy correction factor, different forms of energy heads, loss of head, Modified form of Bernoulli's theorem, Flow measurement, velocity measurement, Energy gradient line and Hydraulic gradient line, Impulse momentum equation, momentum correction factor, Vortex flow.

Dimensional Analysis: Dimensional homogeneity and dimensionless ratios. Reduction of parameters in a physical problem Dimensionless parameters, Similitude and model studies.

Motion of Viscous Fluids: Introduction to laminar and turbulent flows, boundary layer concept, separation, drag lift on immersed body, Reynolds number and its significance.

Darcy's Weisbach equation: Equation of pipe flow, friction charts and its use, minor losses in pipes and fittings, losses due to sudden enlargement and contraction, hydraulic and energy gradient lines, pipes in series and parallel, elementary concept of water hammer.

Text Books

1. Introduction to Fluid Mechanics and Fluid Machines, S.K. Som and G. Biswas, 2nd Ed ,Tata McGraw Hill Education Publishing Company Limited, 2007.
2. Fluid Mechanics, F.M. White, 4th International Editions ,McGraw-Hill, 2005.

Reference Books

1. Fluid mechanics and Hydraulic machines, Dr. R. K. Bansal , 9 th Edition, Laxmi Publication, Delhi, 2005
2. Fluid Mechanics and Machines, Kotharduraon and Rudramoorthy, 2nd Edition, New Age Internationals, 2007
3. Hydraulics And Fluid Mechanics Including Hydraulics Machines**,** Dr. P.N.Modi, Dr. S.M. Seth, 14th Edition, Standard Book House / Rajsons Publications p ltd, Delhi, 2011.
4. Fluid Mechanics, Mohanty A.K., 2nd Edition, Prentice Hall of India, 2005.
5. Fluid Mechanics, Streeter, 7 th Edition, Tata McGraw Hill (SI),2000

Course Outcomes: After completion of this course student will be able to:

MEU401.1 Understand and determine the various physical properties of the fluids.
MEU401.2 Apply and analyze fluid systems using the integral form of the continuity, momentum equations.
MEU401.3 Apply Bernoulli's Equation for various fluid systems and flow measuring devices.

MEU401.4 Apply dimensional analysis method for developing the relative equation from given parameter.
MEU401.5 Apply the boundary layer concept foe analyzed the fluid flow problem.
MEU401.6 Analyze and explain physical significance of flow through the pipes

MEU402 KINEMATICS OF MACHINES

Teaching Scheme : 03 L+ 01T **Total : 04** **Credit: 04**
Evaluation Scheme: 15 CT1 + 15 CT2 + 10 TA + 60 ESE **Total Marks: 100**
Duration of ESE: 2 hrs. 30 min

Course Objectives:

I. To understand the basic components and layout of linkages in the assembly of a system/ machine.
II. To understand the principles in analysing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism.
III. To understand the motion resulting from a specified set of linkages, design few linkage mechanisms and cam mechanisms for specified output motions.
IV. To understand the basic concepts of toothed gearing and kinematics of gear trains.
V. To understand the basics of synthesis of simple mechanisms.
VI. To understand different types of Brakes, clutches, bearing for their capacity.

Concepts of kinematics, Classification of links, pair ,chain ,mechanisms mechanisms, Grashof's law, Different four bar mechanisms, Inversions of single slider, double slider kinematics' chain, Grubler's criterion , Kutrbach's theory, straight line mechanisms, steering mechanism.
Kinematics Analysis of Mechanisms: Displacement analysis, Transmission angle, coupler curve and their properties, radius of curvature of coupler curves, Velocity analysis: Relative Velocity method, instantaneous center of rotation method, transmission ratio. Acceleration analysis: Relative acceleration method, Corriolis component of acceleration, analytical method for four bar mechanism, Klein's construction for slider crank mechanism and four bar mechanism.

Synthesis of Mechanism: Introduction to type, Number and dimensional synthesis, graphical method of two positions, three position and four position, synthesis for Input output co-ordination. Overlay's method, Frendentein's equation.

Friction: Friction angle, friction circles and friction axis. Pivot and collar bearings. Brakes, clutches, types, constructional details, operation and calculation of leading dimensions.

Cams: Introduction, types of cam and follower, different motions of followers, graphical layout of cam profiles, pressure angle, cam with specified contours.

Gear: Introduction terminology, gear tooth profiles, interference, spur, helical gears, spiral gears, and its efficiency, bevel and worm gears.

Gear Trains: Types of gear trains, speed ratio, applications.

Text Books:

1. Theory of Machines, S.S. Rattan, 2nd Edition Tata Mc-Graw Hill Company, New Delhi, 2005.
2. Theory of Machines and Mechanisms, P.L. Ballaney, 3rd Edition, Khanna Publishers Delhi, 2000.

Reference Books:

1. The Theory of Machines, Thomas Baven, 3rd Edition, CBS Publishers and Distributors, 2000.
2. Theory of Machines and Mechanisms, Joseph Edward Shigley and Johan Joseph Uicker Jr., 2nd Editions ,McGraw-Hill Inc, 1995

Course Outcomes: After completion of this course student will be able to:

MEU402.1 Identify the mechanisms for various applications

MEU402.2 Analyse mechanisms using graphical methods

MEU402.3 Apply the basic kinematic principles for design of machine elements.

MEU403 THERMAL ENGINEERING & ENERGY CONVERSION

Teaching Scheme: 04 L + 00 T Total : 04 Credit : 04

Evaluation Scheme: 15CT1+15CT2+10TA+60ESE Total Marks : 100

Duration of ESE : 2hrs.30min

Course Objectives:

I. Understand thermal related basic components and their uses
II. Explain the different thermodynamic processes
III. Explain the working principles of IC engines, Boiler, condensers, & jet-propulsion
IV. Understand construction, working and applications of centrifugal and reciprocating compressors
V. Explain working and applications of Gas turbine turbines and air compressor
VI. Understand the need & types of non-conventional energy sources

Steam power plant: Steam power cycle, reheat, regenerative cycles, analysis limited to two stages only, deaerator, typical layout of steam power plant, efficiencies in steam power plant, concept of co-generation, Steam generators: Classification, Early and modern water-tube type steam generator arrangements, Economiser, superheater, reheaters, steam generator control, air preheater, principle of fluidized bed boiler, cylone separator. Electrostatic precipitator.

Steam turbines and condensers : flow through nozzles, critical pressure ratio and choked flow, nozzle efficiency, determination of throat and exit areas, concept of super saturated flow and Wilson line (no numerical), type of steam turbines, Types of steam turbines such as impulse, reaction turbines. Compounding, Velocity diagrams. Graphical and analytical methods for work and power developed, axial thrust and efficiency. Turbine governing and control, throttle governing, need of a condenser and its types, quantity of cooling water required, condenser and vacuum efficiency. Sources of air in condensers and its effect on performance

Air Compressors: Industrial uses of compressed air, Methods of compression and efficiencies of compression. clearance volume and its effect on work done and volumetric efficiency, condition for minimum work in two stage compression, Intercooling and its effects. Comparison between reciprocating and rotary compressors, centrifugal and axial flow compressors, difference between fans, blowers and compressors, general equations for rotary machines. Working and construction of Screw compressor,Vane, Roots blower.

I.C. Engines: Classification of I.C. engines, General description of Petrol and Diesel engine, working, calculations limited to engine brake power, Gas Turbines, Closed cycle and open cycle plant arrangement, advantages, analysis of Brayton cycle, Effect of reheating, Performance of Gas turbine power plant. Components of GT power plant. Introduction to jet propulsion, Ramjet, turbojet.

Refrigeration and Air conditioning: Vapor compression Refrigeration and COP, vapor absorption refrigeration. Air conditioning: classification and applications. Psychometric charts elementary treatment with simple problems.

Non conventional energy sources: Introduction to non conventional energy sources i.e. Solar, Wind, Tidal & Ocean, Geothermal energy and Magneto Hydrodynamics, its advantages, disadvantages.

Text Books

1. Basic and Applied Thermodynamics, P.K. Nag, 2nd Edition, Tata Mc-Graw Hill Pub., 2010.
2. Power Plant Engineering, P.K. Nag, 3rd Edition, Tata Mc-Graw Hill Publishing, 2008.

Reference Books:

1. Gas Turbines, V Ganesan, 3nd Edition, Tata McGraw Hill, 2010.
2. Thermodynamics-An Engineering Apporach, Y. A. Cengel and M. A. Boles, 3rd Edition, Mc-Graw Hill, 1998.
3. Applied Thermodynamics, Onkar Singh, 3rd Edition, New Age International Publishing, 2009.
4. Thermal Engineering by Mahesh M Rathore, 3rd Edition, Tata Mc-Graw Hill, 2010

Course Outcomes: After completion of course, student will be able to:

MEU403.1. Describe basic thermal system components their functions

MEU403.2. Apply the concepts of thermodynamics to IC engines, Boiler, condensers, Gas turbine for engineering applications

MEU403.3. Describe the construction and working of thermal systems

MEU403.4. Apply appropriate techniques for the performance enhancement of thermal systems

MEU403.5.Understand the need & types of non-conventional energy sources

MEU404 MANUFACTURING PROCESSES

Teaching Scheme : 04 L + 00 T Total : 04 Credit : 04

Evaluation Scheme : 15CT1+15CT2+10TA+60 ESE Total Marks: 100

Duration of ESE: 2 hrs. 30 min

Course Objectives

I. To identify the necessity and importance of manufacturing.
II. To learn the fundamentals of major classes of manufacturing processes.
III. To understand the working principles of different casting and welding operations
IV. To differentiate between these processes in terms of application, function, advantages, disadvantages, quality and productivity

Pattern Making and Mould Design: Introduction to basic manufacturing processes, Pattern materials, allowances, Types of patterns, Design considerations in pattern making, Color codes for patterns and core boxes. Basic principle and Terminology of sand casting, gating system, types of gate ,Risers design, Risering aids, Directional and Progressive solidification. General properties of moulding sands, Types of sands, testing of moulding sand, Mold hardness. Preparation of sand moulds of different types, Moulding processes, core making.

Technology of melting and special casting methods: Melting furnaces pit, open hearth, gas fired cupola and electric hearth furnaces, cupola operation development in cupola melting, Electric furnaces - Direct Arc, Indirect arc and electric induction furnace, Selection of furnace. Modernization and Mechanization of Foundries, permanent mold casting, slush casting, shell molding, Investment or lost wax casting, vacuum process, centrifugal casting, Continuous casting, Die casting equipments and processes for Gravity, pressure and vacuum casting methods, Comparison between casting methods.

Defects, Inspection and testing of casting: Origin and classification of defects, shaping faults, Inclusions and sand defects, Gas defects, shrinkage defects, contraction defects, dimensional errors. Radiography, ultrasonic, Eddy current testing, fluorescent penetrate test.

Mechanical working of metals: Principle of Hot and cold working processes, Different types of hot and cold working processes, e.g. Rolling, types of rolling forging operations, extrusion, piercing, pipe and tube production, manufacture of seamless pipe and tubing. Spinning, embossing and coining, squeezing and bending operations, rotary swaging

Processing of plastics: Compression, Transfer, Injection, Extrusion. Blow moulding,

Rotational moulding and calendaring.

Joining processes: Introduction to riveting, soldering, brazing and welding. Gas welding, working principle and its application, Arc welding: arc initiation, arc maintenance, and arc control, transfer of metal across the gap, Electrode efficiency, Types and purpose of Electrodes, TIG welding: working principle and its application, MIG- welding: working principle and its application. SAW - welding: working principle and its application,

Resistance welding : Working principle and its applications

Other welding processes: Working principle and applications of Friction Welding, Forge Welding, Plasma arc, and Thermit Welding. Ultrasonic, Electro slag, Electron Beam, laser welding.

Welding defects, Testing and Inspection of welds: Various welding defects, weld testing methods. Weld ability. Welding symbols.

Surface Treatment: Electroplating, electroforming, and iodizing, metal spraying, shot penning, polishing, mechanical cleaning.

Text Books:

1. Manufacturing Process-II H. S.Bawa, 3rd Edition, Tata Mc Graw hill Publishing Co. Ltd.2004
2. Workshop Technology-I, B. S. Raghuwanshi, 2nd Edition, Dhanpat Rai and Sons, 2001

References Books:

1. Manufacturing Science Ghosh and Malik, Affiliated East – West PressLtd, 3rd Edition, 2002
2. Processes and Materials of Manufacture, R A LindBerg, 2nd Edition,PHI Pub 2001
3. Rao P N Manufacturing Technology : Metal Cutting and Machine tools, 3rd Edition, Tata McGraw Hill 2001
4. Workshop Technology, Hajra Chaudhary, 4th Edition,Dhanpat Rai and Sons 2001

Course Outcomes: After completion of course, student will be able to:

MEU404.1 Able to understand principles of casting, forming, welding and plastic processing.

MEU404.2 Able to understand advantages and limitations of casting, forming, welding processes.

MEU404.3 Able to understand cause and remedies for different types of defects in cast, formed, welded product.

MEU404.4 Able to select appropriate manufacturing process based on function, material, quality requirement, production volume of a product.

MEU405 MACHINE DRAWING

Teaching Scheme: 02 L **Total: 02** **Credit: 02**

Evaluation Scheme: 08CT1+08CT2+04TA+30 ESE **Total Marks: 50**

Duration of ESE: 02hrs. 30min

Course Objectives:

I. Helping the student in drafting their technical ideas.

II. Creating knowledge about the various practices with regard to the dimensioning, sectioning and development of views.

III. Understanding the importance of the linking functional and visualization aspects in the preparation of the part drawings.

IV. Preparation of the part or assembly drawings as per the conventions.

V. Interpretation of machine drawings that in turn help the students in the preparation of the jobs, components,etc.

Sectional views: conversion of pictorial view into sectional orthographic projections, missing views

Development of surfaces: Development of surface of cubes, prisms, cylinder, pyramids, cones etc.

Intersection of surfaces: Interpenetration of solids, prism and prism, cylinder and cylinder, cylinder and prism, cone and cylinder, cone and prism.

Assembly Drawing: Preparation of detailed and assembly drawing of simple machine assemblies like pedestal bearing, Plummer block, simple eccentric, stuffing box, cross head, connecting rod, tail stock, tool post, c-clamp, screw jack, boiler safety valve etc.

Introduction to Modeling by using Pro/Engineer /CATIA Software.

Text Books:

1. Machine drawing, N.D.Bhatt, 38th Edition ,Charotar Publisher, 2003
2. Machine Drawing, N.Sidheshwar, Shastry, Kanhaiah, 4th Edition, Tata Mcgraw Hill, 2005

Reference Books:

1. Machine Drawing, Narayan, K.L.Reddy, 2nd Edition, New AGE International Publishers, 2004
2. Machine Drawing, P.J.Shah, 3rd Edition, Shah Publishers, 1997
3. Computer Graphics & Design, P.Radhakrishnan, 3rd Edition, Dhanpat Rai & Sons, 2009
4. Using AUTOCAD, James E Fuller, 9th Edition, Denmark Publishing Company, 2004
5. Machine Drawing, R.K.Dhawan, 4th Edition, S.Chand & Co.,2006

Course Outcomes : After completion of the course, the student will be able to:
MEU405.1 Draw the development of surfaces for sheet metal working applications.
MEU405.2 Understand the representation of materials used in machine drawing.
MEU405.3 Draw the machine elements including keys, couplings, cotters, riveted, bolted and welded joints.
MEU405.4 Construct an assembly drawing using part drawings of machine components.
MEU405.5 Represent tolerances and the levels of surface finish of machine elements

MEU406 FLUID MECHANICS LAB

Teaching Scheme : 2 P **Total : 02** **Credit: 01**
Evaluation Scheme: ICA 25 + ESE 25 **Total Marks :50**
Duration of ESE: 3 hrs.

Course Objectives:

I. To validate the various theory concept practically by demonstrating the experiments.
II. To acquire hand on experience to use the various measuring instrument for the fluid flow.
III. To analyze the various frictional losses in fluid flow.

IV. To develop the practically evaluating ability in the different situation of fluid flow.
V. To utilize this practical knowledge for upcoming related subject and research work.

It is representative list of practical. The instructor may choose minimum Eight experiments as per his/her requirement (so as to cover entire content of course MEU401) from the list given below

1. Measurement of fluid pressure by manometer.
2. Determination of metacentric height.
3. Verification of Bernoulli's equation.
4. Flow measurement by venturimeter
5. Flow measurement by orifice meter.
6. Determination of Reynolds number.
7. Study of velocity distribution in Boundary layer and its thickness.
8. Determination of co-efficient of friction for pipes.
9. Determination of head loss due to sudden enlargement and contraction.
10. Determination of losses in bends and elbows.
11. Study of flow through pipes in series and parallel.

Note:
ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A&B
ESE: The end semester Exam for practical shall be based on performance in one of the experiments and may be followed by sample questions

Course Outcomes : After completion of the course, the student will be able to:
MEU406.1 Prove theory concept practically by developing the experiments.
MEU406.2 Use the various measuring instrument for the fluid flow in different situation.
MEU406.3 Analyze the various frictional losses in fluid flow.
MEU406.4 Identify the types of flow by using flow demonstrator.
MEU406.5 Develop the own experimental set-up and analyze for research work.

MEU407 KINEMATICS OF MACHINES LAB

Teaching Scheme : 2 P **Total : 02** **Credit: 01**
Evaluation Scheme: ICA 25 + ESE 25 **Total Marks :50**
Duration of ESE: 3 hrs.

Course Objective:

I. To make the student conversant with commonly used mechanism for industrial application.
II. To develop competency in drawing velocity and acceleration diagram for simple and complex mechanism.
III. To develop analytical competency in solving kinematic problems using complex algebra method.
IV. To develop competency in graphical and analytical method for solving problems in static and dynamic force analysis.
V. To develop a model applying all knowledge of kinematics of machine

It is representative list of practical. The instructor may choose minimum Six experiments as per his/her requirement (so as to cover entire content of course MEU402) from the list given below

List of Experiments:

1. To draw inversions of four bar kinematics chain locating end points and explain working of mechanisms.
2. To draw inversions of single slider crank chain, locating points and explain working of mechanisms.
3. To draw inversions of double slider cranks Kinematic chain locating end points and explains working of mechanisms.

4. To determine relative velocity of given links in mechanisms by relative velocity method or instantaneous center of rotation.
5. To determine relative acceleration of links in mechanisms by relative acceleration method.
6. To draw profile of cam graphically for given follower with its specified motion.
7. Mini Project on Clutch, Brake, and Dynamometers- It is required to select these contrivances from working system..
8. Gear trains – Gear box of any four wheelers should be selected and studied with respect to types of gear, velocity ratio, type of train, arrangement of gears.
9. To determine pressure distribution pattern at different load and speed along the periphery of journal with the help of Journal Bearing Apparatus.

Note:

ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A&B

ESE: The end semester Exam for practical shall be based on performance in one of the experiments and may be followed by sample questions

Course Outcomes: After completion of course, student will be able to:

MEU407.1. Demonstrate knowledge of various mechanisms in order to design and analyze mechanisms essential in mechanical engineering.

MEU407.2. Demonstrate ability towards graphically estimating velocity and acceleration.

MEU407.3. Exhibit skills towards application of principles of static and dynamics force analysis.
MEU407.4. Knowledge attained will comply towards successfully addressing issues relating to gears, cams and followers in real life engineering problems

MEU408 MANUFACTURING PROCESSES LAB

Teaching Scheme : 02 P   Total : 02   Credit: 01
Evaluation Scheme : ICA 25 + ESE 25   Total Marks: 50
Duration of ESE: 3 hrs.

Course Objectives:

I. To understand making of pattern using pattern making tools for sand casting
II. To learn the preparation of two box green sand mould and to understand the construction /working principle of metal melting furnace CUPOLA
III. To understand the preparation of a composite job with the help of Electric Arc Welding and Gas welding.
IV. To learn the principles of sheet metal working and learn how to prepare a job on bending machine

It is representative list of practical. The instructor may choose minimum four job as per his/her requirement (so as to cover entire content of course MEU404) from the list given below

List of Experiments:

1. **Pattern Making Shop:** Study of different types of patterns and pattern making tools, One job on preparation of a pattern.
2. **Foundry Shop:** Study of any two furnaces, Study of foundry tools, Demonstration of casting Sand preparation and testing. One job on preparation of green sand mould.
3. **Welding Shop:** Preparation of a composite job with the help of Electric Arc Welding and Gas welding.
4. **Sheet Metal Working** Demonstration of Mechanical and Hydraulic presses. Preparation of a job on bending Machine.

Note:

ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A&B

ESE: The end semester Exam for practical shall be based on performance in one of the experiments and may be followed by sample questions

Course Outcomes: After completion of course, student will be able to:
MEU408.1 Ability to make a pattern using pattern making tools for sand casting
MEU408.2 Able to prepare two box green sand mould and able to understand the working of Cupola

MEU408.3 Ability to make a composite job with the help of Electric Arc Welding and Gas welding.
MEU408.4 Ability to make a job on bending machine

MEU409 COMPUTER AIDED DRAFTING LAB

Teaching Scheme: 04 P **Total : 04** **Credit: 02**
Evaluation Scheme : 50 ICA + 50 ESE **Total Marks: 100**
Duration of ESE: 3 hrs.

Course Objectives:

I. To impart students with the necessary skills for drafting and modeling machine components using CAD tools.
II. To impart the fundamental knowledge in designing and drafting.
III. To develop the Practical knowledge in the field components designing.

It is representative list of practical. The instructor may choose minimum eight Sheet as per his/her requirement (so as to cover entire content of course MEU405) from the list given below

List of Drawing

PART A : Sheets (one each) by using Pro Engineer /CATIA and Sketchbook

1. Sectional Views of objects
2. Developments of surfaces
3. Intersection of solids

PART B : Drawing of following machine elements using Pro/Engineer/CATIA Software (four Sheets)

1. Cotter Joints
2. Knuckle Joints
3. Flange Coupling
4. Wall Bracket
5. Plummer Block
6. Stuffing Box
7. Machine tool Components
8. Rivet and Rivet Joints

PART C : One sheet on: ISI Conventions for various components like bearing, gears, springs, keys and keyways, threads, tap holes and materials

Note:

ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A&B

ESE: The end semester Exam for practical shall be based on performance in one of the experiments and may be followed by sample questions.

Course Outcomes: After completion of course, student will be able to:
MEU409.1. Demonstrate the complete methodology of design &drafting.
MEU409.2 Develop skills in designing the automobile engine components using software like AutoCAD.
MEU409.3. Model and assemble machine parts and Know about the industrial models and their usages in practical design and manufacturing fields.

Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)

Equivalence of Courses in New Structure with Old structure

B. Tech : Mechanical Engineering

Year : Second Year (Semester - III & IV)

Sr. No	Course in old scheme			Course in New Scheme			Remark
	Course Code	Name of the Course	No. of Credits	Course Code	Name of the Course	No. of Credits	
1	ME301	Mechanics of Materials	04	CEU303	Strength of Materials	04	
2	ME302	Material Science and Engineering	04	MEU301	Material Science and Engineering	03	
3	ME303	Fluid Mechanics	04	MEU401	Fluid Mechanics	04	
4	ME304	Engineering Thermodynamics	05	MEU302	Engineering Thermodynamics	04	
5	ME305	Electric Drives and Control	04	EEU311	Electric Drives and Control	04	
6	ME306	General Proficiency- I	02	SHU205	General Proficiency - I	02	
7	ME307	Mechanics of Materials Lab	01	CEU307	Strength of Materials Lab.	01	
8	ME308	Material Science Lab.	01	MEU303	Material Science and Engineering Lab.	01	
9	ME309	Fluid Mechanics Lab	01	MEU406	Fluid Mechanics Lab	01	
10	ME310	Electric Drives and Control Lab.	01	EEU312	Electric Drives and Control Lab.	01	
Semester - IV							
11	ME401	Kinematics of Machines	04	MEU402	Kinematics of Machines	04	
12	ME402	Engineering Mathematics -III	05	SHU301	Engineering Mathematics -III	03	

13	ME403 ME605	Thermal Engineering Energy Conversion (*)	04 04	MEU403	Thermal Engineering & Energy Conversion	04	
14	ME404	Manufacturing Processes	04	MEU404	Manufacturing Processes	04	
15	ME405	Machine Drawing	04	MEU405	Machine Drawing	02	
16	ME406	General Proficiency - II	02	SHU305	General Proficiency - II	02	
17	ME407	Kinematics of Machines Lab	01	MEU407	Kinematics of Machines Lab	01	
18	ME408	Manufacturing Processes Lab	02	MEU408	Manufacturing Processes Lab	01	
19	ME409	Computer Aided Drafting Lab	01	MEU409	Computer Aided Drafting Lab	02	

Note:

1) All students promoted to third year with some backlog courses shall remain in old scheme (212 Credits)

2) All the students who failed in second year (DC students) shall be transferred to new scheme (184 Credits)

Important notes for * courses

i) These courses of old scheme shall be offered during the academic year (2011-12) including summer term for back logger students.

ii) In the academic year 2012-13 and onward all students shall register for courses as per revised curriculum (New Scheme)

iii) If a **DC** student has passed any one subject out of **ME403** and **ME605** then option shall be given to a student to register and pass the other subject as per old curriculum to claim exemption in **MEU403** or register the subject **MEU403** as per revised curriculum.