Final

REVISED DIPLOMA CURRICULUM OF MECHANICAL ENGINEERING (ME) (PART II)

For the State of Meghalaya

(OCTOBER, 2023)

National Institute of Technical Teachers' Training & Research

Block – FC, Sector – III, Salt Lake City, Kolkata – 700 106

Prog. Name: Mechanical Engineering

Semester-III

SL. No	Category of Course	Code No	Course Title	Study Scheme				Evaluation Scheme							Total Marks	Credits
				Pre-requisite	Contact Hours/ week			Theory				Practical				
					L	T	P	End Exam	Progressive Assessment			End Exam	Progressive Assessment			
									Class Test	Assignment	Attendance		Sessional	Viva voce		
1	Programme Course	MEPC201	Computer Aided Machine Drawing	ES 101	0	0	4	0	0	0	0	40	40	20	100	2
2		MEPC203	Material Science & Engineering		3	0	0	60	20	15	5	-	-	-	100	3
3		MEPC205	Fluid Mechanics & Hydraulic Machines		2	1	0	60	20	15	5	-	-	-	100	3
4		MEPC207	Manufacturing Engineering		3	0	0	60	20	15	5	-	-	-	100	3
5		MEPC209	Thermal Engineering-I		3	0	0	60	20	15	5	-	-	-	100	3
		MEPC211	Fluid Mechanics & Hydraulic Machines Lab		0	0	2	-	-	-	-	40	40	20	100	1
		MEPC213	Manufacturing Engineering-I Lab		0	0	2	-	-	-	-	40	40	20	100	1
8		MEPC215	Thermal Engineering-I Lab		0	0	2	-	-	-	-	40	40	20	100	1
9	Summer Intern	SI201 **	Internship-I		0	0	0	-	-	-	-	40	40	20	100	2
TOTAL					11	1	10	240	80	60	20	200	200	100	900	19

**** Internship- I will be conducted for minimum 3-week duration**

Prog. Name: Mechanical Engineering

Semester-IV

SL. No	Category of Course	Code No	Course Title	Study Scheme				Evaluation Scheme							Total Marks	Credits
				Pre-requisite	Contact Hours/ week			Theory				Practical				
					L	T	P	End Exam	Progressive Assessment			End Exam	Progressive Assessment			
									Class Test	Assignment	Attendance		Sessional	Viva voce		
1	Programme Core	MEPC202	Measurements & Metrology		2	1	0	60	20	15	5	-	-	-	100	3
2		MEPC204	Strength of Materials		2	1	0	60	20	15	5	-	-	-	100	3
3		MEPC206	Thermal Engineering-II		2	1	0	60	20	15	5	-	-	-	100	3
4		MEPC208	Materials Testing Lab		0	0	3	-	-	-	-	40	40	20	100	1.5
5		MEPC210	Thermal Engineering – II Lab		0	0	3	-	-	-	-	40	40	20	100	1.5
6	Programme Elective	MEPE202	Automobile Engineering		3	0	0	60	20	15	5	-	-	-	100	3
7		MEPE204	Tool & Die Engineering		3	0	0	60	20	15	5	-	-	-	100	3
8		MEPE206	Automobile Engineering Lab		0	0	2	-	-	-	-	40	40	20	100	1
9	Project	PR202	Minor Project		0	0	4	-	-	-	-	40	40	20	100	2
10	Mandatory	AU202	Essence of Indian Knowledge and Tradition		2	0	0	0	0	0	0	0	0	0	0	0
TOTAL					14	3	12	300	100	75	25	160	160	80	900	21

Sample Path Format for V Semester

Prog. Name: Mechanical Engineering

SL. No	Category of Course	Code No	Course Title	Study Scheme				Evaluation Scheme							Total Marks	Credits
				Pre-requisite	Contact Hours/ week			Theory				Practical				
					L	T	P	End Exam	Progressive Assessment			End Exam	Progressive Assessment			
									Class Test	Assignment	Attendance		Sessional	Viva voce		
1	Programme Core	MEPC301	Advanced Manufacturing Process		3	0	0	60	20	15	5	-	-	-	100	3
2		MEPC303	Theory of Machines & Mechanisms		2	1	0	60	20	15	5	-	-	-	100	3
3		MEPC305	Industrial Engineering & Management		3	0	0	60	20	15	5	-	-	-	100	3
4		MEPC307	CAD/CAM Lab		0	0	2	0	0	0	0	40	40	20	100	1
5		MEPC309	Manufacturing Engineering-II Lab		0	0	2	0	0	0	0	40	40	20	100	1
6	Programme Elective	MEPE301	Heat Transfer		3	0	0	60	20	15	5	-	-	-	100	3
7		MEPE303	Refrigeration & Air-Conditioning		3	0	0	60	20	15	5	-	-	-	100	3
8		MEPE305	Refrigeration & Air-Conditioning Lab		0	0	2	-	-	-	-	40	40	20	100	1
9	Open Elect.	MEOE301	Engineering Economics & Accountancy		3	0	0	60	20	15	5	-	-	-	100	2
10	Intern	SI301 $$	Internship-II		0	0	0	-	-	-	-	40	40	20	100	3
11	Proj.	PR301	Major Project		0	0	2	-	-	-	-	Assessment to be done, credit to be carried over				##
TOTAL					17	1	8	360	120	90	30	160	160	80	1000	23

$$ Internship-II will be conducted for minimum 4-week duration
credit of Major Project to be carried over to VI sem.

Sample Path Format for VI Semester

Prog. Name: Mechanical Engineering

SL. No	Category of Course	Code No	Course Title	Study Scheme				Evaluation Scheme							Total Marks	Credits
				Pre-requisite	Contact Hours/ week			Theory				Practical				
					L	T	P	End Exam	Progressive Assessment			End Exam	Progressive Assessment			
									Class Test	Assignment	Attendance		Sessional	Viva voce		
1	Progr. Core	MEPC302	Design of Machine Elements		**2**	**1**	**0**	**60**	**20**	**15**	**5**	**-**	**-**	**-**	**100**	**3**
2		MEPC304	Production & Operation Management		**3**	**0**	**0**	**60**	**20**	**15**	**5**	**-**	**-**	**-**	**100**	**3**
3	Hum	HS302	Entrepreneurship & Start-up		**3**	**1**	**0**	**60**	**20**	**15**	**5**	**-**	**-**	**-**	**100**	**4**
4	Open Elective	MEOE302	Renewable Energy Technology		**2**	**0**	**0**	**60**	**20**	**15**	**5**	**-**	**-**	**-**	**100**	**2**
5		MEOE304	Project Management		**2**	**0**	**0**	**60**	**20**	**15**	**5**	**-**	**-**	**-**	**100**	**2**
6	Mandatory	AU302	Indian Constitution		**2**	**0**	**0**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0**	**0**
7	Proj.	PR302	Major Project		**0**	**0**	**6**	**-**	**-**	**-**	**-**	**100**	**50**	**50**	**200**	**4##**
8	Semi.	SE302	Seminar		**1**	**0**	**0**	**-**	**-**	**-**	**-**	**0**	**50**	**50**	**100**	**1**
TOTAL					**15**	**2**	**6**	**300**	**75**	**75**	**50**	**100**	**100**	**100**	**800**	**19**

COURSES OF SEMESTER - III

[For Mechanical Engineering (ME)]

COMPUTER AIDED MACHINE DRAWING

L	T	P		Course Code No.: MEPC201
0	0	4		
Total Contact hrs.: Lecture:0 Tutorial:0 Practical: 60 **Credit : 4**			**Total marks: 100**	**Practical:** End Term Exam.:40 P.A: 60

RATIONALE:

The use of computers for various activities in the industry gave new dimensions to design and manufacturing to meet the challenges of global competition. The field of Computer Aided Machine Drawing has widened the scope of traditional design and manufacturing. In order to be competitive in the global economy, it is imperative that all the manufacturing industries adopt CAMD. Thus, we need to train the manpower on CAMD technology for the necessity of the present day industries.

COURSE OUTCOMES:

At the end of the course, the student will be able to:

- Explain the representation of materials used in machine drawing.
- Draw the development of surfaces for sheet metal working applications.
- Draw the machine elements including keys, couplings, cotters, rivetted, bolted and welded joints.
- Construct an assembly drawing using part drawings of machine components.
- Represent tolerances and the levels of surface finish of machine elements.

COURSE CONTENT DETAILS:

Sl. No.	**Topics for practice**	Time Allotted (Hrs.)
I	Introduction to CAD software	5
II	Drawing aids and editing commands	5
III	Basic dimensioning, hatching, blocks and views	10
IV	Isometric drawing, printing and plotting	10
V	Machine Drawing practice using AutoCAD: Detailed drawings of following machine parts are to be given to the students to assemble and draw the sectional or plain elevations, plans and side views with dimensioning and bill of materials using CAD software (10 exercises). 1. Sleeve & Cotter Joint 2. Spigot & Cotter Joint 3. Knuckle Joint 4. Stuffing box 5. Foot Step Bearing 6. Universal Coupling	30

	7. Plummer Block 8. Simple Eccentric 9. Connecting Rod 10. Protected Type Flange Coupling	

REFERENCES:

Books:

1. Bhatt, N.D., Machine Drawing, Charotar Publishing House, 2003.
2. Sidheswar, N., Kannaiah, P. and Sastry, V.V.S., Machine Drawing, Tata McGraw Hill Book Company, New Delhi, 2000.
3. Kannaih, P., Production Drawing, New Age International, 2009.

MATERIAL SCIENCE & ENGINEERING

L	T	P		Course Code No.: MEPC203
3	0	0		
Total Contact hrs.: Lecture:45 Tutorial:0 Practical: 0 **Credit : 3**			**Total marks: 100**	**Theory:** End Term Exam.:60 P.A: 40

RATIONALE:

Materials science and engineering seeks to understand the fundamental physical origins of material behavior in order to optimize properties of existing materials through structure modification and processing, design and invent new and better materials, and understand why some materials unexpectedly fail.

COURSE OUTCOMES:

At the end of the course, the student will be able to:

- Explain about crystal structures and atomic bonds.
- Describe about classification of ferrous metals and their properties.
- Explain about non-ferrous metals, cutting tool materials and composites along with their properties.
- Describe about the various metallic failures and knowledge in testing of materials.
- Explain the principle of corrosion, their types and its prevention methods along with the various surface engineering processes.

COURSE CONTENT DETAILS:

Unit No.	Topics	Time Allotted (Hrs.)
I	**Crystal structures and Bonds:** Unit cell and space lattice: Crystal system: The seven basic crystal systems; Crystal structure for metallic elements: BCC, FCC and HCP; Coordination number forSimple Cubic, BCC and FCC; Atomic radius: definition, atomic radius for Simple Cubic, BCC and FCC; Atomic Packing Factor for Simple Cubic, BCC, FCC and HCP; Simple problems on finding number of atoms for a unit cell. **Bonds in solids:** Classification - primary or chemical bond, secondary or molecular bond; Typesof primary bonds: Ionic, Covalent and Metallic Bonds; Types of secondary bonds: Dispersion bond, Dipole bond and Hydrogen bond.	**9**

II	**Phase diagrams, Ferrous metals and its Alloys:** Isomorphs, eutectic and eutectoid systems; Iron-Carbon binary diagram; Iron and Carbon Steels; flow sheet for production of iron and steel; Iron ores – Pig iron: classification, composition and effects of impurities on iron; Cast Iron: classification, composition, properties and uses; Wrought Iron: properties, uses/applications of wroughtIron; comparison of cast iron, wrought iron and mild steel and high carbon steel; standard commercial grades of steel as per BIS and AISI; Alloy Steels – purpose of alloying; effects of alloying elements – Important alloy steels: Silicon steel, High Speed Steel (HSS), heat resisting steel, spring steel,Stainless Steel (SS): types of SS, applications of SS – magnet steel – composition, properties and uses	**9**
III	**Non-ferrous metals and its Alloys**: Properties and uses of aluminium, copper, tin, lead, zinc, magnesium and nickel; Copper alloys: Brasses, bronzes – composition, properties and uses; Aluminium alloys: Duralumin, hindalium, magnelium – composition, properties and uses; Nickel alloys: Inconel, monel, nicPerome – composition, properties and uses. Anti-friction/Bearing alloys: Various types of bearing bronzes - Standard commercial grades as per BIS/ASME.	**6**
IV	**Failure analysis & Testing of Materials:** Introduction to failure analysis; Fracture: ductile fracture, brittle fracture; cleavage; notch sensitivity; fatigue; endurance limit; characteristics of fatigue fracture; variables affecting fatigue life; creep; creep curve; creep fracture; Destructive testing: Tensile testing; compression testing; Hardness testing: Brinell, Rockwell; bend test; torsion test; fatigue test; creep test. Non-destructive testing: Visual Inspection; magnetic particle inspection; liquid penetrant test; ultrasonic inspection; radiography.	**9**
V	**Corrosion & Surface Engineering:** Nature of corrosion and its causes; Electrochemical re- actions; Electrolytes; Factors affecting corrosion: Environment, Material properties and physical conditions; Types of corrosion; Corrosion control: Material selection, environment control and design; Surface engineering processes: Coatings and surface treatments; Cleaning and mechanical finishing of surfaces; Organic coatings; Electroplating and Special metallic plating; Electro polishing and pho- to-etching ;– Conversion coatings: Oxide, phosphate and chromate coatings; Thin film coatings: PVD and CVD; Surface analysis; Hard-facing, thermal spraying and high-energy processes; Process/material selection. Pollution norms for treating effluents as per standards	**12**

REFERENCES:

Books:

1. A Text Book of Material Science & Metallurgy – O.P. Khanna, Dhanpath Rai and Sons, New Delhi 2003.
2. Material Science & Engineering – R.K. Rajput, S.K. Kataria & Sons, New Delhi, 2004.
3. Material Science – R. S. Khurmi, S. Chand & Co. Ltd., New Delhi, 2005.

FLUID MECHANICS & HYDRAULIC MACHINES

L	T	P		Course Code No.: MEPC205
2	1	0		
Total Contact hrs.: Lecture:30 Tutorial:15 Practical: 0 **Credit :** 3			**Total marks: 100**	**Theory:** End Term Exam.:60 P.A: 40

RATIONALE:

Importance of fluids (i.e. liquids and gases) in mechanical engineering cannot be overstressed. Water is the most important liquid which is widely used by mankind starting from agriculture for production of food to various industrial as well as household purposes. Pressurized oil is used for transmitting power to various production machines as well as mechanised system. However, actual use of or action by various liquids like water & oil can be realised by a group of machines called fluid machines. It is, therefore, essential that mechanical engineers should be well conversant with design, operation and use of these hydraulic machines.

COURSE OUTCOMES:

At the end of the course, the student will be able to:

- Measure various properties such as pressure, velocity, flow rate using various instruments.
- Calculate different parameters such as co-efficient of friction, power, efficiency etc. of various Systems.
- Describe the construction and working of turbines and pumps.
- Test the performance of turbines and pumps.
- Plot characteristics curves of turbines and pumps.

COURSE CONTENT DETAILS:

Unit No.	Topics for practice	Time Allotted (Hrs.)
I	**Properties of fluid:** Density, Specific gravity, Specific Weight, Specific Volume, Dynamic Viscosity, Kinematic Viscosity, Surface tension, Capillarity, Vapour Pressure, Compressibility. **Fluid Pressure & Pressure Measurement:** Fluid pressure, Pressure head, Pressure intensity, Concept of vacuum and gauge pressures, atmospheric pressure, absolute pressure, Simple and differential manometers, Bourdan pressure gauge, Concept of Total pressure on immersed bodies, center ofpressure, Simple problems on Manometers.	**9**
II	**Fluid Flow:** Types of fluid flows, Path line and Stream line, Continuity	**9**

	equation, Bernoulli's theorem, Principle of operation of Venturimeter, Orifice meter and Pitot tube, Derivations for discharge, coefficient of discharge and numerical problems. **Flow Through Pipes:** Laminar and turbulent flows; Darcy's equation and Chezy's equation for frictional losses, Minor losses in pipes, Hydraulic gradient and total gradient line, Numerical problems to estimate major and minor losses.	
III	**Impact of jets:** Impact of jet on fixed vertical, moving vertical flat plates, Impact of jet on curved vanes with special reference to turbines & pumps, Simple Numericals on work done and efficiency.	**6**
IV	**Hydraulic Turbines:** Layout of hydroelectric power plant, Features of Hydroelectric power plant, Classification of hydraulic turbines, Selection of turbine on the basis of head and discharge available, Construction and working principle of Pelton wheel, Francis and Kaplan turbines, Draft tubes – types and construction, Concept of cavitation in turbines, Calculation of Work done, Power, efficiency of turbines, Unit quantities and simple numericals.	**9**
V	**Centrifugal Pumps:** Principle of working and applications, Types of casings and impellers, Concept of multistage, Priming and its methods, Cavitation, Manometric head, Work done, Manometric efficiency, Overall efficiency. Numericals on calculations of overall efficiency and power requiredto drive pumps. **Reciprocating Pumps:** Construction, working principle and applications of single and double actingreciprocating pumps, Concept of Slip, Negative slip, Cavitation and separation.	**12**

REFERENCES:

1. Fluid Mechanics & Hydraulic Machines, S.S. Rattan, Khanna Publishing House, New Delhi.
2. Hydraulic, fluid mechanics & fluid machines – Ramamrutham S, Dhanpath Rai and Sons, New Delhi.
3. Hydraulics and fluid mechanics including Hydraulic machines – Modi P.N. and Seth S.M., Standard Book House. New Delhi.
4. One Thousand Solved Problems in Fluid Mechanics – K. Subramanya, Tata McGraw Hill.
5. Hydraulic, fluid mechanics & fluid machines – S. Ramamrutham, Dhanpat Rai and Sons, New Delhi.
6. Fluid Mechanics and Hydraulic Machines – R. K. Bansal, Laxmi Publications, New Delhi.

MANUFACTURING ENGINEERING

L	T	P		Course Code No.: MEPC207
3	0	0		
Total Contact hrs.: Lecture:45 Tutorial:0 Practical:0 **Credits: 3**			**Total marks: 100**	**Theory:** End Term Exam.:60 P.A: 40

RATIONALE:

Manufacturing is the backbone of any industrial nation. The level of manufacturing activity is directly related to the economic health of a country. Generally, the higher the level of manufacturing activity in a country, the higher is the standard of living of is people. Manufacturing is generally a complex activity, involving people who have a broad range of disciplines and skills and a wide variety of machinery, equipment, and tooling with various levels of automation, including computers, robots, and material handling equipment.

COURSE OUTCOMES:

At the end of the course, the student will be able to

- Identify basic manufacturing processes for manufacturing different components.
- Control different machines and equipment.
- Produce jobs as per specified dimensions and inspect the job for specified dimensions.
- Select the specific manufacturing process for getting the desired type of output.
- Adapt safety practices while working on various machines.

COURSE CONTENT DETAILS:

Unit No.	Topics for practice	Time Allotted (Hrs.)
I	**Cutting Fluids & Lubricants:** Introduction; Types of cutting fluids, Fluids and coolants required in turning, drilling, shaping, sawing & broaching; Selection of cutting fluids, methods of application of cutting fluid; Classification of lubricants (solid, liquid, gaseous), Properties and applications of lubricants. **Lathe Operations:** Types of lathes – light duty, Medium duty and heavy duty geared lathe, CNC lathe; Specifications; Basic parts and their functions; Operations and tools – Turning, parting off, Knurling, facing, Boring, drilling, threading, step turning, taper turning.	**8**
II	**Broaching Machines:** Introduction to broaching; Types of broaching machines – Horizontal type (Single ram & duplex ram), Vertical type, Pull up, pull down, and push down; Elements of broach tool; broach teeth details; Nomenclature; Tool materials. **Drilling:** Classification; Basic parts and their functions; Radial drilling	**8**

	machine; Types of operations; Specifications of drilling machine; Types of drills and reamers.	
III	**Welding:** Classification; Gas welding techniques; Types of welding flames; Arc Welding – Principle, Equipment, Applications; Shielded metal arc welding; Submerged arc welding; TIG / MIG welding; Resistance welding - Spot welding, Seam welding, Projection welding; Welding defects; Brazing and soldering: Types, Principles, Applications. **Milling:** Introduction; Types of milling machines: plain, Universal, vertical; constructional details specifications; Milling operations: simple, compound and differential indexing; Milling cutters – types; Nomenclature of teeth; Teeth materials; Tool signature of milling cutter; Tool & work holding devices.	**8**
IV	**Gear Making:** Manufacture of gears – by Casting, Moulding, Stamping, Coining Extruding, Rolling, Machining; Gear generating methods: Gear Shaping with pinion cutter & rack cutter; Gear hobbing; Description of gear hob; Operation of gear hobbing machine; Gear finishing processes; Gear materials and specification; Heat treatment processes applied to gears. **Press working:** Types of presses and Specifications, Press working operations - Cutting, bending, drawing, punching, blanking, notching, lancing; Die set components- punch and die shoe, guide pin, bolster plate, stripper, stock guide, feed stock, pilot; Punch and die clearances for blanking and piercing, effect of clearance.	**9**
V	**Grinding and finishing processes:** Principles of metal removal by Grinding; Abrasives – Natural & Artificial; Bonds and binding processes: Vitrified, silicate, shellac, rubber, bakelite; Factors affecting the selection of grind wheels: size and shape of wheel, kind of abrasive, grain size, grade and strength of bond, structure of grain, spacing, kinds of bind material; Standard marking systems: Meaning of letters & numbers sequence of marking, Grades of letters; Grinding machines classification: Cylindrical, Surface, Tool & Cutter grinding machines; Construction details; Principle of centreless grinding; Advantages & limitations of centre less grinding; Finishing by grinding: Honing, Lapping, Super finishing; Electroplating: Basic principles, Plating metals, applications; Hot dipping: Galvanizing, Tin coating, Parkerising, Anodizing; Metal spraying: wire process, powder process and applications; Organic coatings: Oil base Paint, Lacquer base, Enamels, Bituminous paints, rubber base coating; Finishing specifications.	**12**

REFERENCES:

Books:

1. Manufacturing technology – P N Rao, Tata McGraw-Hill Publications.
2. Elements of workshop Technology (Volume I & II) – S. K. Hajra Chaudary, Bose & Roy, Media Promoters and Publishers Limited.
3. Production Technology (Volume I & II) – O. P. Khanna & Lal, Dhanpat Rai Publications.
4. Fundamental of metal cutting and machine tools– B. L. Juneja, New age international limited.
5. Manufacturing Technology, Metal Cutting & Machine tools– P. N. Rao, Tata McGraw-Hill Publications.
6. Production Technology – R.B. Gupta, Satya Prakashan, New Delhi.

THERMAL ENGINEERING – I

L	T	P		Course Code No.: MEPC209
3	0	0		
Total Contact hrs.: Lecture:45 Tutorial:0 Practical: 0 **Credits : 3**			**Total marks: 100**	**Theory:** End Term Exam.:60 P.A: 40

RATIONALE:

Amount of useful energy produced and spent is the most important factor by which a country's technical advancement is measured. Useful mechanical and electrical energy is produced from heat energy. It is of paramount importance to an engineer to know the basic principles by which heat energy can be converted into mechanical energy, which in turn can be converted into electrical energy.

Thermodynamics is the field of applied science which deals with the energy possessed by heated gases and vapours and the laws which govern the conversion of this energy into mechanical energy and vice versa. This is the fundamental subject for understanding the process of producing vast amount of mechanical energy from heat energy and therefore necessary to be learned by the engineering students. Understanding the working principles and features of the various machines and plants in which either such heated gas/vapours are produced or conversion of heat to mechanical energy takes place is of great importance.

COURSE OUTCOMES:

At the end of the course, the student will be able to

- Describe various sources of Energy and their applications.
- Classify I.C. engines and understand their working and constructional features.
- Draw the energy flow diagram of an I.C. engine and evaluate its performance.
- Describe the constructional features of air compressor and working of different air compressors.
- Illustrate the applications of refrigeration and Classification of air-conditioning systems.

COURSE CONTENT DETAILS:

Unit No.	Topics for practice	Time Allotted (Hrs.)
I	**Sources of Energy:** Brief description of energy Sources: Classification of energy sources: Renewable, Non-Renewable; Fossil fuels, including CNG, LPG; Solar Energy: Flat plate and concentrating collectors & its applications (Solar Water Heater, Photovoltaic Cell, Solar Distillation); Wind Energy; Tidal Energy; Ocean Thermal Energy; Geothermal Energy; Biogas, Biomass, Bio-diesel; Hydraulic Energy, Nuclear Energy; Fuel cell.	**7**

II	**Internal Combustion Engines:** Assumptions made in air standard cycle analysis; Brief de- scription of Carnot, Otto and Diesel cycles with P-V and T-S diagrams; Internal and external combustion engines; advantages of I.C. engines over external combustion engines; classification of I.C. engines; neat sketch of I.C. engine indicating component parts; Function of each part and materials used for the component parts - Cylinder, crank case, crank pin, crank, crank shaft, connecting rod, wrist pin, piston, cooling pins cylinder heads, exhaust valve, inlet valve; Working of four-stroke and two-stroke petrol and diesel engines; Comparison of two stroke and four stroke engines; Comparison of C.I. and S.I. engines; Valve timing and port timing diagrams for four stroke and two stroke engines.	**10**
III	**I.C. Engine Systems:** Fuel system of Petrol engines; Principle of operation of simple and Zenith carburettors; Fuel system of Diesel engines; Types of injectors and fuel pumps; Cooling system: air cooling, water cooling system with thermo siphon method of circulation and water cooling system with radiator and forced circulation (description with line diagram). Comparison of air cooling and water cooling system; Ignition systems – Battery coil ignition and magneto ignition (description and working). Comparison of two systems; Types of lubricating systems used in I.C. engines with line diagram; Types of governing of I.C. engines – hit and miss method, quantitative method, qualitative method and combination methods of governing; their applications; Objective of super charging.	**10**
IV	**Performance of I.C. Engines:** Brake power; Indicated power; Frictional power; Brake and Indicated mean effective pressures; Brake and Indicated thermal efficiencies; Mechanical efficiency; Relative efficiency; Performance test; Morse test; Heat balance sheet; Methods of determination of B,P., I.P. and F.P.; Simple numerical problems on performance of I.C. engines.	**6**
V	**Air Compressors:** Functions of air compressor; Uses of compressed air; Types of air compressors; Single stage reciprocating air compressor - its construction and working (with line diagram) using P-V diagram; Multi stage compressors – Advantages over single stage compressors; Rotary compressors: Centrifugal compressor, axial flow type compressor and vane type compressors. **Refrigeration & Air-conditioning:** Refrigeration; Refrigerant; COP; Air Refrigeration system: components, working & applications; Vapour Compression system: components, working & applications; Air conditioning; Classification of Air-conditioning systems; Comfort and Industrial Air-Conditioning; Window Air-Conditioner; Summer Air-Conditioning system, Winter Air-Conditioning system, Year-round Air-Conditioning system	**12**

REFERENCES:

Books:

1. Introduction to Renewable Energy – Vaughn Nelson, CRC Press
2. Thermal Engineering – P. L. Ballaney, Khanna Publishers, 2002
3. A Course in Thermal Engineering – S. Domkundwar & C.P. Kothandaraman, Dhanpat Rai.
4. Thermal Engineering – R. S. Khurmi and J.K. Gupta, 18th Edition, S. Chand & Co, New Delhi.
5. Thermal Engineering – R. K. Rajput, 8th Edition, Laxmi publications Pvt Ltd, New Delhi.

FLUID MECHANICS & HYDRAULIC MACHINES LAB

L	T	P		Course Code No.: MEPC211
0	0	2		
Total Contact hrs.: Lecture:0 Tutorial:0 Practical: 30 **Credit : 1**			**Total marks: 100**	**Practical:** End Term Exam.:40 P.A: 60

RATIONALE:

Though in majority of cases we use solids as engineering materials, use or application of fluids (i.e. liquids and gases) in engineering field is also numerous and of great importance.

It is, therefore, necessary to study the physical properties and characteristics of fluids as a distinct group of materials, which have very important use and application in a wide range of fields of engineering and in mechanical engineering in particular.

COURSE OUTCOMES:

At the end of the course, the student will be able to

- Measure various properties such as pressure, velocity, flow rate using various instruments.
- Calculate different parameters such as co-efficient of friction, power, efficiency etc. of various systems.
- Explain the need and importance of calibration of pressure gauges.
- Describe the construction and working of turbines and pumps.
- Test the performance of turbines and pumps and Plot characteristics curves.

COURSE CONTENT DETAILS:

Sl. No.	Topics for practice	Time Allotted (Hrs.)
I	Verification of Bernoulli's theorem.	**3**
II	Determination of Coefficient of Discharge of Venturimeter.	**3**
III	Determination of Coefficient of Discharge, coefficient of contraction and coefficient of velocity of Orifice.	**3**
IV	Determination of coefficient of friction of flow through pipes.	**3**
V	Determination of force exerted by the jet of water on the given vane.	**3**
VI	Determination of minor losses of flow through pipes.	**3**
VII	Calibration of pressure gauge using dead weight pressure gauge tester.	**2**

VIII	Trial on centrifugal pump to determine overall efficiency.	**2**
IX	Trial on reciprocating pump to determine overall efficiency.	**2**
X	Trial on Pelton wheel to determine overall efficiency.	**3**
XI	Trial on Francis/Kaplan turbine to determine overall efficiency.	**3**

REFERENCES:

Books:

1. N. Kumara Swamy, Fluid Mechanics and Machinery Laboratory Manual, Charotar Publishing House Pvt. Ltd., ANAND 388 001, Ed. 2008.

MANUFACTURING ENGINEERING-I LAB

L	T	P		Course Code No.: MEPC213
0	0	2		
Total Contact hrs.: Lecture:0 Tutorial:0 Practical: 30 **Credit : 1**			**Total marks: 100**	**Practical:** End Term Exam.:40 P.A: 60

RATIONALE:

Manufacturing is very important to industry. In particular, the mechanical engineers are involved in different processes at their work place. Practice on different manufacturing processes like moulding, casting, welding and equipment like lathe is dealt in this course, which will make the students improvize their knowledge and implement the same at their work place.

COURSE OUTCOMES:

At the end of the course, the student will be able to:

- Prepare a mould sand mix and molten metal and calculate the amount of metal to be poured in the mould.
- Centre the job and select the proper tool to perform the job on lathe machine.
- Calculate the taper angle and practice different taper turning methods on lathe.
- Prepare the edges for welding and select the suitable electrode, voltage and current.
- Operate the welding transformer and generator to perform various weld joint operations.

COURSE CONTENT DETAILS:

Sl. No.	Topics for practice	Time Allotted (Hrs.)
I	Moulding & casting of (i) Connecting rod (ii) Solid bearing (iii) V-Pulley/Gear Pulley	**3**
II	Arc welding (i) Lap Joint (ii) Butt Joint (iii) T- Joint	**3**
III	Gas welding (i) Lap Joint (ii) Butt Joint	**3**
IV	Spot welding (i) Lap Joint	**3**
V	Turning Exercise (i) Facing, Step Turning & Chamfering (ii) Step Turning & Taper Turning (iii) Step Turning & Groove Cutting (iv) Step Turning & & Knurling (v) Step Turning &Thread Cutting (vi) Turning and Drilling	**3**
VI	Grinding the Lathe Cutting tools to the required angles	**3**
VII	Study of Lathe, Drilling machine, shaping machine and slotting machine	**3**
VIII	The dismantling some of the components of lathe and then assemble the same	**3**
IX	List the faults associated with lathe and its remedies	**3**
X	The routine and preventive maintenance procedure for lathe	**3**

REFERENCES:

Books:

1. Elements of Workshop Technology (Volume I & II) – Hajra Chowdry & Bhattacharaya, MediaPromoters, 11th Edition, 2007.
2. Introduction of Basic Manufacturing Processes and Workshop Technology – Rajendersingh,New age International (P) Ltd. NewDelhi, 2006.
3. Workshop Technology – Raghuwanshi, Khanna Publishers. Jain &Gupta, New Delhi, 2002.
4. Production Technology – Jain & Gupta, Khanna Publishers, New Delhi, 2006.
5. Production Technology – HMT, 18th edition, Tata McGraw Hill, New Delhi.
6. Manufacturing process – Myro N Begman, 5 th edition, Tata McGraw Hill, New Delhi.

THERMAL ENGINEERING – I LAB

L	T	P		Course Code No.: MEPC215
0	0	2		
Total Contact hrs.: Lecture:0 Tutorial:0 Practical: 30 **Credit : 1**			**Total marks: 100**	**Practical:** End Term Exam.:40 P.A: 60

RATIONALE:

For mechanical engineers, it is necessary to understand the importance of fuel properties and learn the methods of determination of various properties of fuels. Also, the working principles of various methods used in determination of properties of fuels. Understanding about different parts of I.C. engine and their working will significantly improve the practical knowledge of the students.

COURSE OUTCOMES:

At the end of the course, the student will be able to:

- Determine flash and fire point of a given sample of fuel using given Apparatus (Abels, Cleveland & Penesky martin)
- Determine Viscosity of a given sample of oil using given apparatus.
- Determine Calorific value of a given sample of fuel using given apparatus.
- Determine amount of carbon residue of a given sample of petroleum product.
- Draw VTD /PTD of given I.C. Engine with an explanation of how the processes are controlled during its operation.
- Describe the functions of various parts of IC engines and the working of IC engines.

COURSE CONTENT DETAILS:

Sl. No.	Topics for practice	Time Allotted (Hrs.)
I	Flash & Fire point tests using Able's/Cleveland/Pensky Martin Apparatus	**3**
II	Viscosity measurement usi/Saybolt viscometer	**3**
III	Calorific value tests using Bomb Calorimeter (Solid and Liquid fuels) and Junkers Gas Calorimeter (Gaseous fuels)	**3**
IV	Carbon residue test using Conradson's apparatus.	**3**
V	Assembling and disassembling of I.C. Engines	**3**
VI	Port timing diagram of Petrol engine	**3**
VII	Port timing diagram of Diesel engine	**3**
VIII	Valve timing diagram of Petrol engine	**3**
IX	Valve timing diagram of Diesel engine	**3**
X	Study of petrol and diesel engine components and Models	**3**

REFERENCES:

Books:

1. Thermal Engineering – P.L. Ballaney, Khanna Publishers, 2002.
2. A Course in Thermal Engineering – S. Domkundwar & C.P. Kothandaraman, Dhanpat Rai &Publication New Delhi
3. Thermal Engineering – R.S. Khurmi and J.K. Gupta, 18th Edition, S. Chand & Co, New Delhi.

COURSES OF SEMESTER - IV

[For Mechanical Engineering (ME)]

MEASUREMENTS & METROLOGY

L	T	P		Course Code No.: MEPC202

2	1	0		
Total Contact hrs.: Lecture:30 Tutorial:15 Practical: 0 **Credits : 3**			**Total marks: 100**	**Theory:** End Term Exam.:60 P.A: 40

RATIONALE:

The Mechanical measurement is primarily concerned with methods of measurement based on agreed units and standards. The practice of mechanical measurement involves precise measurements requiring the use of apparatus and equipment to permit the degree of accuracy required to be obtained. In the broader sense the subject is not limited to length measurement but is also concerned with the metrology, inspection and its various techniques. Thus technicians working in inspection, production and maintenance units need to be thorough in this subject.

COURSE OUTCOMES:

At the end of the course, the student will be able to:

- Define accuracy, precision, calibration, sensitivity, repeatability and such relevant terms in metrology.
- Distinguish between various types of errors.
- Illustrate the principle of operation of an instrument
- Select suitable measuring device for a particular application.
- Appreciate the concept of calibration of an instrument.
- Interpret the data obtained from the different measurements processes and
- Represent the data in the graphical form, statistical form.

COURSE CONTENT DETAILS:

Unit No.	Topics for practice	Time Allotted (Hrs.)
I	**Introduction to measurements**: Definition of measurement; Significance of measurement; Methods of measurements: Direct & Indirect; Generalized measuring system; Standards of measurements: Primary & Secondary; Factors influencing selection of measuring instruments; Terms applicable to measuring instruments: Precision and Accuracy, Sensitivity and Repeatability, Range, Threshold, Hysteresis, calibration; Errors in Measurements: Classification of errors, Systematic andRandom error. **Measuring instruments:** Introduction; Thread measurements: Thread gauge micrometer; Angle measurements: Bevel protractor, Sine Bar; Gauges: plain plug gauge, ring Gauge, snap gauge, limit gauge; Comparators: Characteristics of comparators, Types of comparators; Surface finish: Definition, Terminology of surface finish, Talysurf surface roughness tester; Coordinating measuring ma-chine.	**10**

II	**Transducers and Strain gauges:** Introduction; Transducers: Characteristics, classification of transducers, two coil self-inductance transducer, Piezoelectric transducer; Strain Measurements: Strain gauge, Classification, mounting of strain gauges, Strain gauge rosettes-two and three elements. **Measurement of force, torque, and pressure:** Introduction; Force measurement: Spring Balance, Proving ring, Load cell; Torque measurement: Prony brake, Eddy current, Hydraulic dynamometer; Pressure measurement: Mcloed gauge.	**9**
III	**Applied mechanical measurements:** Speed measurement: Classification of tachometers, Revolution counters, Eddy current tachometers; Displacement measurement: Linear variable Differential transformers (LVDT); Flow measurement: Rotameters, Turbine meter; Temperature measurement: Resistance thermometers, Optical Pyrometer. **Miscellaneous measurements**: Humidity measurement: hair hygrometer; Density measurement: hydrometer; Liquid level measurement: sight glass, Float gauge; Biomedical measurement: Sphygmomonometer.	**8**
IV	**Limits, Fits & Tolerances:** Concept of Limits, Fits, and Tolerances; Selective Assembly; Interchangeability; Hole And Shaft Basis System; Taylor's Principle; Design of Plug; Ring Gauges; IS 919-1993 (Limits, Fits & Tolerances, Gauges} IS 3477-1973; concept of multi gauging and inspection. **Angular Measurement**: Concept; Instruments for Angular Measurements; Working and Use of Universal Bevel Protractor, Sine Bar, Spirit Level; Principle of Working of Clinometers; Angle Gauges (With Numerical on Setting of Angle Gauges). **Screw thread Measurements**: ISO grade and fits of thread; Errors in threads; Pitch errors; Measurement of different elements such as major diameter, minor diameter, effective diameter, pitch; Two wire method; Thread gauge micrometer; Working principle of floating carriage dial micrometer.	**12**
V	**Gear Measurement and Testing**: Analytical and functional inspection; Rolling test; Measurement of tooth thickness (constant chord method); Gear tooth vernier; Errors in gears such as backlash, runout, composite. **Machine tool testing**: Parallelism; Straightness; Squareness; Coaxiallity; roundness; run out; alignment testing of machine tools as per IS standard procedure.	**6**

REFERENCES:

Books:

1. Mechanical measurements – Beckwith Marangoni and Lienhard, Pearson Education, 6th Ed., 2006.
2. Metrology & Measurement – Anand K Bewoor, Vinay Kulakarni, Tata McGraw Hill, New Delhi, 2009.
3. Principles of Industrial instrumentation and control systems – Channakesava. R. Alavala, DELMAR Cenage learning, 2009.
4. Principles of Engineering Metrology – Rega Rajendra, Jaico publishers, 2008.

5. Dimensional Metrology – Connie Dotson, DELMAR, Cenage learning, 2007.
6. Instrumentation measurement and analysis – B.C. Nakara, K.K. Chaudary, second edition, Tata McGraw Hill, 2005.
7. Engineering Metrology – R.K. Jain, Khanna Publishers, New Delhi, 2005.
8. A text book of Engineering Metrology – I.C. Gupta, Dhanpat Rai and Sons, New Delhi, 2005.
9. Metrology for Engineers – J.F.W. Galyer and C. R. Shotbolt, ELBS.
10. Engineering Metrology – K. J. Hume, Kalyani publishers.

STRENGTH OF MATERIALS

L	T	P		Course Code No.: MEPC204
2	1	0		
Total Contact hrs.: Lecture:30 Tutorial:15 Practical: 0 **Credits : 3**			**Total marks: 100**	**Theory:** End Term Exam.:60 P.A: 40

RATIONALE:

Machine parts are subjected to various types of loads resulting in development of stresses and strains. If, these stresses and strains are allowed to develop beyond the safe limit, the concerned part may fail. As a technician, it becomes very essential to understand the effects of loads on any part. Reduction in size with superior material strength are the main considerations of the present day manufacturing world. All these factors are focusing the attention of the technicians and engineers for need based designs by studying the effects of loads, stresses and strains in the parts and find necessary solutions.

COURSE OUTCOMES:

At the end of the course, the student will be able to:

- Compute stress and strain values and find the changes in axial, lateral and volumetric dimensions of bodies of uniform section and of composite section under the influence of normal forces.
- Calculate thermal stresses, in bodies of uniform section and composite sections.
- Define resilience, proof – resilience and modulus of resilience and obtain expressions for instantaneous stress developed in bodies subjected to different loads.
- Compute shear force and bending moment at any section of beam and draw the S.F. & B.M diagrams of for UDL and Point loads.
- Calculate the safe load, safe span and dimensions of cross section.
- Compare strength and weight of solid and hollow shafts of the same length and material and compute the stress and deflection of the closed coil helical spring.

COURSE CONTENT DETAILS:

Unit No.	Topics for practice	Time Allotted (Hrs.)
I	**Simple Stresses and Strains:** Types of forces; Stress, Strain and their nature; Mechanical properties of common engineering materials; Significance of various points on stress – strain diagram for M.S. and C.I. specimens; Significance of factor of safety; Relation between elastic constants; Stress and strain values in bodies of uniform section and of composite section under the influence of normal forces; Thermal stresses in bodies of uniform section and composite sections; Related numerical problems on the above topics. **Strain Energy:** Strain energy or resilience, proof resilience and modulus of resilience; Derivation of strain energy for the following	**10**

	cases: i) Gradually applied load, ii) Suddenly applied load, iii) Impact/ shock load; Related numerical problems.	
II	**Shear Force & Bending Moment Diagrams:** Types of beams with examples: a) Cantilever beam, b) Simply supported beam, c) Over hanging beam, d) Continuous beam, e) Fixed beam; Types of Loads – Point load, UDL and UVL; Definition and explanation of shear force and bending moment; Calculation of shear force and bending moment and drawing the S.F and B.M. diagrams by the analytical method only for the following cases: a) Cantilever with point loads, b) Cantilever with uniformly distributed load, c) Simply supported beam with point loads, d) Simply supported beam with UDL, e) Over hanging beam with point loads, at the centre and at free ends, f) Over hanging beam with UDL throughout, g) Combination of point and UDL for the above; Related numerical problems.	**10**
III	**Theory of Simple Bending and Deflection of Beams:** Explanation of terms: Neutral layer, Neutral Axis, Modulus of Section, Moment of Resistance, Bending stress, Radius of curvature; Assumptions in theory of simple bending; Bending Equation $M/I = \sigma/Y = E/R$ with derivation; Problems involving calculations of bending stress, modulus of section and moment of resistance; Calculation of safe loads and safe span and dimensions of cross- section; Definition and explanation of deflectionas applied to beams; Deflection formulae without proof for cantilever and simply supported beams with point load and UDL only (Standard cases only); Related numerical problems.	**10**
IV	**Torsion in Shafts and Springs:** Definition and function of shaft; Calculation of polar M.I. for solid and hollow shafts; Assumptions in simple torsion; Derivation of the equation $T/J=f_s/R=G\theta/L$; Problems on design of shaft based on strength and rigidity; Numerical Problems related to comparison of strength and weight of solid and hollow shafts; Classification of springs; Nomenclature of closed coil helical spring; Deflection formula for closed coil helical spring (without derivation); stiffness of spring; Numerical problems on closed coil helical spring to find safe load, deflection, size of coil and number of coils.	**9**
V	**Thin Cylindrical Shells:** Explanation of longitudinal and hoop stresses in the light of circumferential and longitudinal failure of shell; Derivation of expressions for the longitudinal and hoop stress for seamless and seam shells; Related numerical Problems for safe thickness and safe workingpressure.	**6**

REFERENCES:

Books:

1. Strength of Materials – D. S. Bedi, Khanna Book Publishing Co. (P) Ltd., Delhi, 2017.
2. Strength of Materials – B. C. Punmia, Ashok Kumar Jain & Arun Kumar Jain, Laxmi Publications, New Delhi, 2013.
3. Strength of Materials – S. Ramamrutham, Dhanpat Rai & Publication New Delhi.
4. Strength of Materials – R. S. Khurmi, S. Chand Company Ltd. Delhi.
5. A Text Book strength of Material– R.K. Bansal, Laxmi Publication New Delhi.

THERMAL ENGINEERING – II

L	T	P		Course Code No.: MEPC206
2	1	0		
Total Contact hrs.: Lecture:30 Tutorial:15 Practical: 0 **Credits : 3**			**Total marks: 100**	**Theory:** End Term Exam.:60 P.A: 40

RATIONALE:

Amount of useful energy produced and spent is the most important factor by which a country's technical advancement is measured. Useful mechanical and electrical energy is produced from heat energy. It is of paramount importance to an engineer to know the basic principles by which heat energy can be converted into mechanical energy which in turn can be converted into electrical energy. Understanding the working principles and features of the various machines and plant components in which either such heated gas/vapours are produced or conversion of heat to mechanical energy takes place, is of great importance to a mechanical engineer.

COURSE OUTCOMES:

At the end of the course, the student will be able to:

- Explain the working cycle of gas turbines, and the working of Jet and Rocket Engines apart from identifying the fuels used for Jet and Rocket propulsion.
- Compute the work done, enthalpy, internal energy and entropy of steam at given conditions using steam tables and Mollier chart.
- Distinguish between water tube and fire-tube boilers and functions of all the mountings and accessories.
- Calculate Velocity of steam at the exit of nozzle in terms of heat drop analytically and by using Mollier chart.
- Explain the principle of working of a steam turbine and difference between the impulse turbines and reaction turbines.

COURSE CONTENT DETAILS:

Unit No.	Topics for practice	Time Allotted (Hrs.)
I	**Gas Turbines:** Air-standard Brayton cycle; Description with p-v and T-S diagrams; Gas turbines Classification: open cycle gas turbines and closed cycle gas turbines; comparison of gas turbine with reciprocating I.C. engines and steam turbines. Applications and limitations of gas turbines; General lay-out of Open cycle constant pressure gas turbine; P-V and T-S diagrams and working; Generallay-out of Closed cycle gas turbine; P-V and T-S diagrams and working. **Jet Propulsion:** Principle of jet propulsion; Fuels used for jet propulsion; Applications of jet propulsion; Working of a turbojet engine; Principle of Ram effect; Working of a Ram jet engine; Principle	**10**

	ofRocket propulsion; Working principle of a rocket engine; Applications of rocket propulsion; Comparison of jet and rocket propulsions.	
II	**Properties of Steam:** Formation of steam under constant pressure; Industrial uses of steam; Basic definitions: saturated liquid line, saturated vapour line, liquid region, vapour region, wet region, superheat region, critical point, saturated liquid, saturated vapour, saturation temperature, sensible heat, latent heat, wet steam, dryness fraction, wetness fraction, saturated steam, superheated steam, degree of superheat; Determination of enthalpy, internal energy, internal latent heat, entropy of wet, dry and superheated steam at a given pressure using steam tables and Mollier chart for the following processes: Isochoric process, Isobaric process, Hyperbolic process, Isothermal process, Isentropic process, Throttling process, Polytropic process; Simple direct problems on the above using tables and charts; Steam calorimeters: Separating, throttling, Combined Separating and throttling calorimeters – problems.	**10**
III	**Steam Generators:** Function and use of steam boilers; Classification of steam boilers with examples; Brief explanation with line sketches of Cochran, Babcock and Wilcox Boilers; Comparison of water tube and fire tube boilers; Description with line sketches and working of modern high pressure boilers Lamont and Benson boilers; Boiler mountings: Pressure gauge, water level indicator, fusible plug, blow down cock, stop valve, safety valve, (dead weight type, spring loaded type, high pressure and low water safety alarm); Boiler accessories: feed pump, economiser, super heaterand air pre-heater; Study of steam traps & separators; Explanation of the terms: Actual evaporation, equivalent evaporation, factor of evaporation, boiler horse power and boiler efficiency; Formula for the above terms without proof; Simple direct problems on the above; Draught systems (Natural, forced & induced).	**10**
IV	**Steam Nozzles:** Flow of steam through nozzle; Velocity of steam at the exit of nozzle in terms of heat drop using analytical method and Mollier chart; Discharge of steam through nozzles; Critical pressure ratio; Methods of calculation of cross-sectional areas at throat and exit for maxi- mum discharge; Effect of friction in nozzles and Super saturated flow in nozzles; Working steam jet injector; Simple numerical problems.	**6**
V	**Steam Turbines:** Classification of steam turbines with examples; Difference between impulse & reaction turbines; Principle of working of a simple De-lavel turbine with line diagrams- Velocity diagrams; Expression for work done, axial thrust, tangential thrust, blade and diagram efficiency, stage efficiency, nozzle efficiency; Methods of reducing rotor speed; compounding for velocity, for pressure or both pressure and velocity; Working principle with line diagram of a Parson's Reaction turbine–velocity diagrams; Simple problems on single stage impulse turbines (without blade friction) and reaction turbine including data on blade height. Bleeding, re-heating and re-heating factors (Problems omitted); Governing of steam turbines: Throttle, By-pass & Nozzle control governing.	**9**

REFERENCES:

Books:

1. A Course in Thermal Engineering – S. Domkundwar & C. P. Kothandaraman, Dhanpat Rai & Publication, New Delhi.
2. Thermal Engineering – R. K. Rajput, Laxmi Publication New Delhi.
3. Thermal Engineering – P. L. Ballaney, Khanna Publishers, 2002.
4. Treatise on Heat Engineering in MKS and SI Units – V. P. Vasandani & D.S. Kumar, Metropolitan Book Co. Pvt. Ltd, New Delhi.

MATERIAL TESTING LAB

L	T	P		Course Code No.: MEPC208
0	0	3		
Total Contact hrs.: Lecture:0 Tutorial:0 Practical: 45 **Credit : 1.5**			**Total marks: 100**	**Practical:** End Term Exam.:40 P.A: 60

RATIONALE:

Material testing is required to be done before any material is used in different applications. Testing involves identifying the elasticity and yield points. Also, the failure aspect is checked. Behavior depends on the type of the material and based on its characteristics, applicability is chosen. Material testing gives clear idea about the materials and accordingly their usage is decided.

COURSE OUTCOMES:

At the end of the course, the student will be able to:

- Identify the given specimen by viewing the micro structure using metallurgical microscope.
- Identify the cracks in the specimen using different techniques.
- Determine the various types of stress and plot the stress strain diagram for mild steel.
- Determine the torsion, bending, impact and shear values of given materials.
- Determine the modulus of rigidity, strain energy, shear stress and stiffness of coil spring.

COURSE CONTENT DETAILS:

Sl. No.	Topics for practice	Time Allotted (Hrs.)
I	Prepare a specimen and examine the microstructure of the Ferrous and Non- ferrous metals using the Metallurgical Microscope.	**5**
II	Detect the cracks in the specimen using (i) Visual inspection and ring test (ii) Die penetration test (iii) Magnetic particle test.	**5**
III	Determination of Rockwell's Hardness Number for various materials like mild steel, highcarbon steel, brass, copper and aluminium.	**5**
IV	Finding the resistance of materials to impact loads by Izod test and Charpy test.	**5**
V	Torsion test on mild steel – relation between torque and angle of twist determination ofshear modulus and shear stress.	**5**
VI	Finding Young's Modulus of Elasticity, yield points, percentage elongation and percentagereduction in area, stress strain diagram plotting, tests on mild steel.	**5**
VII	Determination of modulus of rigidity, strain energy, shear stress and stiffness by load deflection method (Open & Closed coil spring)	10

VIII	Single or double Shear test on M.S. bar to finding the resistance of material to shear load.	5

REFERENCES:

Books:

1. Measurement system (Application and Design) – Ernest O Doebelin.
2. Strength of Materials – R. S. Khurmi, S. Chand Company Ltd. Delhi.
3. A Text Book strength of Material– R.K. Bansal, Laxmi Publication New Delhi.

L	T	P		Course Code No.: MEPC210
0	0	3		
Total Contact hrs.: Lecture:0 Tutorial:0 Practical: 45 **Credit : 1.5**			**Total marks: 100**	**Practical:** End Term Exam.:40 P.A: 60

RATIONALE:

Understand the working of boilers, compressors and IC engines is required for mechanical engineers. Also, to observe various parts of the engines and understand their functions. This lab covers performing various tests on IC engines and calculate performance parameters. It is needed to understand economical and optimum running conditions of the engines.

COURSE OUTCOMES:

At the end of the course, the student will be able to:

- Evaluate the performance characteristics of single cylinder diesel/petrol engine at different loads and draw the heat balance sheet.
- Find the indicated power of individual cylinders of an engine by using morse test.
- Evaluate the performance characteristics Multi stage air compressor.
- Evaluate the co efficient of performance of refrigerator.
- Find the thermal conductivity of material.

COURSE CONTENT DETAILS:

Sl. No.	Topics for practice	Time Allotted (Hrs.)
I	Study of high-pressure boiler with model	**5**
II	Study of boiler mountings and accessories	**5**
III	Conduct performance test on VCR test rig to determine COP of the refrigerator	**5**
IV	Conduct performance test on multi stage reciprocating compressor	**5**
V	Conduct Morse test to determine the indicated power of individual cylinders	**4**
VI	Conduct Performance test on 2-S CI/SI engine	**3**
VII	Conduct Performance test on 4-S CI/SI engine	**3**
VIII	Conduct Heat balance test on CI/SI engine	**3**
IX	Conduct Economical speed test on 4-S CI/SI engine	**3**
X	Thermal conductivity test on 1) Thick slab 2) Composite wall 3) Thick	**3**

	cylinder	
XI	Leak detection of refrigeration equipment	**3**
XII	Conduct performance test on A/C test rig to determine COP of the refrigerator	**3**

REFERENCES:

Books:

1. Thermal Engineering – P. L. Ballaney, Khanna Publishers, 2002
2. A Course in Thermal Engineering – S. Domkundwar & C. P. Kothandaraman, Dhanpat Rai & Publication New Delhi
3. Thermal Engineering – R. S. Khurmi and J. K. Gupta, 18th Edition, S. Chand & Co, New Delhi.

PROGRAM ELECTIVE – I (Any One)

AUTOMOBILE ENGINEERING

L	T	P		Course Code No.: MEPE202
3	0	0		
Total Contact hrs.: Lecture:45 Tutorial:0 Practical: 0 **Credit : 3**			**Total marks: 100**	**Theory:** End Term Exam.:60 P.A: 40

RATIONALE:

Automobiles are the principal transport systems. Its manufacture and maintenance give a major scope for employment. The technicians who pass out from technical institutes join in automobile companies for production or servicing of vehicles. Moreover, many entrepreneurs go for servicing of automobiles or trading in auto-components. Thus, the automobile engineering is an important subject to be in the regular curriculum of the technicians.

COURSE OUTCOMES:

At the end of the course, the student will be able to:

- Identify the components of an automobile with their working.
- Explain the concepts of cooling and lubricating systems.
- Explain the concepts of Ignition and Transmission and steering systems.
- Identify different suspension systems and their applications.
- Differentiate the special vehicles according to the usage.

COURSE CONTENT DETAILS:

Unit No.	Topics	Time Allotted (Hrs.)
I	**Introduction to basic structure of an automobile:** Basic engine components; Cylinder block; Cylinder head; Gaskets; cylinder liners, types of cylinder liners; Piston and piston pin; piston rings, types of piston rings; Connecting rod; Crank shaft; Cam shaft; Crankcase; Engine valves; Fly- wheel and Governor.	**6**
II	**Cooling and lubrication system:** The necessity of cooling system; Types of cooling system- air cooling and water cooling; Air cooling system; Types of water cooling system –Thermosyphon system and pump circulation system; Advantages and disadvantages of air cooling and water cooling systems; The components of water cooling system – fan, radiator, pump and thermostat; The necessity of lubrication system; S.A.E rating of lubrication system; Types of lubrication system; Petrol lubrication and high pressure lubrication system.	**12**

	Fuel feed system: Conventional fuels and alternative fuels: Cetane and octane numbers; Types of carburettors; Working of simple carburettor; Multi point and single point fuel injection systems; Different fuel transfer pumps; Working of S.U electrical and A.C mechanical pump; Fuel filters; Fuel injection pump; Fuel injectors.	
III	**Ignition system:** Introduction to ignition system; Battery Ignition systems and magneto Ignition system; Electronic Ignition system; Construction and working of lead acid battery; Elements of charging system; Elements of starting system; Types of lights used in the automobile: **Transmission and steering system:** General arrangement of clutch; Principle of friction clutches; Constructional details of Single plate clutch; Constructional details of multi-plate clutch; Constructional details of centrifugal clutch; Necessity for gear ratios in transmission; Types of gear boxes; Working of sliding mesh gear box; Working of constant mesh gear box; Working of propeller shaft Working of propeller shaft; Working of universal joint; Working of differential; Types of rear axle; Purpose of front axle; Necessity of steering system; Caster, camber and king pin inclination; Rack and pinion steering system; Power steering.	**12**
IV	**Suspension system:** Necessity of suspension system; Torsion bar suspension systems; Leaf spring and coil spring suspension system; Independent suspension for front wheel and rear wheel; Working of telescopic shock absorber; Functions of brakes; Types of brakes; Working of internal expanding brake; Working of disc brake.	**9**
V	**Special vehicles:** Introduction to Special vehicles; Tractor; Motor grader; Scrappers; Excavators; Duper trucks.	**6**

REFERENCES:

Books:

1. Automobile Engineering Vol I, II, Kirpal Singh, Standard Publishers Distributors, Delhi. 2012.
2. Automobile Mechanics, A.K. Babu, S.C. Sharma, Khanna Publications, New Delhi
3. Automotive Mechanics: Principles and Practices, Joseph Heitner, East West Press
4. Automotive Mechanics, S. Srinivasan, 2nd Edition, Tata McGraw Hill
5. Automobile Engineering Vol I and Vol II, K. M. Gupta, Umesh Publications.
6. Automotive Engineering, Jain and Asthana, Tata McGraw Hill.

PROGRAM ELECTIVE – II (Any One)

TOOL & DIE ENGINEERING

L	T	P		Course Code No.: MEPE204
3	0	0		
Total Contact hrs.: Lecture:45 Tutorial:0 Practical: 0 **Credit : 3**			**Total marks: 100**	**Theory:** End Term Exam.:60 P.A: 40

RATIONALE:

Tool and die engineering is a specialized field in the industry of manufacturing involving mechanics who create gauges, cutting tools, machine tools, molds, dies, fixtures, jigs, and other tools utilized in the processes of manufacturing. Die and tool design process includes designing and building moulds, dies, and fixtures in order to ensure that products are manufactured flawlessly. A die is a specialized manufacturing tool used in manufacturing industries to cut, engrave or shape material usually with the help of a press. Tool and Die makers develop fixtures, dies, jigs, moulds, gauges, machine tools, cutting tools and other tools used in manufacturing processes, which is required for mechanical engineers.

COURSE OUTCOMES:

At the end of the course, the student will be able to:

- Select cutting tools and its material using data book and manufacturer's catalogue.
- Estimate tool wear and tool life.
- Use press tools and dies effectively.
- Design strip layout for given component.
- Decide appropriate cutting fluid for machining process improvement.

COURSE CONTENT DETAILS:

Unit No.	Topics	Time Allotted (Hrs.)
I	**Jigs and fixtures**: – Necessity for jigs and fixtures - Elements of fixtures, design considerations, locators, types of locators, clamping and guiding devices, swarf disposal methods.	**6**
II	**Work holding devices for flat, round and irregular surface**: Design of drill jigs, bush specifications. Fixture for lathe operations, milling, broaching and welding fixtures, fixtures for CNC machines, modular fixtures.	**12**
III	**Press working**: tools, blanking and piercing tools, load variation during blanking-Calculation of press tonnage for blanking and	**12**

	piercing. Types of dies, simple, compound, combination and progressive dies- Design of compound and progressive dies. Bending and drawing dies: Bending allowances, bending methods. Bending pressure-calculation of blank size and press tonnage for drawing, metal flow during drawing operations - Fine blanking, Embossing and Coining.	
IV	**Tool for forging, Design of drop forging dies**: - Rolling, strip rolling theory, stress distribution in rolling, Roll separation force and torque. Forces acting on single point and multiple point cutting tools.	**6**
V	**CAD for tooling**: Turret press FMS-Computer applications (CAD / CAM) in short metal press work – Quick die change method – Single minute exchange of dies- group tooling –Design of single point tools – Plastic as a tooling materials – Fluidized bed fixturing.	**9**

REFERENCES:

Books:

1. Tool Design – Cysil Donaldson TMH
2. Tool Design – Cole G.B.
3. Die Design Hand Book – ASTME
4. Jigs and Fixtures – Calving-Hoose
5. Jig and Fixture Design Hand Book – William and Boyes
6. Fundamentals of tool design – ASTME & Edward G. Hoffman
7. Fundamentals of Fixture Design – V. Koraskove Mir
8. Metal Hand Book- ASM

PROGRAM ELECTIVE – III (Any One)

AUTOMOBILE ENGINEERING LAB

L	T	P		Course Code No.: MEPE206
0	0	2		
Total Contact hrs.: Lecture:0 Tutorial:0 Practical: 30 **Credit : 1**			**Total marks: 100**	**Practical:** End Term Exam.:40 P.A: 60

RATIONALE:

Automobile is one of the principal transport systems. Practical exposure to such engineering lab improves the scope for employment. The technicians who pass out from technical institutes join in automobile companies for production or servicing of vehicles. Moreover, many entrepreneurs go for servicing of automobiles or trading in auto-components. Thus, the automobile engineering lab and expertise in this is important for the technicians.

COURSE OUTCOMES:

At the end of the course, the student will be able to:

- Identify the components of an automobile with their working principle
- Explain the concepts of cooling and lubricating systems
- Explain the concepts of Ignition and Transmission and steering systems.
- Identify different suspension systems and their applications.
- Differentiate the special vehicles according to the usage.

COURSE CONTENT DETAILS:

Sl. No.	Topics for practice	Time Allotted (Hrs.)
I	Introduction, demonstration and use of tools, instruments and equipment in auto-shop	**2**
II	Study and draw valve timing diagram of various engine types	**2**
III	Study of automobile chassis with respect to layout, location and function of visible components	**2**
IV	Study of automobile engine	**2**
V	Study of automobile gear box	**2**

VI	Study of carburetor	**2**
VII	Overhauling of clutch and gear assembly	**3**
VIII	Overhauling the units of braking system	**3**
IX	Servicing of air-filter	**3**
X	Study of fuel injection system	**3**
XI	Charging of battery and its parameters	**2**
XII	Testing of ignition system of engine	**2**
XIII	Study of lubricating system	2

REFERENCES:

Books:

1. Automobile Engineering Vol I, II, Kirpal Singh, Standard Publishers Distributors, Delhi. 2012.
2. Automobile Mechanics, A.K. Babu, S.C. Sharma, Khanna Publications, New Delhi.
3. Automotive Mechanics: Principles and Practices, Joseph Heitner, East West Press.
4. Automotive Mechanics, S. Srinivasan, 2nd Edition, Tata McGraw Hill.
5. Automobile Engineering Vol I and Vol II, K. M. Gupta, Umesh Publications.
6. Automotive Engineering, Jain and Asthana, Tata McGraw Hill.

MINOR PROJECT

L 0	T 0	P 4		**Course Code. No.: PR 202**
Total Contact hrs.: 30 **Credit: 2**			**Total Marks: 100**	**Practical:** End Term Exam. :40 P.A. : 60

RATIONALE

Minor Project offers students an opportunity to apply theoretical knowledge in a practical setting, thereby enhancing their technical skill and problem solving skill. This course has been designed for students to understand the basics of carrying out any engineering project which includes Literature survey, methodology, setting up objective and scope of the project work.

COURSE OUTCOMES:

After completing this course, student will be able to:

- Identify the objective and scope of work
- Undertake interdisciplinary literature survey.
- Prepare methodology of the project work.
- Demonstrate necessary field and laboratory experiments.
- Handle necessary equipment.

COURSE CONTENT DETAILS

UNIT NO.	CONTENT	HOURS
UNIT –I	**Objective and Scope of work** • Introduction to the project. • Clear statement of project objectives. • Explanation of the scope and limitations of the project. • Justification for why the project is important or relevant.	**12**
UNIT –II	**Literature Survey** • Review of existing literature and research related to the project. • Identification of gaps in current knowledge. • Discussion of relevant theories, models, and previous work in the field. • Proper citations and references to sources.	**12**
UNIT –III	**Methodology** • Detailed explanation of the research methods and approaches to be used. • Description of data collection techniques (if applicable). • Explanation of any experiments or simulations to be conducted. • Ethical considerations and research ethics, if applicable.	**12**
UNIT –IV	**Handling of Instruments and Experiments** • Description of the tools, equipment, or software to be used. • Details on how experiments or simulations will be conducted. • Safety precautions and protocols, if relevant. • Data collection and analysis methods.	**12**
UNIT –V	**Comprehensive Progress Presentation** • Regular progress reports or presentations to track the development of the project.	**12**

	• Presentation of findings, data, and results obtained so far. • Discussion of any challenges encountered and how they were addressed. • Feedback received from mentors or advisors and any adjustments made to the project plan.	

ESSENCE OF INDIAN KNOWLEDGE & TRADITION

L 2	T 0	P 0		Course Code No.: AU 202
Total Contact hrs.: 30 Credit: 0			Total marks: NA	

RATIONALE:

Considering the need of protecting Indian knowledge and tradition, the diploma level students of Automobile Engineering should be facilitated the concepts Indian traditional knowledge and to make them understand the importance of roots of knowledge system and methods of application in today's life and how to protect traditional knowledge system. Interpretation of the concepts of Intellectual property to protect the traditional knowledge as well as importance of Traditional knowledge in Agriculture and Medicine must be known.

COURSE OUTCOME:

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

- Discuss the concepts of traditional Indian knowledge and roots of knowledge system and indigenous knowledge system
- Explain the technique of protection of traditional Indian knowledge
- Discuss legal frameworks of traditional knowledge
- State intellectual property rights
- State traditional knowledge in Different Sectors

COURSE CONTENT

UNIT	TOPIC/SUB-TOPIC	HRS.	TOTAL HRS.
1	Introduction to traditional knowledge: Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge (Unani / Siddha/ Ayurveda), Indigenous Knowledge (IK), characteristics, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge of Meghalaya	07	**30**
2	Protection of traditional knowledge (TK): The need for protecting traditional knowledge, Significance of TK Protection, value of TK in global economy, Role of Governmentto harness TK.	07	
3	Legal framework and TK: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016.	06	
4	Traditional knowledge and intellectual property: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, Geographical Indications (GI).	04	
5	Traditional Knowledge in Different Sectors: Traditional knowledge and engineering, Traditional medicine system, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK	06	

REFERENCE BOOKS:

1. Traditional Knowledge System in India, by Amit Jha, 2009.

2. "Knowledge Traditions and Practices of India" Kapil Kapoor.

3. Madhya Himalayi Sanskriti mein Gyan, Vigyan evam Paravigyan by Prof PC Pandey.

Suggested Online Link:

Web Links:
1.https://www.youtube.com/watch?v=LZP1StpYEPM
2.http://nptel.ac.in/courses/12110600/