

**DIPLOMA CURRICULUM OF
MECHANICAL ENGINEERING
(SECOND YEAR)
(4th Semester)**

(To be implemented from 2025-26)

Prepared by;



**National Institute of Technical Teachers' Training & Research Kolkata
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Vetted by:

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PROGRAMME TITLE: MECHANICAL ENGINEERING

SEMESTER - IV

SL · No	Category of Course	Code No	Course Title	Study Scheme			Evaluation Scheme				Total Marks	Credits	
				Pre- re- quisite	Contact Hours/ week			Theory		Practical			
					L	T	P	End Exam	Progressive Assessment	End Exam			Progressive Assessment
1	Programm e core	MEPC202 TH-01	Thermal Engineering-II		3	0	0	70	30	-	-	100	3
2		MEPC204 TH-02	Metrology and Measurement		3	0	0	70	30	-	-	100	3
3		MEPC206 TH-03	Computer-integrated Manufacturing (CIM)		3	0	0	70	30	-	-	100	3
4		MEPC208 PR-01	Thermal Engineering-II lab		0	0	4	-	-	15	35	50	2
5		MEPC210 PR-02	Metrology and Measurement Lab		0	0	4	-	-	15	35	50	2
6		MEPC212 PR-03	CAD/CAM Lab		0	0	4	-	-	15	35	50	2
7	Programm e elective	MEPE202 (Any one)	(a). Refrigeration and Air Conditioning (TH-4A) (b). Renewable Energy Technologies (TH-4B) c) Hydraulics & Pneumatics (TH-4C)		3	0	0	70	30	-	-	100	3
8		MEPE204 (Any one)	(a). Computer-Aided Design and Manufacturing (TH-5A) (b). Tool Engineering (TH-5B) (c). Mechatronics (TH-5C)		3	0	0	70	30	-	-	100	3
9	Minor Project	PR202	MINOR PROJECT (PR-04)		0	0	4	-	-	30	70	100	2

10	Mandatory	AU202	Essence of Indian knowledge and tradition		2	0	0	0	0	0	0	0	0
TOTAL					17	0	16	350	150	75	175	750	23

SEMESTER - IV COURSES

THERMAL ENGINEERING-II

L	T	P	Total Marks: 100	Course Code: MEPC202 (TH-01)
3	0	0		Theory Assessment
Total Contact Hours				End Term Exam : 70
Theory : 45Hrs				Progressive Assessment : 30
Pre Requisite : Thermal Engineering-I (MEPC209)				
Credit : 3				Category of Course : PC

RATIONALE: Subject knowledge of thermal engineering is required in many industries. The objective of this course is to establish basic fundamental and practical knowledge in the field of gas turbines, jet propulsion, properties of steam, steam generator etc, These are major fields of mechanical engineering. Student will be able to understand different systems and apply its competencies in major fields in related industries. Knowledge of alternate fuels is required as emerging field and today's need of society which will be provided by the course content.

LEARNING OUTCOMES:

After completion of the course, the students 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 explain the function 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.
- State the necessity of governing and compounding of a turbine.
- Explain the principle of working of a steam turbine and distinguish between the impulse turbines and reaction turbines.

DETAILED COURSE CONTENTS

Unit No.	Topic/Sub-Topic	Allotted Time (Hours)
I	<p>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; General lay-out of Closed cycle gas turbine; P-V and T-S diagrams and working.</p> <p>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 of Rocket propulsion; Working principle of a rocket engine; Applications of rocket propulsion; Comparison of jet and rocket propulsions.</p>	10

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 heater and air preheater; 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).	8
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 maximum discharge; Effect of friction in nozzles and Super saturated flow in nozzles; Working steam jet injector; Simple numerical problems.	10
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.	7

REFERENCES:

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.

METROLOGY AND MEASUREMENT

L	T	P	Total Marks: 100	Course Code: MEPC204 (TH-02)
3	0	0		Theory Assessment
Total Contact Hours				End Term Exam 70
Theory : 45Hrs				Progressive Assessment 30
Pre Requisite :				
Credit 3				Category of Course : PC

RATIONALE: This subject focuses on the principles of measurement, accuracy, precision, and quality control in engineering. It covers topics like measurement systems, errors, calibration, limits, fits, tolerances, and the use of instruments like vernier calipers, micrometers, gauges, and CMM. This subject is essential for ensuring accuracy in manufacturing and engineering processes.

LEARNING OUTCOMES:

After completion of the course, the students will be able to

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

DETAILED COURSE CONTENTS

Unit No.	Topic/Sub-Topic	Allotted Time (Hours)
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 and Random 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; Co-ordinate measuring machine.	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.	10

III	Applied mechanical measurements: Speed measurement: Classification of tachometers, Revolution counters, Eddy current tachometers; Displacement measurement: Linear variable Differential transformers (LVDT); Flow measurement: Rotometers, 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: Sphygmo monometer	8
IV	Unit-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	10
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; Coaxiality; roundness; run out; alignment testing of machine tools as per IS standard procedure.	7

REFERENCES:

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 cgraw Hill, 2005.
7. A text book of Engineering metrology – I.C. Gupta, Dhanpat Rai and Sons, New Delhi, 2005
8. Metrology for Engineers – J.F.W. Galyer and C. R. Shotbolt, ELBS
9. Engineering Metrology – K. J. Hume, Kalyani publishers

Computer-integrated Manufacturing (CIM)

L	T	P	Total Marks: 100	Course Code: MEPC206 (TH-03)	
3	0	0		Theory Assessment	
Total Contact Hours				End Term Exam	70
Theory : 45Hrs				Progressive Assessment	30
Pre Requisite : Nil					
Credit 3				Category of Course : PC	

RATIONALE: Computer Integrated Manufacturing (CIM) encompasses the entire range of product development and manufacturing activities with all the functions being carried out with the help of dedicated software packages. CIM is considered a natural evolution of the technology of CAD/CAM. The product data is created during design and this data is transferred from the modeling software to manufacturing software without any loss of data.

LEARNING OUTCOMES:

After completion of the course, the students will be able to

- Describe basic components and networks involved in CIM.
- Illustrate hardware, software and product modeling at industry level
- Apply process planning and program coding of task.
- Design a manufacturing cell and cellular manufacturing system.
- Design automated material handling and storage systems for a typical production system.

DETAILED COURSE CONTENTS

Unit No.	Topic/Sub-Topic	Allotted Time (Hours)
I	Concept of Computer Integrated Manufacturing (CIM); Basic components of CIM; Dis-tributed database system; distributed communication system, computer networks for manufacturing; future automated factory; social and economic factors.	10
II	Computer Aided Design (CAD): CAD hardware and software; product modelling, automatic drafting; engineering analysis; FEM design review and evaluation; Group Technology Centre.	10
III	Computer Aided Manufacturing (CAM), Computer assisted NC part programming; Computer assisted robot programming; computer aided process planning (CAPP); computer aided material requirements planning (MRP)	8
IV	Computer aided production scheduling; computer aided inspection planning; computer aided inventory planning, Flexible manufacturing system (FMS); concept of flexible manufacturing.	10
V	Integrating NC machines, robots, AGVs, and other NC equipment; Computer aided quality control; business functions, computer aided forecasting; office automation	7

REFERENCES:

1. CAD, CAM, CIM by P. Radhakrishnan and S. Subramanian, New Age International Publishers.
2. Computer Integrated Manufacturing by Paul G. Rankey, Prentice Hall.
3. Robotics Technology and Flexible Automation – S.R. Deb, TMH

THERMAL ENGINEERING-II LAB

L	T	P	Total Marks: 50	Course Code: MEPC208 (PR-01)	
0	0	4			
Total Contact Hours				Practical Assessment	
Practical	: 60Hrs			End Term Exam	35
				Progressive Assessment	15
Pre Requisite : Nil					
Credit	2			Category of Course : PC	

RATIONALE: Thermal Engineering-II Lab provides hands-on experience with heat exchangers, boilers, steam turbines, and refrigeration systems. It helps students understand energy conversion, efficiency analysis, and thermal system performance in practical applications.

LEARNING OUTCOMES:

After completion of the course, the students 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

LIST OF EXPERIMENTS

1. Study of high pressure boiler with model
2. Study of boiler mountings and accessories
3. Conduct performance test on VCR test rig to determine COP of the refrigerator
4. Conduct performance test on multi stage reciprocating compressor
5. Conduct Morse test to determine the indicated power of individual cylinders
6. Conduct Performance test on 2-S CI/SI engine.
7. Conduct Performance test on 4-S CI/SI engine.
8. Conduct Heat balance test on CI/SI engine.
9. Conduct Economical speed test on 4-S CI/SI engine.
10. Thermal conductivity test on 1) Thick slab 2) Composite wall 3) Thick cylinder
11. Leak detection of refrigeration equipment
12. Conduct performance test on A/C test rig to determine COP of the refrigerator

REFERENCES

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, NewDelhi

METROLOGY AND MEASUREMENT LAB

L	T	P	Total Marks: 50	Course Code: MEPC210 (PR-02)		
0	0	4				
Total Contact Hours				Theory Assessment		
Practical : 60Hrs				End Term Exam	35	
				Progressive Assessment	15	
Pre Requisite : Nil						
Credit 2			Category of Course : PC			

RATIONALE: Metrology and Measurement Lab helps students understand precision measurement techniques and quality control in manufacturing. It provides hands-on experience with instruments like micrometers, vernier calipers, dial gauges, and coordinate measuring machines (CMM) for accurate dimensional analysis.

LEARNING OUTCOMES:

After completion of the course, the students will be able to

- Measure various component of linear measurement using Vernier calipers and Micrometre.
- Measure various component of angle measurement using sine bar and bevel Protractor
- Measure the geometrical dimensions of V-thread and spur gear

LIST OF EXPERIMENTS

1. Measure the diameter of a wire using micrometre and compare the result with digital micrometre
2. Measure the angle of the machined surface using sine bar with slip gauges.
3. Measure the angle of a V-block / Taper Shank of Drill / Dovetail using universal bevel protractor.
4. Measure the dimensions of ground MS flat/cylindrical bush using Vernier Caliper compare with Digital/Dial Vernier Caliper.
5. Measure the geometrical dimensions of V-Thread using thread Vernier gauge.
6. Measure the thickness of ground MS plates using slip gauges

REFERENCES

1. Engineering Metrology – R. K. Jain
2. Engineering precision metrology – R. C. Gupta
3. A Hand book of Industrial Metrology – ASME

CAD/CAM LAB

L	T	P	Total Marks: 50	Course Code: MEPC212 (PR-03)
0	0	4		
Total Contact Hours				Theory Assessment
Practical : 60Hrs				End Term Exam 35
				Progressive Assessment 15
Pre Requisite : Nil				
Credit 2			Category of Course : PC	

RATIONALE: CAD/CAM Lab provides hands-on experience in computer-aided design (CAD) and computer-aided manufacturing (CAM) for product modeling and machining. It helps students develop skills in 3D modeling, CNC programming, and simulation for modern manufacturing applications.

LEARNING OUTCOMES:

After completion of the course, the students will be able to

- Explain the 3D commands and features of a CAD software
- Create 3D solid model and find the mass properties of simple solids
- Demonstrate the working of CNC turning and milling machine
- Develop the part program using simulation software for Lathe and Milling
- Assess the part program, edit and execute in CNC turning and machining centre

LIST OF EXPERIMENTS

S. No.	Topics for practice
PART-A	Introduction: Part modelling; Datum Plane; constraint; sketch; dimensioning; extrude; revolve; sweep; blend; protrusion; extrusion; rib; shell; hole; round; chamfer; copy; mirror; assembly; align; orient. Exercises: 3D Drawings of 1). Geneva Wheel; 2). Bearing Block; 3). Bushed bearing; 4). Gib and Cotter joint; 5). Screw Jack; 6). Connecting Rod: Note: Print the orthographic view and sectional view from the above assembled 3D drawing.
PART-B	CNC Programming and Machining: Introduction; 1). Study of CNC lathe, milling; 2). Study of international standard codes: G-Codes and M-Codes; 3). Format – Dimensioning methods; 4). Program writing – Turning simulator – Milling simulator, IS practice – commands menus; 5). Editing the program in the CNC machines; 6). Execute the program in the CNC machines; Exercises: Note: Print the Program from the Simulation Software and make the Component in the CNC Machine. CNC Turning Machine: (Material: Aluminium/Acrylic/Plastic rod) 1. Using Linear and Circular interpolation - Create a part program and produce component in the Machine. 2. Using Stock removal cycle – Create a part program for multiple turning operations

<p>and produce component in the Machine.</p> <p>3. Using canned cycle - Create a part program for thread cutting, grooving and produce component in the Machine.</p> <p>CNC Milling Machine (Material: Aluminium/ Acrylic/ Plastic)</p> <p>1. Using Linear interpolation and Circular interpolation – Create a part program for grooving and produce component in the Machine.</p> <p>2. Using canned cycle - Create a part program for drilling, tapping, counter sinking and produce component in the Machine.</p> <p>3. Using subprogram - Create a part program for mirroring and produce component in the Machine.</p>

REFERENCES

1. Machine Drawing – P.S. Gill S. K. Kataria & Sons, Delhi., 17th Revised edition, 2001
2. Mechanical Draughtsmanship - G.L. Tamta Dhanpat Rai & Sons, Delhi, 1992
3. Inside AutoCAD – D. Raker and H. Rice, BPB Publications, New Delhi, 1985
4. CAD/CAM/CIM – P. Radhakrishnan, S. Subramaniyan & V. Raju, New Age International Pvt. Ltd., New Delhi, 3rd Edition,
5. Engineering AutoCAD, A.P. Gautam & Pradeep Jain, Khanna Book Publishing Co., Delhi

REFRIGERATION AND AIR CONDITIONING

L	T	P	Total Marks: 100	Course Code: MEPE202(a) TH-4A
3	0	0		Theory Assessment
Total Contact Hours				End Term Exam 70
Theory : 45Hrs				Progressive Assessment 30
Pre Requisite : Nil				Category of Course : PC PE
Credit 3				

RATIONALE: Main objective of the course in refrigeration and air conditioning is to make the students understand the basics of Refrigeration cycles. The basics of vapor compression and vapor absorption systems, components and refrigerants and lubricants of a refrigeration system, control strategies for refrigeration system and air conditioning systems are elaborated in this course.

LEARNING OUTCOMES:

After completion of the course, the students will be able to

- Define refrigeration and types of Refrigeration cycles
- Explain Vapor Compression and Vapor Absorption System working principles
- Identify the components required for refrigeration system.
- Identify the controlling components for a refrigeration system.
- Explain the working principles of Air-conditioning.

DETAILED COURSE CONTENTS

Unit No.	Topic/Sub-Topic	Allotted Time (Hours)
I	Introduction to Refrigeration: Definition of Refrigeration; Refrigerating effect-unit of refrigeration- Coefficient of performance; Types of Refrigeration-Ice, dry ice, Steam jet, Throttling, Liquid nitrogen refrigeration; Carnot refrigeration Cycle; Air refrigeration- Bell - Coleman cycle, PV& TS diagram; Advantage and disadvantages in air refrigeration; Simple problems	10
II	Refrigeration systems: Basic Components, Flow diagram of working of Vapour compression cycle; Representation of the vapour compression cycle on P-H, T-S & P-V Diagram; Expression for Refrigerating effect, work done and power required; Types of Vapour Compression cycle; Effects of super heating and under cooling, its advantages and disadvantages; Simple Vapour absorptions cycle and its flow diagram; Simple Electrolux system for domestic units; Comparison of Vapour absorption and vapour compression system; Simple problems on vapour compression cycle.	10
III	Refrigeration equipment: Compressor - types of compressors; Hermetically sealed and Semi hermetically sealed compressor; Condensers - Air Cooled, water cooled, natural and forced draught cooling system; Advantages and disadvantages of air cooled and water cooled condensers; Evaporators -natural, convection, forced convection types.	8
IV	Refrigerant flow controls: Capillary tube; Automatic Expansion valve; Thermostatic expansion valve; High side and low side float valve; Solenoid valve; Evaporator pressure regulator. Application of refrigeration: Slow and quick freezing; Cold storage and Frozen storage; Dairy refrigeration; Ice making industry; Water coolers.	8

V	<p>Air conditioning: Introduction to Air conditioning; Factors affecting Air conditioning; Psychometric chart and its use; Psychometric process-sensible heating and cooling, Humidifying and dehumidifying; Adiabatic saturation process; Equipment used in air conditioning cycle; Air conditioning units and plants.</p> <p>Refrigeration and Air-conditioning tools: Tools used in refrigeration and Air conditioner installation; Installation procedure; Faults in refrigeration and air conditioning system; Servicing procedure.</p>	9
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REFERENCES:

1. Refrigeration and Air Conditioning – Sadhu Singh, Khanna Book Publishing Co., New Delhi
2. Refrigeration and Air Conditioning – S. Domakundawar, Dhanpat Rai publications.
3. Refrigeration and Air Conditioning – A.S.Sarao & G.S. Gabi, 6th edition, Satya Prakashan publications, New Delhi, 2004.
4. Principles of Refrigeration – Roy J.Dossat, 5th edition, Pearson Publications, 2001.
5. Refrigeration and Air Conditioning – M.Zakria Baig, Premier/ Radiant Publishing House.
6. Refrigeration and Air Conditioning – C.P Arora, Tata McGraw Hill Education, 2000.

RENEWABLE ENERGY TECHNOLOGIES

L	T	P	Total Marks: 100	Course Code: MEPE202(b) (TH-4B)
3	0	0		Theory Assessment
Total Contact Hours				End Term Exam 70
Theory : 45Hrs				Progressive Assessment : 30
Pre Requisite : Nil				
Credit 3				Category of Course : PC PE

RATIONALE: The knowledge of renewable energy technologies is very much needed for diploma holders of mechanical engineering. The course is designed to give knowledge of various renewable energy sources, systems and applications in the present context and need.

LEARNING OUTCOMES:

After completion of the course, the students will be able to

- Illustrate importance of renewable energy sources
- Describe various types of renewable energy technologies
- State applications of different renewable energy sources

DETAILED COURSE CONTENTS

Unit No.	Topic/Sub-Topic	Allotted Time (Hours)
I	Scenario of Renewable Energy (RE) Sources: Needs of renewable energy, advantages and limitations of RE, present energy scenario of conventional and RE sources. Solar Energy: Energy available from the sun, spectral distribution, solar radiation outside the earth's atmosphere and at the earth's surface, solar radiation geometry, Instruments for solar radiation measurements, empirical equations for prediction of availability of solar radiation, radiation on tilted surface solar energy conversion into heat, types of solar collectors, evacuated and non-evacuated solar air heater, concentrated collectors, thermal analysis of liquid flat plate collector, air heater and cylindrical parabolic collector, solar energy thermal storage, heating and cooling of buildings, solar pumping, solar cooker, solar still, solar drier, solar refrigeration and air conditioning, solar pond, heliostat, solar furnace photovoltaic system for power generation, solar cell modules and arrays, solar cell types, material, applications, advantages and disadvantages	10
II	Wind Energy: Energy available from wind, basics of lift and drag, basics of wind energy conversion system, effect of density, angle of attack and wind speed, windmill rotors, horizontal and vertical axes rotors, drag, lift, torque and power coefficients, tip speed ratio, solidity of turbine, wind turbine performance curves, wind energy potential and site selection, basics of wind farm	10

III	Bio Energy : Types of biogas plants, biogas generation, factors affecting biogas generation, advantages and disadvantages, biomass energy, energy plantation, gasification, types and applications of gasifiers, concept of green energy.	8
IV	Ocean Energy: OTEC principle, open, closed and hybrid cycle OTEC system, Energy from tides, estimation of tidal power, tidal power plants, single and double basin plants, site requirements, advantages and limitations, wave energy, wave energy conversion devices, advantages and disadvantages, ocean thermal energy	10
V	Geothermal energy: Introduction, vapor and liquid dominated systems, binary cycle, hot dry rock resources, magma resources, advantages and disadvantages, applications	7

REFERENCES:

1. Solar Energy: Principles of Thermal Collection and Storage, S. P. Sukhatme and J. K. Nayak, McGraw Hill Education
2. Solar Engineering of Thermal Processes, John A. Duffie, William A. Beckman, John Wiley, New York
3. Non-conventional energy resources, Shobh Nath Singh, Pearson India
4. Solar Energy Engineering, Soteris Kalogirou, Elsevier/Academic Press
5. Principles of Solar Energy, Frank Krieth & John F Kreider, John Wiley, New York

HYDRAULICS & PNEUMATICS

L	T	P	Total Marks: 100	Course Code: MEPE202(c) (TH-4C)	
3	0	0		Theory Assessment	
Total Contact Hours				End Term Exam	70
Theory : 45Hrs				Progressive Assessment	30
Pre Requisite : Nil					
Credit 3				Category of Course : PC PE	

RATIONALE: The course aims to provide students with knowledge of fluid power applications in industry and an understanding of hydraulic and pneumatic components and systems. It covers topics like fluid properties, pumps, actuators, control valves, hydraulic circuits, pneumatic systems, troubleshooting, and applications. The course objectives are to teach fluid power principles, hydraulic and pneumatic components, circuit design, and applications in industrial processes.

LEARNING OUTCOMES:

After completion of the course, the students will be able to

- Describe the working principles of fluid power systems.
- Illustrate the fluids and components used in modern industrial fluid power system.
- Develop the design, construction, and operation of fluid power circuits.
- Explain working principles of a pneumatic power system and its components
- Apply the troubleshooting methods in fluid power systems.

DETAILED COURSE CONTENTS

Unit No.	Topic/Sub-Topic	Allotted Time (Hours)
I	Fluid Power Principles and Hydraulic Pumps Introduction to Fluid Power – Advantages and Applications – Fluid power systems – Types of fluids Properties of fluids and selection – Basics of Hydraulics – Pascal’s Law – Principles of flow – Friction loss – Work, Power, and Torque- Problems, Sources of Hydraulic power: Pumping Theory – Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of pumps – Fixed and Variable displacement pumps – Problems.	10
II	Hydraulic Actuators and Control Components -Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Rotary Actuators-Hydraulic motors – Control Components: Direction Control, Flow control and pressure control valves – Types, Construction, and Operation – Accessories: Reservoirs, Pressure Switches – Filters –types and selection- Applications – Fluid Power ANSI Symbols – Problems.	10
III	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, Deceleration circuits, Sizing of hydraulic systems, Hydrostatic transmission, Electro-hydraulic circuits, –Servo and Proportional valves – Applications- Mechanical, hydraulic servo systems.	8

IV	Pneumatic and Electro Pneumatic Systems -Properties of air –Air preparation and distribution – Filters, Regulator, Lubricator, Muffler, Air Control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit – classification- single cylinder and multi-cylinder circuits-Cascade method – Integration of fringe circuits, Electro Pneumatic System – Elements – Ladder diagram – timer circuits-Problems, Introduction to fluidics and pneumatic logic circuits.	10
V	Trouble Shooting and Applications -Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Conditioning of hydraulic fluids Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications- mobile hydraulics; Design of Pneumatic circuits for metalworking, handling, clamping counter and timer circuits. – Low-cost Automation – Hydraulic and Pneumatic power packs, IOT in Hydraulics and pneumatics.	7

REFERENCES:

1. Fluid Power with Applications- Anthony Esposito, Prentice Hall, 2009.
2. Fluid Power Theory and Applications-James A. Sullivan, Fourth Edition, Prentice Hall, 1997.
3. Pneumatics Concepts, Design and Applications -Jagadeesha. T., Universities Press, 2015.
4. Oil Hydraulics Systems – Principles and Maintenance S.R. Mujumdar-Tata McGraw Hill, 2001
5. Hydraulic and Pneumatic Controls- R., Srinivasan. Vijay Nicole Imprints, 3rd edition,2019.

Computer-Aided Design and Manufacturing

L	T	P	Total Marks: 100	Course Code: MEPE204(a) (TH-5A)
3	0	0		
Total Contact Hours				Theory Assessment
Theory : 45Hrs				End Term Exam 70
				Progressive Assessment 30
Pre Requisite : Nil				
Credit 3			Category of Course : PC PE	

RATIONALE: This subject focuses on the use of computer technology for designing and manufacturing products. It covers CAD for creating detailed 2D and 3D models, and CAM for automated machining and production processes. These subject helps students understand modern design techniques, CNC programming, simulation, and integration of digital tools in manufacturing industries.

LEARNING OUTCOMES:

After completion of the course, the students will be able

- Provide an outline of how computers are being used in mechanical component design.
- Illustrate the application of computers in various aspects of Manufacturing
- Program the CNC machines
- Describe the concept of flexible manufacturing

DETAILED COURSE CONTENTS

Unit No.	Topic/Sub-Topic	Allotted Time (Hours)
I	INTRODUCTION Product cycle- Design process- sequential and concurrent engineering- Computer aided design — CAD system architecture- Computer graphics — co-ordinate systems- 2D and 3D transformations- homogeneous coordinates — Line drawing -clipping- viewing transformation-brief introduction to CAD and CAM — Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM – CAD/CAM concepts —Types of production — Manufacturing models and Metrics — Mathematical models of Production Performance	10
II	GEOMETRIC MODELING Representation of curves- Hermite curve- Bezier curve- B-spline curves-rational curves-Techniques for surface modeling — surface patch- Coons and bicubic patches- Bezier and B-spline surfaces. Solid modeling techniques- CSG and B-rep.	10
III	CAD STANDARDS	8

	Standards for computer graphics- Graphical Kernel System (GKS) — standards for exchange images- Open Graphics Library (OpenGL) — Data exchange standards — IGES, STEP, CALS etc. — communication standards.	
IV	FUNDAMENTAL OF CNC AND PART PROGRAMING Introduction to NC systems and CNC — Machine axis and Co-ordinate system- CNC machine tools- Principle of operation CNC- Construction features including structure- Drives and CNC controllers- 2D and 3D machining on CNC- Introduction of Part Programming, types — Detailed Manual part programming on Lathe & Milling machines using G codes and M codes- Cutting Cycles, Loops, Sub program and Macros- Introduction of CAM package.	10
V	CELLULAR MANUFACTURING AND FLEXIBLE MANUFACTURING SYSTEM (FMS) Group Technology(GT), Part Families–Parts Classification and coding–Simple Problems in Opitz Part Coding system–Production flow Analysis–Cellular Manufacturing–Composite part concept–Types of Flexibility — FMS — FMS Components — FMS Application & Benefits — FMS Planning and Control — Quantitative analysis in FMS ME8691 Computer Aided Design and Manufacturing	7

REFERENCES:

1. Mastering CAD CAM -Ibrahim Zeid -Tata McGraw-Hill Publishing Co. 2007.
2. Automation, Production Systems and Computer Integrated Manufacturing -Mikell. P. Groover - Prentice Hall of India, 2008.
3. CAD/CAM/CIM- P, Radhakrishnan, S..Subramanian and V Raju.- 2nd Edition, New Age International (P) Ltd, New Delhi, 2000.
4. CAD/CAM Principles -Chris McMahan and Jimmie Browne -Practice and Manufacturing management” Second Edition, Pearson Education, 1999.
5. Principles of Computer Graphics-William M Neumann and Robert F.Sproul, McGraw Hill Book Co. Singapore, 1989.
6. Computer Graphics-Donald Hearn and M. Pauline Baker. Prentice Hall, Inc, 1992.
7. Computer graphics principles & practice- Foley, Wan Dam, Feiner and Hughes –Pearson Education – 2003.

Tool Engineering

L	T	P	Total Marks: 100	Course Code: MEPE204(b) (TH-5B)
3	0	0		
Total Contact Hours				Theory Assessment
Theory : 45Hrs				End Term Exam 70
				Progressive Assessment 30
Pre Requisite : Nil				
Credit 3				Category of Course : PC PE

RATIONALE: Tool Engineering is a subject that focuses on the design, development, and application of cutting tools, jigs, fixtures, and dies used in manufacturing. It covers tool materials, tool design, machining processes, and optimization techniques to enhance production efficiency, precision, and quality in industrial applications.

LEARNING OUTCOMES:

After completion of the course, the students will be able to

- Illustrate concepts, principles and procedures of tool engineering
- Classify and explain various tools and tool operations
- Select proper tool and a die for a given manufacturing operation to achieve highest productivity
- Estimate tool wear and tool life

DETAILED COURSE CONTENTS

Unit No.	Topic/Sub-Topic	Allotted Time (Hours)
I	Metal Cutting: Mechanics of Metal cutting; requirements of tools; cutting forces; types of chips; chip thickness ratio; shear angle ; simple numerical only; types of metal cutting process; or- thogonal; oblique and form cutting; Cutting fluids: types; characteristics and applications. Tool wear: Types of wear; Tool life; Tool life equations.	10
II	Machinability: definition; factors affecting machinability; machinability index. Tool materials: Types; characteristics; applications; Heat treatment of tool steels; Specification of carbide tips; Types of ceramic coatings. Cutting Tool Geometry: Single point cutting tool; drills; reamers; milling; cutters.	10
III	Types of dies and construction: Simple Die; Compound Die; Progressive Die; Combination Die. Punch & Die mountings: pilots; strippers; misfeed detectors; Pressure Pads; Knock outs; stock guide; Feed-Stop; guide bush; guide pins.	8
IV	Die Design Fundamentals: Die Operations; blanking; piercing; shearing; cropping; notching; lancing; coining; embossing; stamping; curling; drawing; bending; forming; Die set; Die shoe; Die area; Calculation of clearances on die and punch for blanking and piercing dies; Strip layout; Calculation of material utilization factor.	10

V	<p>Forming Dies: Bending methods; Bending Dies; bend allowance; spring back; spanning; bending pressure; pressure pads; development of blank length.</p> <p>Drawing: operations; Metal flow during drawing; Calculation of Drawing blank size; variables affecting metal flow during drawing; single action and double action dies; combination dies.</p> <p>Fundamentals of other Tools: Constructional features of - Pressure Die casting dies; metal extrusion dies; injection molding dies; forging dies; plastic extrusion dies.</p>	7
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REFERENCES:

1. Tool Design - Donaldson Anglin, Tata McGraw Hill.
2. Production Technology- H.M.T.Jain, Tata McGraw Hill.
3. A Text Book of Production engineering – P.C. Sharma, S.Chand & Co.
4. Production Technology, R.K.Jain, Khanna Publishers.

MECHATRONICS

L	T	P	Total Marks: 100	Course Code: MEPE204(c) TH-5C
3	0	0		
Total Contact Hours				Theory Assessment
Theory : 45Hrs				End Term Exam 70
				Progressive Assessment 30
Pre Requisite : Nil				
Credit 3				Category of Course : PC PE

RATIONALE: It is an interdisciplinary subject that integrates mechanical engineering, electronics, computer control, and automation. It covers sensors, actuators, microcontrollers, PLCs, and robotics, helping students understand modern automated systems used in industrial and manufacturing applications.

LEARNING OUTCOMES:

After completion of the course, the students will be able to

- Describe about various types of sensors and transducers.
- Explain the concept of various mechanical, electrical and pneumatic actuation systems.
- Explain the basic mathematical building blocks for mechanical, electrical, thermal and fluid actuation system and its interfacing of input/output requirements.
- Illustrate the basic PLC architecture and PLC programming concepts.
- Describe the design examples of mechatronics system. Explain the condition monitoring of production systems using sensors.

DETAILED COURSE CONTENTS

Unit No.	Topic/Sub-Topic	Allotted Time (Hours)
I	Introduction to Mechatronics: Mechatronics; Importance of Mechatronics; Systems: Measurement systems; Control systems and their types; Closed-loop control System; Automatic water level controller; Sequential controllers-washing machine Measurement System terminology: Displacement, Position & Proximity Sensors; Velocity and Motion Sensors; Force Sensors; Fluid Pressure Sensors; Flow Sensors; Liquid Level Sensors; Temperature Sensors; Light Sensors; Selection of Sensors.	10
II	Mechanical Actuation Systems: Types of motion; Freedom and constraints; Loading; Gear Trains; Pawl & Ratchet; Belt & Chain drives; Bearings: Selection, Ball & Roller bearings; Mechanical aspects of motor selection. Electrical Actuation Systems: Switches & Relays; Solenoids; D.C Motors; A.C.Motors; Stepper Motors: Specifications and Control of stepper motors; Servomotors: D.C Servomotor and A.C Servomotor. Pneumatic & Hydraulic Systems: Power supplies; DCV; PCV; Cylinders; Rotary actuators.	10
III	Mathematical Model: Introduction to Mathematical model; Mechanical System building blocks; Electrical System building blocks; Fluid System building blocks; Thermal System building blocks. System Model: Engineering Systems: Rotational, Translational Systems; Electro-Mechanical System; Hydro-Mechanical System.	8

	Input/Output Systems: Interfacing; Input/output ports; Interface requirements: Buffers, Hand-shaking, Polling and interrupts, Serial interfacing; Introduction to PIA; Serial communications interface; Example of interfacing of a seven-segment display with a decoder.	
IV	Programmable Logic Controller (PLC): Definition; Basic block diagram and structure of PLC; Input/Output processing; PLC Programming: Ladder diagram, its logic functions, Latching and Sequencing; PLC mnemonics; Timers; Internal relays and Counters; Shift registers; Master and Jump Controls; Data handling; Analog input/output; Selection of PLC.	10
V	Design Examples & Advanced Applications in Mechatronics: Design process stages; Traditional Vs Mechatronics designs; Possible design solutions: Timed switch, Wind-screen wiper motion, Bath room scale; Case studies of Mechatronics systems: A pick-and-place robot, Car park barrier, Car engine management system, Automatic Camera and Automatic Washing Machine only. Sensors for Condition Monitoring Systems of Production Systems: Examples of Monitoring methods: Vibration monitoring, Temperature monitoring, Wear behavior monitoring; Mechatronics control in automated manufacturing: Monitoring of Manufacturing processes, On-line quality monitoring, Model based systems, Hardware in-the-loop simulation, Supervisory control in manufacturing inspection, Integration of heterogeneous systems	7

REFERENCES:

1. Mechatronics – W. Bolton, Pearson Education India.
2. A Text Book on Mechatronics – R.K.Rajput, S.Chand & Co, New Delhi.
3. Mechatronics – M.D.Singh & Joshi, Prentice Hall of India.
4. Mechatronics – HMT, Tata McGraw Hill, New Delhi.
5. Mechatronics System – Devadas Shetty, PWS Publishing
6. Exploring Programmable Logic Controllers with applications – Pradeep Kumar Srivastava, BPB Publications.

MINOR PROJECT

L	T	P	Total Marks: 100	Course Code: PR202 (PR-04)
0	0	4		Laboratory Assessment
Total Contact Hours				End Term Exam 30
Practical		: 60Hrs		Progressive Assessment 70
Pre Requisite : Nil				
Credit		2		Category of Course : Project

RATIONALE:

A Minor project is generally requires a larger amount of effort and more independent work than that involved in a normal assignment. It requires students to undertake their own fact-finding and analysis. The students will select the topic, perform and design work. Minor project is as preparation for the students to take on more responsibilities and bigger project in the future. It is a learning experience, which aims to provide students with the opportunity to synthesize knowledge from different areas of learning, and critically and creatively apply it to real life situations. The leadership quality, co-ordination of job and maintaining good communal harmony is an important factor of this type of activity.

LEARNING OUTCOMES:

After completion of the course, the students will be able to

- Plan a Minor Project
- Execute a Minor Project with team.
- Implement hardware/software/analytical/numerical techniques, etc. based on project requirements.
- Optimize time related works through sharing of work responsibility
- Develop cost awareness and utilisation of fund.
- Prepare a technical report on the project.

GUIDELINES FOR MINOR PROJECT

- Minimum three and maximum five students can form a group for the minor project.
- Project type can include
 - Development of a simple prototype system/product.
 - Investigation of performance of some systems using experimental method
 - Analysis of components/systems/devices using suitable software
 - Investigation of optimum process/material for product development using market survey.
 - Solution for society/industry problems
- Project domain may not be limited to the specific area / discipline.
- Project report to be prepared and submitted by the students with following components:
 1. Title
 2. Objectives
 3. Relevance and significance
 4. Methodology
 5. Analysis-Simulation/experimentation/survey/testing etc.
 6. Result and Discussion
 7. Conclusion

ESSENCE OF INDIAN KNOWLEDGE AND TRADITION

L	T	P	Total Marks: NA	Course Code: AU202
2	0	0		Theory Assessment
Total Contact Hours				End Term Exam
Theory	: 30Hrs			0
Pre Requisite				Progressive Assessment*
: Nil				100
Credit	0			Category of Course : Mandatory

***Mandatory Audit Courses will be assessed only for confirmation of student learning without reflecting in the total scores or Credit.**

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

DETAILED COURSE CONTENTS

UNIT	TOPIC/SUB-TOPIC	Allotted 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 Odisha	07
2	Protection of traditional knowledge (TK): The need for protecting traditional knowledge, Significance of TK Protection, value of TK in global economy, Role of Government to 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
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REFERENCES:

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/>