Name of the Course : Mechanical Engineering (Production) Subject: WELDING TECHNOLOGY				
Course code: ME (P)		Semester : **Fifth.**		
Duration : 17 weeks		Maximum Marks : 150		
Teaching Scheme:		Examination Scheme:		
Theory : **3** hrs/week		Internal Assessment: **20** Marks		
Tutorial: NIL		Teacher's Assessment (Assignment & Quiz): **10** Marks		
Practical : **2** hrs/week		End Semester Exam: **70** Marks		
Credit: **4**		Practical: Internal Sessional continuous evaluation: **25** Marks		
		Practical: External Sessional examination: **25** Marks		
Aim :-				
S. No.				
1	To study the Definition & Classification of Welding.			
2	Detailed study on different types of Welding Processes practised in industry.			
3	To understand the Weld Joint Design, Symbols of Welding & Welding Metallurgy.			
4	To know weld defects & their causes and weld distortions & their remedies.			
5	To study Advanced Welding Techniques and welding of Non-Ferrous Metals & Cast Iron.			
Objective :-				
S. No.	The Students should be able to:			
1.	• Define & classify different types of Welding Processes.			
2.	• Understand different types of Welding Processes and explain advantages & disadvantages of them.			
3.	• Understand welding symbols & fabrication drawings for welding.			
4.	• Decide the appropriate Welding Procedure & its variable values for a given case.			
5.	• Explain different types of weld defects & the reasons behind it.			
Pre-Requisite: Elementary knowledge on Physics, Material Science.				
Contents			Hrs/week	
WELDING TECHNOLOGY				
Chapter		Name of the Topic	Hours	Marks
GROUP-A				
1	1.0 1.1 1.2 1.3	**Introduction** Definition of Welding Classification of welding process as per AWS. Advantages of Welding over other fabrication process.	02	
2	2.0 2.1	**Weld Joint Design & Symbols** Different types of weld joints. Groove Weld, Fillet weld and their typical sketch with nomenclature.	04	

	2.2 2.3 2.4 2.5	Edge preparation in Weld Joints. Basic Welding Symbols Standard location of elements in Weld Symbols. Supplementary Weld Symbol.		

3	3.0	**Arc Welding Processes**	10	
	3.1	Principle of arc, Arc welding equipments, Duty Cycle, electrodes – construction, types and specification, power sources – AC, DC, DCEN & DCEP, Welding positions.		
	3.2	Shielded Metal Arc Welding (SMAW): Working principle, Power Sources, Electrode Specification, Welding Parameters, advantages, disadvantages, limitations.		
	3.3	Gas metal Arc welding (GMAW) MIG & MAG: Working principle arc characteristics, power sources, different types of metal transfer processes, wire feeder, shielding gases, Welding Parameters, advantages, disadvantages, application. Electro Gas Welding (EGW): Working principle, power sources, wire feeder, shielding gases, Welding Parameters, advantages, disadvantages, application.		
	3.4	Flux Cored Arc Welding (FCAW): Working principle arc characteristics, power sources, wire feeder, shielding gases, advantages, disadvantages, application.		
	3.5	Gas Tungsten Arc Welding (GTAW/ TIG): Working principle, power sources, welding torch, electrodes, shielding gas, Welding Parameters, advantages, disadvantages, application.		
	3.6	Plasma Arc Welding (PAW): Working principles, shielding gas & plasma gas, arc types, Welding Parameters, advantages, disadvantages, application.		
	3.7	Submerged Arc Welding (SAW): Working principle, equipments, power source, wire feeder, flux, advantages, disadvantages, application.		
	3.8	Stud Welding (SW) : Working principle, equipments, advantages, limitations, application.		
	3.9	Carbon Arc Welding(CAW): Working principle, limitations.		
	3.10	Atomic Hydrogen Welding (AHW): Working principle, Limitations.		
GROUP – B				

4	4.0 4.1 4.3 4.4 4.4 4.5 4.6	Electric Resistance Welding Processes (ERW) Fundamentals of resistance welding, Variables of resistance welding, Welding Equipment. Spot Welding (RSW): Working Principle, Types of Spot Welding Namely Stitch, Multiple Spot, Series Spot, Roller Spot etc. Seam Welding (RSEW): Working Principle, Welding Techniques, Butt Seam & Foil Butt Seam welding. Flash Butt Welding: Working Principle, Welding Techniques. Projection Welding(RPW): Working Principle, Welding Techniques. Percussion Welding: Working Principle, Welding Techniques.	04	
5	5.0 5.1 5.3 5.3 5.4 5.5 5.6	Solid State Welding (SSW) Brief Knowledge of the following processes: Cold Welding Forge Welding Diffusion Welding/ Bonding Friction Welding Ultrasonic Welding Explosive Welding	02	
6	6.0 6.1 6.2 6.3 6.4	Other Welding Processes Thermit Welding(TW): Working Principle, Advantage, Limitation, Application. Electro Slag Welding (ESW): Working Principle, Application. Induction Welding (IW): Working Principle, Application. Oxy-Fuel Welding (OFW) & Cutting (OFC): Brief Knowledge of Different types of OFW Oxy-Acetylene Welding: Equipments – Oxygen and A	06	

		cetylene cylinder pressure regulators. Welding torch, goggles etc. Types of flames – Neutral flame, Oxidizing flame, carburising flame. (Sketches, definitions and application). 6.5 Laser Beam Welding (LBW): Working Principle, Welding Equipment Basic Structure and Application. 6.6 Electron Bean Welding (EBW): Working Principle, Welding Equipment Basic Structure and Application. 6.7 Brazing & Soldering : Working Principle, Filler material used, Different Types of Brazing/Soldering, Application. 6.8 Under Water Welding: Different types of Underwater Welding setup and Application.		
GROUP – C				
7	7.0 7.1 7.2 7.3 7.4 7.5	Welding of Alloy Steels & Other Metals Welding of Cast Iron, Difficulties of C.I Welding. Welding of Stainless Steel, Low Alloy Steel & High Strength Steel. Welding of Copper. Welding of Aluminium. Welding of Bronze.	03	
8	8.0 8.1 8.2 8.3 8.4 8.5 8.6 8.7	Welding Metallurgy Definition and concept of weldability. Effect of different alloying elements on weldability. Thermal affect of welding on grain structure of parent metal. Heat Affected Zone(HAZ) Welding Distortion and its control. Preheating and calculation of preheating temperature. Stress Relieving & Post-Weld Heat Treatment (PWHT).	04	
9	9.0 9.1 9.2 9.3	Weld Defects Definition of Weld Discontinuity & Weld Defect. General Classification of Weld Defects. Different Types of Weld Defects & their causes/remedies.	04	

10	10.0 10.1 10.2 10.3 10.4 10.5 10.6 10.7 10.8	Welding Inspection & Tests Visual Inspection Ultrasonic Test Liquid Particle Test (LPT) Magnetic Particle Test (MPT) Radiographic Test (RT) Eddy Current Test Destructive Test: Tensile Test, Bend Test, Impact Test, Hardness Test. Welding Procedure Specification (WPS) & Procedure Qualification Record (PQR)	05	
11	11.0 11.1 11.2	Safety in Welding Welding Hazards. Precaution & Remedy.	01	
		Sub Total:	45	
		Internal Assessment Examination & Preparation of Semester Examination	6	
		Total	51	

GROUP	Module Or Chapter	OBJECTIVE QUESTIONS				SUBJECTIVE QUESTION			
		To Be Set	To Be Answered	Marks Per Question	Total Marks	To Be Set	To Be Answered	Marks Per Question	Total Marks
A	1, 2, 3	8	ANY 20	1	**20**	3	FIVE (At Least Two From Group A & B)	10	**50**
B	4, 5, 6, 7	6				3			
C	8, 8, 10, 11, 12	6				2			

WELDING TECHNOLOGY LAB

Mechanical Engg (Production)	**Course offered in Fifth Semester**	**Course Duration 17 weeks**	**2 Hrs per week**	**Full Marks 50**

D E T A I L C O U R S E C O N T E N T

1.	Fillet welding of T-joint of two M.S. Plate by OXY-acetylene welding.
2.	Arc welding of a single V-butt joint of two M.S. plate.
3.	Double V-butt joint of two 50 mm. thick M.S plate by MIG welding.
4.	Single V-butt joint of two aluminum plate by TIG welding.
5.	Spot welding of two M S plates
6.	Dye penetrant test (DPT) of fillet weld of the job mentioned in SL No 1.
7.	Magnetic particle Inspection (MPI) of the butt joint of SL No. 2
8.	Ultrasonic Flow Detection (UFD) of Double V butt joint of the Job of SL. No. 3
8.	Tensile Test & Bend Test of a V-Butt joint weld specimen.
10.	Eddy current test of a welded joint.

NB : At least three jobs and two non-destructive test are to be performed by each student.

Name of the Course : Diploma in Mechanical Engineering (Production) Subject Title: Engineering Metrology(Same with Mechanical engg).	
Course code: MEP	**Semester :** Fifth
Duration : 17 weeks	**Maximum Marks : 100**
	Examination Scheme:
Teaching Scheme:	**Internal Assessment**: 10 Marks
Theory : 2 hrs/week	**Teacher's assessment (Assignment & Quiz)**: 05 Marks
Tutorial: hrs/week	**End Semester Exam**: 35 Marks
Practical : 2 hrs/week	**Practical: Internal Sessional continuous evaluation**:25 Marks
Credit: 3	**Practical: External Sessional Examination**:25 Marks

Aim :-	
S.No	
1	The mechanical Engineering technician often come across measuring different parameters of machined components and the appropriate fittment of interchangeable components in the assemblies. For the above purpose the student is also required to analyze the quantitative determination of physical magnitude. During previous semesters different systems of measurement and their units etc have been introduced in the different subjects. The different methods and instruments which can be used for linear and angular measurements, geometrical parameters (like surface finish, Squareness, Parallelism, Roundness etc ..) and the use of gauges and system of limits, Fits, Tolerances etc. are often required to be dealt in detail by diploma technician on the shop floor. The student is also required to analyze, Interpret and present the data collected for ensuring the quality. The knowledge of the subject also forms the basis for the design of mechanical measurements systems, design & drawing of mechanical components.
S No	The student will able to
	1. Select appropriate instrument/s for specific measurement. 2. Measure Physical quantity 3. Measure & adjust errors of measurement 4. Design & use of gauge system in manufacturing industry 5. Analyze and interpret the data obtained from the different measurements processes
Pre-Requisite:-	

S.No		
1	Unit system & basic physics	
Contents		Hrs/week
Chapter	*Name of the Topic*	**Hours**
Group A		
01	**Limits, Fits ,Tolerances and Gauges** Tolerances, Selective Assembly, Interchangeability, Limits Of Size, Allowances, Clearances, Interference, IS 919- 1993 , Fits, Selection Of Fits, Numerical Problems On Limits Of Size And Tolerances, , Taylor's Principle, Gauge Design, hole and shaft basis system, Plain Plug Gauge IS: 3484 -1966, Plain Ring Gauge IS: 3485 -1972, Snap Gauge IS: 3477 -1973.	05
02	**Linear Measurement** Description, working principle, method of reading, least count for Vernier Calipers, Micrometers(outside micrometer, Inside Micrometer, Stick Micrometers), depth gauge & Height Gauge, Feeler gauge, Slip Gauges (category, use, Selection of Slip Gauges for setting particular dimension**)**	**04**
03	**Angular Measurement** Concept, Instruments for Angular Measurements, construction, Working principle and Use of Universal Bevel Protractor, Sine Bar, Spirit Level, Principle of Working of Clinometers, Angle Gauges (With Numerical on Setting of Angle Gauges).	**03**
04	**Comparators** Definition, Classification, use of comparators, Working principle of different type of comparators like mechanical comparator (Dial indicator, Sigma comparator), Pneumatic comparator, Electrical Comparators**,** Optical Comparators**,** characteristics of good comparator, Relative advantages and disadvantages.	**04**
Group B		
05	**Screw thread Measurements** Terminology of thread, Pitch errors, Measurement of different elements such as major diameter, minor diameter, effective diameter, pitch & thread angle, Working principle of floating carriage dial micrometer, Screw Thread Micrometer, pitch measuring m/c, Two wire method, thread gauge (plug gauge, ring gauge & snap gauge)	**04**

	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.	**03**
	Measurement of surface finish Primary and secondary texture, Sampling length, Lay, terminology as per IS 3073-1967, direction of lay, Sources of lay and its significance, CLA, Ra, RMS, Rz values and their interpretation, Symbol for designating surface finish on drawing, Various techniques of qualitative analysis, Working principle of stylus probe type instruments.	**03**
	Machine tool testing Parallelism by dial indicator, Straightness testing by straight edge, spirit level & Autocollimators, flatness testing by dial gauge, level or Autocollimators, optical flats Squareness Testing - by dial indicator, optical square, indicating method., alignment testing of lathe machine tool as per IS standard procedure.	**04**
	Total	**30**

Practical:

Skills to be developed:

Intellectual Skills:

1. To understand principle, working of various measuring instruments.

2. Selection of proper instruments for measurement.

3. Calculation of least count of instrument.

4. Take reading using the instrument

5. Interpret the observation and results

Motor Skills:

1. Setting the instruments for zero error adjustment.

2. Proper alignment of the instrument with work piece

3. Handling of instruments

4. Care and maintenance of instruments.

5. Measure the dimensions form the instruments.

6. Calibration and traceability of the instruments

7. Graphical representation of data.

LIST OF PRACTICALS

List of Practical: (Any five)

1. Standard use of basic measuring instruments. Surface plate, v-block, sprit level, combination set, filler gauge, screw pitch gauge, radius gauge, vernier caliper, micrometer and slip gauges to measure dimension of given jobs.

2. To find unknown angle of component using sine bar and slip gauges.

3. Study and use of optical flat for flatness testing.

4. Measurement of screw thread elements by using screw thread micrometer, screw pitch gauge.

5. Study and use of dial indicator as a mechanical comparator for run out measurement, and roundness comparison.

6. Measurement of gear tooth elements by using gear tooth vernier caliper and verification of gear tooth profile using profile projector,

7. Alignment Testing of lathe machine tool.

Examination Schedule Internal practical Sessional:

Attending classes, practicing programs & submitting respective assignment in time		5 x 4 = 20	
Viva - voce		5	
Total:		25	
Examination Schedule: External practical Sessional examination Examiner: **Lecturer**			
For submission of assignment in scheduled time		5 x 2 = 10	
On spot program		10	

viva voce		05	
Total		25	

.

Reference books :- Nil

Suggested List of Laboratory Experiments :- Nil

Suggested List of Assignments/Tutorial :- as mentioned in list of practical

Examination Scheme:

GROUP	**Chapter**	**ONE OR TWO SENTENCE ANSWER QUESTIONS**				**GROUP**	**Chapter**	**SUBJECTIVE QUESTIONS**			
		TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS			TO BE SET	***TO BE ANSWERED***	MARKS PER QUESTION	TOTAL MARKS
A		5	10	1	1 X	A		5	**FIVE,** TAKING AT LEAST TWO FROM	5	5 X 5
B		5				B		5			

					10 = 100				EACH GROUP		= 25

List of Books:

Author	Title	Publication
N V Raghavendra L Krishnamurthy	Engineering Metrology & Measurements	Oxford
R.K.Rajput	Mechanical Measurement & Instrumentation	S.K. Kataria & Sons
R. K. Jain.	Engineering metrology	Khanna Publisher, Delhi
M. Mahajan	A text book of metrology	Dhanpat Rai and Sons,
I.C. Gupta	A text book of Engineering metrology	Dhanpat Rai and Sons,
M. Adithan and R.Bahl	Metrology Lab. Manual	T.T.T.I. Chandigarh.
K. J. Hume	A text book of Engineering metrology	Kalyani publishers
J.F.W. Galyer and C. R. Shotbolt	Metrology for Engineers	ELBS

2. IS/ International Codes:

IS 919 – 1993 Recommendation for limits, fits and tolerances

IS 2029 – 1962 Dial gauges.

IS 2103 – 1972 Engineering Square

IS 2909 – 1964 Guide for selection of fits.

IS 2921 – 1964 Vernier height gauges

IS 2949 – 1964 V Block.

IS 2984 – 1966 Slip gauges.

IS 3139 – 1966 Dimensions for screw threads.

IS 3179 – 1965 Feeler gauges.

IS 3455 – 1966 Tolerances for plain limit gauges.

IS 3477 – 1973 Snap gauges.

IS 6137 – 1971 Plain plug gauges.

IS 3651 – 1976 Vernier Caliper

IS 4218 - Isometric screw threads

IS 4440 – 1967 Slip gauges accessories

IS 5359 – 1969 Sine bars

IS 5402 – 1970 Principle and applications of sine bars

IS 5939 – 1970 Sine angles, sine tables.

Course code: ME (P)	Semester : **Fifth.**
Duration : 17 weeks	Maximum Marks : 150
Teaching Scheme	Examination Scheme:
Theory : **4** hrs/week	Internal Assessment: **30** Marks
Tutorial: NIL	Teacher's Assessment (Assignment & Quiz): **10** Marks
Practical : **3** hrs/week	End Semester Exam: **70** Marks
Credit: **4**	Practical: Internal Practical continuous evaluation: **35** Marks
	Practical: External Practical examination: **35** marks

Aim :-	
S. No.	
1	To study definition, classification of Automation. Levels of Automation.
2	To study transfer machines.
3	To study NC & CNC Machines, their basic structure.
4	To study logic gates & PLC .
5	To study programming for CNC machining.

Objective :-	
S. No.	The Students should be able to:
1.	• Define, Classify Automation; Levels of Automation, Purpose & Application of Different types of Automation.
3.	• Understand transfer machines & transfer line.
4.	• Explain NC & CNC machines and their operation.
4.	• Understand basic features of PLC & Robotics.
5.	• Write part programmes for manufacturing different machine parts.

Pre-Requisite: Elementary knowledge Machine Tools

Contents	Hrs/week
AUTOMATION & CNC MACHINES	

Chapter		Name of the Topic	Hours	Marks
GROUP-A				
1	1.0 1.1 1.3 1.4 1.5	**Automation** Concept of mechanisation, Definition of automation, Types of automation – fixed automation programmable automation and flexible automation. Application. Levels of automation, Advantages and disadvantages of automation, reasons of automating.	04	

2	2.0 2.1 2.2 2.3 2.4 2.5 2.6	**Transfer Machining** Concept of Transfer Machining. Components of a transfer machine, Types of transfer machines – In-line transfer machines, Rotary type transfer machines (Geneva Mechanism & related simple numerical problem) and Drum type transfer machines, Transfer Mechanism – Pawl Type, Walking Beam type, Rotating Bar/ Finger type, Belt driven Conveyor type and Cart-on-track type. Advantages and Disadvantages of transfer machines. Application.	06	
3	3.0 3.1 3.2 3.3 3.4	**NC Concept** Basic idea, NC technology – its advantages, limitations. Application of NC CNC concept DNC concept.	03	
GROUP - B				
4	4.0 4.1 4.2 4.3 4.4 4.5 4.6 4.7 4.8 4.9 4.10	**CNC Machines** Nomenclature of CNC machine axes Types of CNC machine tools – CNC metal cutting machine tools turning centre and machining centre) CNC metal forming machine tools, Features of CNC machine tools, Main Components Of CNC - Machine Control Unit (MCU), Feedback Devices – transducers, encoders, position control sensors, speed sensors, interpolators (linear, circular) etc. Structural design – Re-circulating ball-screw-nut drive, Roller Slide, Drive Motors etc. Advantage & Disadvantages of using CNC. Accuracy in CNC. Application of CNC.	10	
5	5.0 5.1 5.2 5.3	**Classification of CNC** Classification based on feed back control – open loop and closed loop, Classification based on Tool Positioning System – Absolute & Incremental. Classification based on control system – Point To Point control, straight line control and continuous path control.	04	
6	6.0 6.1 6.2 6.3 6.4 6.5	**Tooling Arrangement** Tooling on CNC machining centres – types of cutting tools. Qualified tooling Preset tooling Spindle tooling. Automatic tool changer (ATC).	03	

GROUP – C				
7	7.0 7.1 7.2 7.3 7.4 7.5	**Programmable Logic Controller (PLC)** : Concept of PLC with block diagram. Elements of Logic Controls. Logic Gates – AND, OR, NOT, NAND, NOR Components of PLC, Advantages of PLC. Application of PLC. Ladder diagram.	04	
8	8.0 8.1 8.2 8.3 8.4 8.5 8.6	**Robotics** Definition of Robot Objective of Using Industrial Robots, Main components of a Robot. Degrees of Freedom Basic co-ordinate systems – Cartesian , Polar, Cylindrical and Revolute co-ordinate systems, Concept of Work Envelops.	06	
9	9.0 9.1 9.2 9.3 9.4 9.5	**NC & CNC Programming** Part Programming & its Methods. NC machine codes (ISO and EIA) – G Code, M Code Tool length offset, Tool radius compensation Automatically Programmed Tool. Part Programming for simple turned and prismatic component in CNC lathe, CNC milling, parametric subroutines (macros).	10	
		Sub Total:	**48**	
		Practice of CNC Programming	**12**	
		Internal Assessment Examination & Preparation of Semester Examination	**6**	
		Total	**68**	

GROUP	Module Or Chapter	OBJECTIVE QUESTIONS				SUBJECTIVE QUESTION			
		To Be Set	To Be Answered	Marks Per Question	Total Marks	To Be Set	To Be Answered	Marks Per Question	Total Marks
A	1, 2, 3	4	20	1	**20**	3	FIVE (At Least One from each group)	10	**50**
B	4, 5, 6,	6				3			
C	7, 8, 9	10				2			

Reference Book List:

Sr. No	Author	Title	Publication
01	B.S.Pabla and M.Adithan	CNC Machine	New age International(P)Ltd
02	Steve Krar & Arthur Gill	CNC Technology & Programming	Tata- McGrawHill
03	Mikell P. Groover	Automation, Production Systems & Computer Integrated Manufacturing	Prentice Hall - India
04	S. K. Hajra Choudhury	Workshop Technology – Vol II (M/c Tools)	Media Promoters & Publishers (P) Ltd.
05	B. S. Raghuwanshi	Workshop Technology – Vol II (M/c Tools)	Dhanpat Rai & Co.
06	J.S.Narang	CNC Machine & Automation	Dhanpat Rai & Co.

Name of the Course : Mechanical Engineering (Production) **Subject: THERMAL POWER**	
Course code: MEP	**Semester : Fifth**
Duration : 17 weeks	**Maximum Marks : 200**
Teaching Scheme	**Examination Scheme:**
Theory : **3** hrs/week	Internal Assessment: **20** Marks
Tutorial: hrs/week	Teacher's Assessment (Assignment & Quiz): **10** Marks
Practical : **2** hrs/week	End Semester Exam: **70** Marks
Credit: **4**	Practical: Internal Sessional continuous evaluation: **50** Marks
	Practical: External Sessional examination: **50** marks

Aim :-	
S. No.	
1	To study of various sources of energy.
2	To study the Boilers and their application in different process industries.
3	To study the Steam Condensers and their application in actual power generation.
4	To study the Internal Combustion Engine
5	To study the Air Compressors and their application in different process industries.
6	To understand the fundamentals of Refrigeration and Air-Conditioning.
Objective :-	
S. No.	The Students should be able to:
1.	• Know various sources of energy & their applications.
2.	• Explain construction & working principle of different Boilers and their different Mountings and Accessories.
3.	• Understand the Steam Power Cycles and their application in actual power generation.
4.	• Explain construction & working principle of different Steam Condensers and their utility in actual power generation.
5.	• Understand the Internal Combustion Engine and usual fuel and alternative Fuel which can be used for I.C. Engine.
4.	• Select appropriate type and calculate performance parameters of Air Compressors to suit the requirements.
5.	• Explain Refrigeration and Air-Conditioning Processes and their application.

Pre-Requisite: Elementary knowledge on Physics, basic Mathematics and Thermal Engineering-I

Contents			Hrs/week	
THERMAL ENGINEERING- I				
Chapter		**Name of the Topic**	**Hours**	**Marks**
		GROUP-A		
1	1.0	SOURCES OF ENERGY	**06**	
	1.1	Brief description of energy sources, including Classification of energy sources. Renewable and Non-Renewable sources of energy. Conventional and Non-Conventional sources of energy.		
	1.2	Brief description on available form of energy, conversion to useful form and its application.		

	1.2.1 1.2.2 1.2.3 1.2.4 1.2.5 1.2.6	Fossil fuels, including CNG, LPG. Solar energy, including Flat plate and concentrating collectors. Solar Water Heater. Photovoltaic Cell, Solar Distillation. Wind energy, Tidal energy, Geothermal energy. Biomass energy, including Biogas, Bio-diesel. Hydroelectric energy, Nuclear energy Fuel cell		
2	2.0 2.1 2.2 2.3 2.4 2.5 2.6 2.7 2.8	**BOILERS (STEAM GENERATOR)** Classification of Boilers. Fire Tube & Water Tube Boilers with example, working principle, difference, applications. Construction & working principle of Cochran, Babcock and Wilcox and La-Mont Boilers. Definition of Boiler Mountings and Accessories, important names of Boiler Mountings and Accessories and their functions. Basic conception and comparison of Stoker fired, Fluidized Bed and Pulverised Fuel Boilers. Boiler Performance (Simple numerical on Boiler Performance). Boiler Draught, Classification and comparison of boiler draught and Calculation of chimney heights (Simple numerical related to chimney heights calculation) Necessity of boiler feed water treatment. Modern high pressure boiler & its characteristics.	**07**	
3	3.0 3.1.0 3.1.1 3.1.2 3.1.3 3.1.4 3.2.0 3.2.1	**STEAM CONDENSER** Working Principle, Purpose of using and Classification of Steam Condensers. Comparison between Surface Condenser and Jet Condenser. Dalton's Law Of Partial Pressure as applicable to Condenser. Definition of Condenser Vacuum, Vacuum Efficiency and Condenser Efficiency. (No numerical) Sources of air leakage in Steam Condenser. Working Principle, Purpose of using and Classification (Natural Draught and Mechanical Draught) of Cooling Towers. Labelled schematic flow diagram of Cooling Water Circulation of a Surface Condenser with and without Cooling Tower.	**06**	
		GROUP-B		
4	4.0.0 4.1.1 4.1.2 4.1.3 4.1.4 4.1.4 4.1.5 4.1.6	**INTERNAL COMBUSTION (I.C.) ENGINES.** Classification of I.C. Engines. Main components of I.C.Engines. Two stroke & Four stroke Engines And their comparison. S.I. & C.I.Engines And their comparison. Indicator Diagrams. Valve timing diagram. Scavenging, Supercharging, Detonation, Knocking. Ignition systems, Cooling systems & Lubricating systems.	**10**	

	4.2.1 4.2.2 4.2.3	Engine fuels, Octane Number, Cetane Number. Indicated M.E.P., Indicated power(I.P), Brake Power(B.P.), Morse test, Efficiencies of I.C.Engines(Simple Problems). Alternate Fuels.		
5	5.0.0 5.1.0 5.1.1 5.1.2 5.2.0 5.2.1 5.2.2 5.2.3 5.3.0	**AIR COMPRESSER** Uses of Compressed Air Working Principle and Classification of Air Compressors. Definition of Compression Ratio, Compressor Capacity, Free Air Delivery and Swept volume. Reciprocating air compressor Construction and Working Principle of Single Stage and Two Stage Compressor. Volumetric Efficiency, Isothermal Efficiency & Mechanical Efficiency. (Simple numerical on single stage compressor) Advantages of Multi Staging.	**08**	
6	6.0 6.1 6.2 6.3 6.4 6.5	**REFRIGERATION & AIR CONDITIONING** Definition of Refrigeration, Tonne of Refrigeration (Unit of Refrigeration) and Coefficient of Performance (COP) of Refrigerator & Heat Pump. Refrigerant, desirable properties of a refrigerant and common commercial refrigerants & their suitability of use. **Air Refrigeration:** Basic Principle, representation on P-V & T-S diagrams, labelled schematic flow diagram Bell Coleman Cycle (Reversed Joule Cycle). (Simple numerical) **Vapour Compression Refrigeration:** Basic Principle, representation on P-V, P-H & T-S diagrams, labelled schematic flow diagram and function of components of Ideal Vapour Compression Refrigeration Cycle. (No numerical) **Application of Refrigeration System:** Water Cooler, Refrigerator, Ice Plant and Cold Storage. (Labelled schematic lay-out only)	**08**	
		Sub Total:	**45**	
		Internal Assessment Examination & Preparation of Semester Examination	**6**	
		Total	**51**	

Practical:

Skills to be developed:

Intellectual Skill :

1. Understand working principle and construction of Boilers and their application.
2. Understand working principle of Steam Condensers and cooling Tower.
3. Understand the working principle of Internal Combustion Engine.
4. Understand working principle of Reciprocating Air Compressor.
5. Understand different Refrigeration Cycle and Air-Conditioning Processes.

Motor Skills :

1. Collect and write technical specification of Steam Boiler.

2. Collect and write technical specification of Cooling Tower.
3. Report on visit to Steam Power Plant.
4. Conduct trial on multi-cylinder I.C. Engine.
5. Conduct trial on single stage, single cylinder reciprocating compressor.
6. Conduct trial on Refrigeration Test Rig for calculation of COP, power required and refrigeration effect.

List of Practical:

1. Study of Boiler and Boiler Parts. (Both Fire Tube and Water Tube Boilers)
2. Study of Boiler Mountings and Accessories.
3. Study and compare between Surface Condenser and Jet Condenser.
4. Trace the cooling water circulation of a surface condenser with cooling tower.
5. Study of schematic layout of Steam Power Plant.
6. Conduct Morse Test and find efficiency of I.C. Engine.
7. Study of single stage, single cylinder reciprocating compressor and find efficiencies.
8. Collection and analysis of Manufacturer's Catalogue for Reciprocating / Rotary Compressor.
9. Study of Refrigeration Unit / Air- Conditioning Unit. (Refrigerator / Window Air-Conditioner)
10. Trial on Refrigeration Test Rig for calculation of COP, power required and refrigeration effect.

Note: At least **FIVE (05)** nos. of Practical / Study are to be conducted.

Text Books

Name of Authors	Titles of the Book	Edition	Name of the Publisher
Domkundwar V. M.	A Course in Thermal Engineering.		Dhanpat Rai & Co.
Dr. D.S.Kumar	Engineering Thermodynamics (Principles & Practices)		S.K. Kataria & Sons
P. L. Ballaney	A Course in Thermal Engineering.		Khanna Publishers
R. S. Khurmi	A text book of Thermal Engineering.		S. Chand & co. Ltd.
R. K. Rajput	A Course in Thermal Engineering.		Laxmi Publication, Delhi
Patel and Karmchandani	Heat Engine Vol. - I & II		Acharya Publication
P. K. Nag	Engineering Thermodynamics		Tata McGraw Hill
B. K. Sarkar	Thermal Engineering		Tata McGraw Hill
A.R. Basu	Thermal Engineering (Heat Power)		Dhanpat Rai & Co.

Reference books :- Nil

Suggested List of Laboratory Experiments :- Nil

Suggested List of Assignments / Tutorial :-

1. Simple numerical on Carnot Power Cycle with steam.
2. Draw labelled schematic flow diagram and write function of components of the following Steam Power Cycles:
    - Simple Reheat Cycle.
    - Simple Regenerative Cycle.
    - Actual Reheat-Regenerative Cycle.
3. Draw valve timing Diagram of 2 stroke and 4-stroke I.C. Engine.
4. Draw labelled schematic flow diagram of air in Multistage Air Compressor.

EXAMINATION SCHEME: END SEMESTER EXAMINATION

GROUP	MODULE OR CHAPTER	OBJECTIVE QUESTIONS				SUBJECTIVE QUESTION			
		TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS	TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS
A	1,2,3	8	ANY 20	1	20	4	FIVE, (AT LEAST TWO FROM EACH GROUP)	10	50
B	4,5,6	12				6			

EXAMINATION SCHEME FOR PRACTICAL SESSIONAL

Internal Examination: Examiner- Lecturer in Mechanical Engg. / Jr. Lecturer			
Five No. of Experiments / Study attended & respective lab note submitted in due time.	5 x 6 = 30		
VIVA VOCE	20		
TOTAL	50		
External Examination: Examiner- Lecturer in Mechanical Engg. / Jr. Lecturer			
Submission of Signed Lab Note Book (for five experiments / study)	5 x 4 = 20		
On spot experiment / study (one for each group consisting 15 students / explanation or study item)	20		
VIVA VOCE	10		
TOTAL	50		

Name of the Course : Diploma in Mechanical Engineering (Production) Subject Title:Mechatronics. (Same with Mechanical engg).	
Course code: MEP	**Semester :** Fifth
Duration : 17 weeks	**Maximum Marks : 100**
Teaching Scheme:	**Examination Scheme:**
Theory : 3 hrs/week	**Internal Assessment**: 10 Marks
	Teacher's assessment (Assignment & Quiz): 05 Marks
Tutorial: hrs/week	**End Semester Exam**: 35 Marks
Practical : 2 hrs/week	**Practical: Internal Sessional continuous evaluation**:25 Marks
Credit: 4	**Practical: External Sessional Examination**:25 Marks

Aim :-	
S.No	
1	The integration of electronics engineering, electrical engineering, computer technology, and intelli control engineering with mechanical engineering is increasingly forming a crucial part in the desig manufacture and maintenance of wide range of engineering products and processes. As a conseque there is a need for a diploma engineers to understand systems used in automation.
S No	Students should be able to:
	1. Identify various input and output devices in an automated system. 2. Understand and draw ladder diagrams. 3. Write simple programs for PLCs. 4. Interpret and use operations manual of a PLC manufacturer. 5. Use simulation software provided with the PLC. 6. Understand interfacing of input and output devices.
Pre-Requisite:-	

S.No	Elementary knowledge on basic electronics, basic electrical engineering, mechanical device, hydraulic & pneumatic circuit, transducer & sensor.	
1		
Contents		Hrs/week
Chapter	*Name of the Topic*	**Hours**
Group A		
01	Concept of Mechatronics, Constituents of Mechatronics System, Application of Mechatronics in manufacturing, Introduction to Sensors & transducers, Principle of working and applications of Limit switches, proximity switches like inductive, capacitive and optical (deflecting and through beam type) , Thumb wheel switches , magnetic reed switches, Optical encoders- displacement measurement, rotary, incremental.	03
02	**Pneumatic, Hydraulic & Electrical Actuation System** : Actuator – solenoids – on-off applications, latching, triggering, Types of relays- solid state, Types of motors – DC motors, DC brushless motors, AC motors, stepper motors, servo motors	**03**
03	**Computing Elements in Mechatronics: 8085 Microprocessor** - Architecture, Pin configuration, working of microprocessor, and applications. Introduction to ICs used for interfacing such as – Programmable peripheral devices , USART, memory, keyboard, display – LCD,LED,I/O device, ADC, DAC. **8051 Microcontroller** - Architecture, Pin configuration, working of microcontroller, Applications. Comparison of microprocessor and microcontroller , advantages and disadvantages **Programmable Logic Controller** - Introduction, PLC definition, PLC block diagram, Difference between relay panel and PLC, power supply, input/output modules (analog, digital) concepts of sink/source, set/reset,	**05** **03**

	latch/unlatch, advantages and disadvantages. Installation , troubleshooting and maintenance of PLC	**08**
Group B		
04	**PLC Programming** – Ladder diagrams and sequence listing, large process ladder diagram construction, flowcharting as a programming method , Basic PLC functions. Register basics, timer functions, counter functions Intermediate functions – Arithmetic functions, number comparison and numbe conversion functions Data handling functions- SKIP, Master control relay, Jump, Move, Block move, Table to register and register to table move functions. FIFO and LIFO functions, File Arithmetic and Logic function PLC digital bit functions and applications Sequencer functions and cascading of sequencers PLC matrix functions Discrete and analog operation of PLC, Networking of PLCs. PLC auxiliary commands and functions,	**22**
05	Online, offline, stop/run modes of operations, uploading/downloading between PLC and PC, Introduction to SCADA and DCS	**04**
Suggested List of Assignments/Tutorial :- Nil		

Practical:

Intellectual Skills:

1. Identification of various sensors and transducers used in automated systems
2. Interpretation of circuits in automation
3. Interpretation and use

Motor skills:

1. Use of simulation software for PLCs
2. Preparation of ladder diagrams
3. Testing of interfacing ICs

List Of Practical:

Term work shall consist of detailed report on the following experiments:

1. Identification and demonstration of different sensors and actuators.
2. Demonstration of the working of various digital to analog and analog to digital converters.
3. Development of ladder diagram, programming using PLC for
    a) measurement of speed of a motor
    b) motor start and stop by using two different sensors
    c) simulation of a pedestrian traffic controller
    d) simulation of four road junction traffic controller
    e) lift / elevator control
    f) washing machine control
    g) tank level control
    h) soft drink vending machine control
4. Trace, interpret and demonstrate working of at least two electro pneumatic systems.
5. Trace, interpret and demonstrate working of at least two electro hydraulic systems.

List of Books:

Sr.No.	Author	Title	Publication
01	Bolton W.	Mechatronics- Electronic control systems in Mechanical and Electrical Engineering	Pearson Education Ltd.
02	Histand B.H. and Alciatore D.G.	Introduction to Mechatronics and Measurement systems	Tata McGraw Hill Publishing
03	John W. Webb and Ronald Reis	Programmable Logic Controllers	Prentice Hall of India
04	NIIT	Programmable Logic Control – Principles and Applications	Prentice Hall of India
	Paul P.L. Regtien	Sensors for Mechatronics	Elsevier
	Appu Kuttan K.K.	Introduction to Mechatronics	Oxford
	Surekha Bhanot	Process Control Principles & Applications	Oxford
05	Kolk R.A. and	Mechatronics systems design	Vikas Publishing, New Delhi

	Shetty D.		
06	Mahalik N.P.	Mechatronics principles, concepts and applications	Tata McGraw Hill Publishing
		Mechatronics	S. Chand

Internal practical Sessional examination Scheme

Attending classes, practicing programs & submitting respective assignment in time		5x4= 20	
Viva - voce		5	
Total:		25	
Examination Schedule: External practical Sessional examination Examiner: **Lecturer / Jr. Lecturer**			
For submission of assignment in scheduled time		5x2= 10	
On spot activity		10	
viva voce		05	
Total		25	

GROUP	**Chapter**	**ONE OR TWO SENTENCE ANSWER QUESTIONS**				**GROUP**	**Chapter**	**SUBJECTIVE QUESTIONS**			
		TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS			TO BE SET	***TO BE ANSWERED***	MARKS PER QUESTION	TOTAL MARKS
A	1,2,3	5	10	1	1 x 10 = 10	A	1,2,3	5	**FIVE,** TAKING AT LEAST TWO FROM EACH GROUP	5	5 x 5 = 25
B	4,5	5				B	4,5	5			

MODERN MACHINING PROCESSES.

Name of the course: Mechanical Engineering(Production) **Subject: MODERN MACHINING PROCESSES.**	
Course Code:ME(P)	Semester:Fifth.
Duration:17 weeks	Maximum Marks: 150
Teaching Scheme	Examination Scheme
Theory:3 hrs/week	End Semester Exam:70
Tutorial:hrs/week	Teacher's Assesment(Assignment & Quiz):10 Marks
Practical:2 hrs/week	Internal Assesment:20 Marks
Credit:4	Practical Sessional internal continuous evaluation:25 Marks
	Practical Sessional external examination: 25 Marks

Aim:-	
Sl. No.	
1.	To study the need of Unconventional machining processes.
2.	To understand the USM,AJM processes.
3.	To study ECM,EDM processes.
4.	To study EBM,LBM,PAM processes.
Objective:-	
Sl. No.	The students should be able to:
1.	Know the need of unconventional machining processes.
2.	Know mechanism of USM, AJM.
3.	Understand material removal by ECM, EDM process.
4.	Understand characteristic of machining by LBM,EBM,PAM processes.
Pre-Requisite: Elementary knowledge of Machining & Machine Tools.	

Contents			**Hrs./week**	
ADVANCED MANUFACTURING PROCESS.				
Chapter		Name of the Topic	Hours	Marks
		GROUP-A		
1	1.0	**INTRODUCTION** :	03	
	1.1	Need for non –traditional processes, classification, historical background, definitions and application of various processes, comparative analysis.		
2	2.0	**MECHANICAL PROCESS**	06	
	2.1	Abrasive Jet machining (AJM) – Fundamental principle, process parameters, operational characteristics schematic layout, application possibilities.		
	2.2	Ultrasonic machining (USM) – Fundamental principles, process parameters, Transducer, Tool feed machanism, analysis of process parameters, application possible.		
		GROUP-B		
3	3.0	**CHEMICAL MACHINING**	03	
	3.1	Fundamental principles, process parameters, application possiblies		

4	4.0	**ELECTROCHEMICAL PROCESSES**	06	
	4.1	Electro-chemical machining (ECM) – fundamental principles,process parameters, classification, metal removal rate, choice of electrolytes, Application possibilities. Electro chemical Grinding (ECG) – Fundamental Principles, process Parameters, Classification, Application possibilities.		
5	5.0	**ELECTRO – DISCHARGE MACHINING (EDM) :**	08	
	5.1	Fundamental Principle, metal removal, machining accuracy, selection of tool materials, choice of dielectric, application. Adaptive control in EDM . Power supply in EDM.		
		GROUP-C		
6	6.0	**LASER BEAM MACHINING (LBM)** :	06	
	6.1	Fundamental Principle, Solid State Laser, machining application other application other application.		
7	7.0	**ELECTRON BEAM MACHINING (EBM)**	06	
	7.1	Fundamental Principle, generation of electron beam, application.		
8	8.0	**PLASMA ARC MACHINING (PAM) :**	07	
	8.1	Fundamental principle, schematic arrangement, applications		
		Sub Total	45	
Internal Assesment Examination & Preperation of Semester Examination			6	
		Total	51	

Practical:

Skills to be developed:

Intellectual Skill :

1. Understand AJM & USM.
2. Understand ECM.
3. Understand EDM.
4. Understand EBM,LBM,PAM

Motor Skills :

1. Conduct trial on USM.
2. Study of ECM.
3. Study of WEDM, LBM,EBM,PAM.

List of Practical:

Modular experiments to illustrate and study various non-traditional production processes:

1. Abrasive Jet machining (AJM) and ultrasonic machining
2. Ultrasonic machining (USM)
3. Electrochemical Machining (ECM)
4. Electro-discharge machining (EDM)
5. Electron beam machining (EBM)
6. Laser beam machining (LBM)

7. Plasma arc machining (PAM).

Name of Authors	**Title of the Book**	**Name of the publishers**
A Bhattacharyya	New Technology	Institution of Engineers(I)
Pandey & Sham	Modern Machining Process	Tata McGraw Hill Pub. Co. ltd.
P.K.Mishra	Unconventional Machining	Narosa Publishing co.
Reference books: Nil		
Suggested list of laboratory experiments:- Nil		
Suggested list of Assignments/Tutorial:-		
1.Draw schematic diagram of USM. 2. Draw graphically effect of various factors on MRR in AJM. 3. Draw Layout of Wire cut EDM machine.		

EXAMINATION SCHEME:END SEMESTER EXAMINATION

GROUP	MODULE/CHAPTER	OBJECTIVE QUESTIONS				SUBJECTIVE QUESTION			
		TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS	TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS
A	1,2	5	ANY 20	1	20	3	FIVE(AT LEAST TWO FROM EACH GROUP)	10	50
B	3,4,5	8				3			
C	6,7,8	7				3			

EXTERNAL Examination: Examiner- Lecturer in Mechanical Engg. / Jr.Lecturer/Demonstrator.			
External Examination: Examiner- Lecturer in Mechanical Engg./Jr. Lecturer/Demonstrator.			
Submission of Signed Lab Note Book (for five experiments/study)	5*2=10		
On spot experiment (one for each group consisting 15	10		

EXAMINATION SCHEME FOR PRACTICAL SESSIONAL:-

Internal Examination: Examiner- Lecturer in Mechanical Engg./Jr. Lecturer/Demonstrator.			
Five No. of Experiments / Study attended & respective lab note submitted in due time.	5*3=15		
VIVA VOCE	10		
TOTAL	25		

students / explanation of study item)			
VIVA VOCE	5		
TOTAL	25		

Name of the Course : Mechanical Engineering (Production) **Subject Title: Professional Practices-III**	
Course code: MEP	**Semester : Fifth**
Duration :	**Maximum Marks : 50**
Teaching Scheme	**Examination Scheme**
Theory : hrs/week	Mid Semester Exam: Marks
Tutorial: hrs/week	Assignment & Quiz: Marks
Practical : 2 hrs/week	End Semester Exam: Marks
Credit: 1	**Practical: Internal Sessional continuous evaluation**:25 Marks
	Practical: External Sessional Examination:25 Marks

Aim :-	
S.No	
1	To develop general confidence, ability to communicate and attitude, in addition to basic technological concepts through Industrial visits, expert lectures, seminars on technical topics and group discussion.
Objective :-	
S No	The student will able to
1	Acquire information from different sources.
2	Prepare notes for given topic.
3	Present given topic in a seminar.
4	Interact with peers to share thoughts.
5	Prepare a report on industrial visit, expert lecture
Pre-Requisite:-Nil	

Contents		Hrs/week
Chapter	**Name of the Topic**	
01	**Student Activities** – Students in a group of 3 to 4 shall perform **ANY ONE** of the following activities (Other similar activities may be considered) and write a report as a part of term work. **Activities :-** 1. Collection of data regarding loan facilities or other facilities available through different organizations / banks to budding entrepreneurs 2. Survey and interviews of successful entrepreneurs in near by areas 3. Survey of opportunities available in thrust areas identified by Government or DIC. 4. Measuring Screw thread parameters on floating carriage dial micrometer and select the optimum diameter of wire. 5. Survey of data regarding different types of pumps with specifications from manufacturers catalogue, local markets, end users (any other engineering products may be considered for survey) 6. Survey of farm implements used by farmers	5
02	**Group Discussion :** The students should discuss in group of six to eight students and write a brief report on the same, as a part of term work. The topic of group discussions may be selected by the faculty members. Some of the suggested topics are (**any one**)- i) CNG versus LPG as a fuel. ii) Petrol versus Diesel as a fuel for cars. iii) Trends in automobile market. iv) Load shading and remedial measures. v) Rain water harvesting.	5

	vi) Trends in refrigeration Technology. vii) Disaster management. viii) Safety in day to day life. ix) Energy Saving in Institute. x) Nano technology. xi) Co-ordinate system in CNC Machines & Linear Motion Guide.(MECHATRONICS).	
03	CAM SOFTWARE COURSE 1. Introduction of **CAM** software. 2. Identify Different **icons** and **tool bar** on the Screen. 3. Import **Model** for machining. 4. **Position** the Model to **Reference zero** point. 5. **Measure** the Model for Tool Selection. 6. Define the **Block** from which the part will be cut. 7. Define the cutting **Tools** to be used. 8. Define the cutting **feed, rapid movement and rpm**. 9. Define Set up options (**Rapid Move Heights** – **Start and End Point**). 10. Define **Boundary** for selected area machining. 11. Create a **Roughing Tool Path** Strategy. 12. Create a **Finishing Tool Path** Strategy. 13. Edit **Tool Path.** 14. Tool Path **Transformation.** 15. **Animate** and **simulate** the tool path. 16. Create an **NC Program** and output as a post-processed **nc** data file. 17. **Save** the **CAM Project** to an external directory.	20
	Total	30

Text Books			
Name of Authors	Titles of the Book	Edition	Name of the Publisher
Mark Ratner and Daniel Ratner	Nanotechnology		Pearson Educatuion, New Delhi
Yoram Korem	Computer Control of Manufactring System		Mcgraw Hill Publication
Sunil Chopra, Peter Meindl	Supply Chain Management		Pearson Education, New Delhi
Reference books :- Nil			
Suggested List of Laboratory Experiments :- Nil			
Suggested List of Assignments/Tutorial :- Nil			

	Internal Practical Sessional Examination	
Chapter	**Topic**	
1	**Submission of Report on student activity**	**5**

	by scheduled date	
2	**Group Discussion**	**5**
3	**Practice of CAM**	**10**
	Viva - voce	**5**
	Total:	**25**
	External Practical Sessional Examination **Examiner: Lecturer/ Jr. Lecturer**	
	Submission of signed report & assignment	**5**
	On spot CAM activity	**10**
	Viva voce	**10**
	Total:	**25**