West Bengal State Council of Technical & Vocational Education and Skill Development
(Technical Education Division)

Syllabus
of

Diploma in Mechanical Engineering [ME]

Part-II (4th Semester)

Revised 2022

CURRICULUM STRUCTURE FOR PART-II (SEMESTER 4) OF THE FULL-TIME DIPLOMA COURSES IN MECHANICAL ENGINEERING

BRANCH: **MECHANICAL ENGINEERING**				**SEMESTER 4**						
SL No	**Category**	**Code No**	**Course Title**	**L**	**P**	**Total Class per week**	**Credit**	**Full marks**	**Internal Marks**	**ESE Marks**
1	**Program Core**	**MEPC202**	**Theory of Machine**	**3**		**3**	**3**	**100**	**40**	**60**
2	**Program Elective**	**MEPE202**	**Program Elective**	**2**		**2**	**2**	**100**	**40**	**60**
3	**Program Core**	**MEPC204**	**Manufacturing Process-II**	**3**		**3**	**3**	**100**	**40**	**60**
4	**Program Core**	**MEPC206**	**Thermal Engineering-II**	**3**		**3**	**3**	**100**	**40**	**60**
5	**Program Core**	**MEPC208**	**Engineering Metrology**	**3**		**3**	**3**	**100**	**40**	**60**
6	**Program Core**	**MEPC210**	**Computer Aided Machine Drawing Practice**		**3**	**3**	**1.5**	**100**	**60**	**40**
7	**Program Core**	**MEPC212**	**Thermal Engineering-II Lab**		**2**	**2**	**1**	**100**	**60**	**40**
8	**Program Core**	**MEPC214**	**Engineering Metrology and Mechanical Measurement Lab**		**2**	**2**	**1**	**100**	**60**	**40**
9	**Program Core**	**MEPC216**	**Manufacturing Processes-II Practice**		**2**	**2**	**1**	**100**	**60**	**40**
10	**Minor Project**	**PR202**	**Minor Project**		**3**	**3**	**1.5**	**100**	**60**	**40**
			Total	**14**	**12**	**26**	**20**	**1000**	**500**	**500**

STUDENT CONTACT HOURS PER WEEK: 26 hours (Lecture-14 hours; Practical-12 hours)
Theory and Practical Period of 60 minutes each
FULL MARKS-1000 (Internal Marks-500; ESE Marks-500)
L-Lecture, P-Practical, ESE- End Semester Examination

Credit Distribution	**Credit**
Program Elective	2
Program Core	16.5
Minor Project	1.5
Total	20

Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately in each subject.

Program Elective (Any one)	**Total Credit**
1. Refrigeration & Air Conditioning (Sub code: **MEPE202/1)**	**2**
2.Tool Engineering (Sub code: **MEPE202/2)**	

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Name of the Course: Diploma in Mechanical Engineering			
Category: Programme Core	**Semester : Fourth**		
Code No. : MEPC202	**Theory : 100** Marks		
Course Title : Theory of Machine	**Examination Scheme:**		
Duration : 17 weeks (Total hours per week = 3)	**External Assessment**		
	End Semester Examination		**60 marks**
	Internal Assessment		
Total lecture class/week: 3	Class test	20	**40 marks**
	Assignment &viva voce	10	
Credit : 3	Class attendance	10	
	Total marks		**100**
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.			

1. Course Outcomes:

After completion of this course the students will be able to-

i) Demonstrate the working principle for different types of mechanism used in different machines.
ii) Determine the velocity ratio for different types of gear train and power transmitted by belt drive.
iii) Select specific mechanical power transmission drives for given application.
iv) Draw the profile of radial cam for transmitting given motion of follower.
v) Choose relevant brakes and clutches for various applications.
vi) Determine the mass of flywheel required for given crank-effort diagram of an engine / machine.
vii) Locate the position of balance mass for a rotating component containing several unbalanced masses in different planes.

2. Theory Components:

The following topics/subtopics should be taught and assessed in order to achieve the course outcomes:

Unit	**Topics & Sub-topics**	**Approx. Teaching Hours**
Unit: 1 **Fundamentals of Mechanisms**	1.1**Kinematics of Machines:** Definition of Statics, Dynamics, Kinematics, Kinetics, Kinematic link, Kinematic Pair and its types, constrained motion and its types, Kinematic chain and its types, Mechanism, machine and structure, inversion of mechanism. 1.2 **Working principle of Mechanisms:** four bar chain mechanism, Pantograph, Slider Crank mechanism, Whitworth quick-return mechanism, Crank and slotted lever quick return mechanism. 1.3 **Velocity of a point in mechanism:** Determining the velocity of a point in 4-bar chain mechanism & slider-Crank mechanism by relative velocity method and instantaneous centre method (use graphical method only).	**06**
Unit: 2 **Power Transmission**	2.1 **Types of Drives** – applications and comparisons of Belt, Chain, Rope& Gear drives. 2.2 **Belt Drives** – Types of pulleys, flat belt, V– belt & its applications, materials for flat and V-belt, angle of lap, belt length for open and cross belt drive. Slip and creep and its effect in power transmission. Determination of velocity ratio, ratio of tight side and slack side tensions, centrifugal tension and initial tension, condition for maximum power transmission (simple numerical on flat belt drive). 2.3 **Gear Drives** –Types of gears and gear trains, their selection for different application, train value & Velocity ratio for compound, reverted and simple epicyclic gear train, Law of gearing. (Simple problems on gear train).	**12**

Unit: 3 **Flywheel and Governors**	3.1 **Flywheel** - Purpose and application of flywheel, Effect of use of flywheel with the help of suitable turning moment diagram (no numerical). Coefficient of fluctuation of energy, coefficient of fluctuation of speed and its significance. (Simple problems on determination of mass of flywheel using crank effort diagram). 3.2 **Governors** – Types of governor, purpose and application, terms used in governor- radius of rotation & height, equilibrium speed, maximum, minimum & mean equilibrium speed, sleeve lift (Simple problems on porter governor); Concept on sensitiveness, stability, isochronism and hunting. 3.3 Comparison between Flywheel and Governor.	**08**
Unit: 4 **Cams and Followers**	4.1 Purpose and application of cams and followers. 4.2 Classification of cams and followers. 4.3 Different follower motions and their displacement diagrams like uniform velocity, SHM, uniform acceleration and retardation. 4.4 Drawing of profile of radial cam with knife-edge and roller follower with and without offset for reciprocating motion (graphical method).	**08**
Unit: 5 **Brakes & Clutches**	5.1 Functions and types of brakes. 5.1.1 Construction and working of i) shoe brake, ii) band brake, iii) Internal expanding shoe brake iv) disc brake. 5.1.2 Concept of Self Locking & Self energizing brakes. 5.1.3 Concept of braking force and braking torque for shoe & band brake. 5.2 Clutches- Uniform pressure and Uniform wear theories. 5.2.1 Function of clutch and its application, Construction and working of i) single plate clutch, ii) multi-plate clutch, iii) centrifugal clutch iv) cone clutch v) diaphragm clutch. (No numerical).	**06**
Unit: 6 **Balancing of Rotating Masses & Vibrations**	6.1 Concept of balancing of high speed rotating masses, balancing of a single rotating mass. Graphical method for balancing of several masses revolving in same plane & different planes. (simple numerical) 6.2 Concept and causes of vibration in machines, harmful effects and remedies.	**05**
	Sub Total : Total Lecture Classes	**45**
	No. of classes required for conducting Internal Assessment examination	**06**
	Grand Total :	**51**

3. Suggested Home Assignments/Students' Activities: (any four)

Students should conduct following activities in-group/ individual and prepare report about 5 pages for each activity

i) List the different mechanical power transmission systems used in a typical car.

ii) Identify the type of clutch (es) & brake(s) used in two wheeler / 4-wheeler.

iii) List different types of power transmission devices available in different workshop / laboratories of the institute.

Iv) Determine the radius of rotation of fly ball (porter governor) for different speed of governor and draw a graph between radius of rotation versus speed.

v) Make a chart (with diagram) on different types of gear train: a) simple gear train – tumbler gears for feed reversing in lathe, b) compound gear train – All geared head stock in lathe, c) reverted gear train – back gear in lathe, d) epicyclic gear train – differential gear box in automobile.

vi) Find the ratio of time of cutting stroke to the time of return stroke by varying stroke length for quick return mechanism of a shaper machine.

vii) Determination of velocity of follower link and connecting link of 4-bar linkage mechanism by relative velocity method [graphically] (two problems).

viii) Determination of velocity of the slider of slider-crank mechanism by instantaneous centre method [graphically] (two problems).

ix)Draw the profile of a radial cam with knife-edge and roller follower with offset for reciprocating motion.

x) Determine graphically the balancing of several masses rotating in a single plane / different planes (two problems).

xi) Determine the mass of flywheel using given crank effort diagram. (Planimeter may be used).

4. Suggested scheme for question paper design for conducting internal assessment examination :(Duration: 45 minutes)

Questions to be set as per Bloom's Taxonomy				
	Distribution of Theory Marks			
	Level 1 (Remember)	**Level 2 (understand)**	**Level 3 (Apply & above)**	**Total**
Class Test - 1	4	8	8	20
Class Test - 2	4	8	8	20

5. Suggested Scheme for End Semester Examination [duration 3 hours**]**

A: Multiple Choice Type Questions(Carrying 1 mark each)				
Group	**Unit**	**To be Set**	**To be Answered**	**Total Marks**
A1	1& 2	07	10	10 x 01 = **10**
A2	3 & 4	04		
A3	5 & 6	04		
	Total:	**15**	**10**	**10**
B: Fill-in the Blank Type Questions(Carrying 1 mark each)				
Group	**Unit**	**To be Set**	**To be Answered**	**Total Marks**
B1	1& 2	07	10	10 x 01 = **10**
B2	3 & 4	04		
B3	5 & 6	04		
	Total:	**15**	**10**	**10**
C: Very Short Answer Type Questions(Carrying 1 mark each)				
Group	**Unit**	**To be Set**	**To be Answered**	**Total Marks**
C1	1& 2	07	10	10 x 01 = **10**
C2	3 & 4	04		
C3	5 & 6	04		
	Total:	**15**	**10**	**10**
			Sub-Total [A+B+C]:	**30**
D: Short Answer Type Questions(Carrying 2 marks each)				
Group	**Unit**	**To be Set**	**To be Answered**	**Total Marks**
D1	1& 2	05	06	06 x 02 = **12**
D2	3 & 4	03		
D3	5 & 6	02		
	Total:	**10**	**06**	**12**
E: Subjective Type Questions(Carrying 6 marks each)				
Group	**Unit**	**To be Set**	**To be Answered**	**Total Marks**
E1	1& 2	04	03	06 x 03 = **18**
E2	3 & 4	03		
E3	5 & 6	02		
	Total:	**09**	**03**	**18**
			Sub-Total [D+E]:	**30**
			Total [A+B+C+D+E]:	**60**

6. Rubrics for the Assessment of Students Activity: (20 marks)

Sl No.	**Performance Indicators**
1	Originality of completing the assigned task
2	Presentation skill
3	In time submission of assignment report / micro-project task
4	Viva-voce
Total	

7. Suggested Learning Resources:

Sl. No.	Title of Book	Author	Publication
1	Theory of machines	Khurmi & Gupta	S. Chand & Co
2	Theory of Machines	S. S. Rattan	McGraw Hill companies
3	Theory of machines	Abdulla sharif	Dhanpat Rai & Co
4	Theory of machines	P.L. Ballaney	Khanna Publication
5	Theory of machines	V.P. Singh	Dhanpat Rai & Co
6.	Theory of machines	Bevan T	CBS Publication

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Name of the Course: Diploma in Mechanical Engineering			
Category: Programme Elective	**Semester : Fourth**		
Code no. : MEPE202/1	**Theory : 100** Marks		
Course Title : Refrigeration & Air Conditioning	**Examination Scheme:**		
Duration :17 weeks (total hours per week =2)	**External Assessment**		
	End Semester Examination		**60 marks**
	Internal Assessment		
Total lecture class/week: 2	Class test	20	**40 marks**
	Assignment &viva voce	10	
Credit : 2	Class attendance	10	
	Total marks		**100**
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.			

1. Course outcomes (COs):

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

a. Identify the type of refrigeration system and explain its working principle.
b. Calculate the performance of air refrigeration & vapor compression refrigeration systems.
c. Identify different components of refrigeration & air-conditioning system.
d. Demonstrate psychrometric processes on psychrometric chart.
e. Explain the working methods of comfort air-conditioning.

2. Theory Components:

The following topics/subtopics should be taught and assessed in order to develop unit outcomes for achieving the course outcomes:

Unit	Topics and Sub-topics	Approx. Teaching Hours
Unit: 1: **Introduction**	1.1 Definition of Refrigeration, Air-conditioning, Refrigerant. 1.2 Necessity of Refrigeration, Air-conditioning. 1.3 Refrigerating effect, Tonne of Refrigeration, Coefficient of performance. 1.4 Difference between refrigerator and heat pump. 1.5 Major application areas of refrigeration, air-conditioning.	**02**
Unit: 2: **Air Refrigeration System**	2.1 Flow diagram of Carnot Refrigerator and representation of Carnot refrigeration cycle on p-V & T-s plane, Determination of COP of Carnot refrigerator and simple numerical on it. Properties of air as refrigerant. 2.2 Flow diagram of Brayton Refrigerator and representation of Brayton refrigeration cycle on p-V & T-s plane, Determination of COP. (Simple numerical) 2.3 Necessity of air-craft refrigeration, Flow diagram and working principle of air-craft refrigeration by using Simple Air Cooling system.	**06**
Unit: 3: **Vapour Compression Refrigeration System**	3.1 Flow diagram and working principle of vapour compression refrigeration system, Representation of ideal vapour compression cycle on p-h & T-s plane, COP of the cycle. Desirable properties of refrigerant. 3.2 Effect on the performance of refrigerator due to – (i) superheating of refrigerant before suction, (ii) sub-cooling or under cooling of refrigerant after condensation, (iii) change in suction pressure of refrigerant and (iv) change in discharge pressure of refrigerant. 3.3 Simple numerical on ideal vapour compression cycle. 3.4 Flow diagram and working principle of Domestic refrigerator. 3.5 Flow diagram and working principle of Ice plant.	**08**

	3.6 Flow diagram and working principle of Water cooler. 3.7 Flow diagram and working principle of Cold storage.	
Unit: 4 **Vapour Absorption Refrigeration System**	4.1 Flow diagram and working principle of practical vapour absorption (two fluids) refrigeration system. 4.2 Flow diagram and working principle of Electrolux (three fluids) refrigeration system, Role of three fluids. 4.3 Comparison between vapour compression system and vapour absorption system	**02**
Unit: 5 **Psychrometry**	5.1 Properties of moist air. 5.2 Use of Sling psychrometer and psychrometric chart. 5.3 Discussion on various psychrometric processes using psychrometric chart and flow diagram. 5.4 Use of heating coils, cooling coils, humidifier, and dehumidifier. 5.5 Concept of By-pass factor, Apparatus dew point (ADP), Sensible heat factor. 5.6 Simple numerical using psychrometric chart.	**08**
Unit: 6 **Air-conditioning**	6.1 Air Conditioning & Types of air conditioning 6.2 Introduction to Industrial air conditioning, Factors affecting the human comfort. 6.3 Flow diagram and working principle of room air conditioner - Split type. 6.4 Flow diagram and working principle of summer, winter and all the year-round air conditioner. 6.5 Flow diagram and working principle of air-washer.	**04**
Sub Total : Total Lecture Classes		**30**
No. of classes required for conducting Internal Assessment examination		**4**
Grand Total :		**34**

3. Suggested Home Assignments/Students' Activities: (any four)

i)Illustrate the flow diagram of simple air craft cooling system.

ii) Illustrate the flow diagram of automobile air conditioning system.

iii) Illustrate the flow diagram of refrigeration system in cold storage.

iv) Illustrate the flow diagram of water cooler.

v) Illustrate the flow diagram of central air conditioning system.

vi) One problem on each Psychrometric process using Psychrometric chart.

vii) Two problems on Vapour compression cycle.

viii) Illustrate the flow diagram of three fluid refrigeration system.

4. **Suggested scheme for question paper design for conducting internal assessment examination**: (Duration: 45 minutes)

Questions to be set as per Bloom's Taxonomy				
	Distribution of Theory Marks			
	Level 1 (Remember)	**Level 2 (understand)**	**Level 3 (Apply & above)**	**Total**
Class Test - 1	4	8	8	20
Class Test - 2	4	8	8	20

5. Suggested Scheme for End Semester Examination [duration 3 hours]

A: Multiple Choice Type Questions (Carrying 1 mark each)				
Group	**Unit**	**To be Set**	**To be Answered**	**Total Marks**
A1	1 & 2	5	10	10 x 01 = **10**
A2	3 & 4	5		
A3	5 & 6	5		
	Total:	**15**	**10**	**10**
B: Fill-in the Blank Type Questions (Carrying 1 mark each)				
Group	**Unit**	**To be Set**	**To be Answered**	**Total Marks**

B1	1 & 2	5	10	10 x 01 = **10**
B2	3 & 4	5		
B3	5 & 6	5		
	Total:	**15**	**10**	**10**
C: Very Short Answer Type Questions (Carrying 1 mark each)				
Group	**Unit**	**To be Set**	**To be Answered**	**Total Marks**
C1	1 & 2	5	10	10 x 01 = **10**
C2	3 & 4	5		
C3	5 & 6	5		
	Total:	**15**	**10**	**10**
			Sub-Total [A+B+C]:	**30**
D: Short Answer Type Questions (Carrying 2 marks each)				
Group	**Unit**	**To be Set**	**To be Answered**	**Total Marks**
D1	1 & 2	3	06	06 x 02 = **12**
D2	3 & 4	3		
D3	5 & 6	4		
	Total:	**10**	**06**	**12**
E: Subjective Type Questions (Carrying 6 marks each)				
Group	**Unit**	**To be Set**	**To be Answered**	**Total Marks**
E1	1 & 2	3	03	06 x 03 = **18**
E2	3 & 4	3		
E3	5 & 6	3		
	Total:	**09**	**03**	**18**
			Sub-Total [D+E]:	**30**
			Total [A+B+C+D+E]:	**60**

6. Rubrics for the Assessment of Students Activity: (20 marks)

Sl No.	Performance Indicators
1	Originality of completing the assigned task
2	Presentation Skill
3	In Time submission of Assignment report / micro-project task
4	Viva-voce

7. Suggested Learning Resources:

Sl. No.	Title of Book	Author	Publication
1	A text book of Refrigeration & Air conditioning	R. S. Khurmi	S. Chand and Co.
2	A text book of Refrigeration & Air conditioning	R. K. Rajput	S. K. Kataria
3	A text book of Refrigeration & Air conditioning	Manohar Prasad	New Age Publication
4	A text book of Refrigeration & Air conditioning	P. N. Ananthanarayanan	Tata McGraw Hill
5	A text book of Refrigeration & Air conditioning	C. P. Arora	Tata McGraw Hill

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Name of the Course: Diploma in Mechanical Engineering			
Category: Programme Elective	**Semester : Fourth**		
Code no.: MEPE202/2	**Theory : 100** Marks		
Course Title: Tool Engineering	**Examination Scheme:**		
Duration : 17 weeks (Total class hour/week = 2)	**External Assessment**		
	End Semester Examination		**60 marks**
	Internal Assessment		
Total lecture class/week: 2	Class test	20	**40 marks**
	Assignment &viva voce	10	
Credit : 2	Class attendance	10	
	Total marks		**100**
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.			

1. Course outcomes (COs):

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

a. Select tools for making product as per industrial requirement.

b. Select jigs and fixtures, press tools and dies for making product economically.

c. Explain the working of various dies such as extrusion die, injection-moulding die and blow-moulding die.

d. design the step to be followed for making specific die punch set used in a press tool &also steps of design for making jig or fixture for producing given product.

2. Theory Components:

The following topics / subtopics should be taught and assessed in order to develop unit outcomes for achieving the identified course outcomes.

Unit	Topics and Sub-topics	Teaching Hours
Unit: 1 Introduction, Cutting Tools and Tool Holders	**1.1** Concept, meaning and definition of tool, tool design, tool engineering and importance of process planning in tool engineering. **1.2** Tool-types, classification & applications. **1.3** Cutting tool: Types, classification, features and application. **1.4** Cutting tool materials, compositions, properties and application. **1.5** Carbide inserts: Types, ISO designation and applications. **1.6** Tool holders for turning and milling carbide inserts: Types, ISO designation and applications. **1.7** Tool holding and tool mounting systems for conventional milling and drilling machine tools. **1.8**	**08**
Unit: 2 Jigs and Fixtures	**2.1** Concept, meaning, difference and benefits of jig and fixtures. **2.2** Concept and meaning of locating and clamping. **2.3** Concept and importance of degree of freedom. **2.4** 3-2-1 principle of locating. **2.5** Locators: Types and applications. **2.6** Clamping devices: Types and applications. **2.7** Concept and importance of fool proofing and ejecting. **2.8** Steps to design jig and fixture.	**08**

Unit: 3 **Press Tools**	**3.1** Press working process: Types and application **3.2** Press tools: Types, working, components and their function. **3.3** Concept, meaning, definition and calculations of press tonnage and shut height of press tool. **3.4** Shear action in die cutting operation. **3.5** Centre of pressure: Concept, meaning, definition, method of finding and importance. **3.6** Die clearance: Concept, meaning, definition, effects and methods of application. **3.7** Cutting force: Methods to calculate and methods of reducing. **3.8** Shear angle: Concept, need and method to give shear angle on punch and die. **3.9** Cutting die: Types, application and steps to design a progressive cutting die.	**10**
Unit: 4 **Dies and Moulds**	**4.1** Types, working and application of bending dies, drawing dies and forging dies. **4.2** Working and application of following dies / moulds: Extrusion, plastic injection and blow moulding.	**04**
	Total Lecture Classes (Sub Total):	**30**
	No. of classes required for conducting Internal Assessment:	**04**
	Grand Total :	**34**

3. Suggested Home Assignments/Students' Activities: (any four)

i) Sketches of different types of cutting tools showing details of tool angles.

ii) One assignment on designation of carbide tools.

iii) Sketches of 3-2-1 principle of locating.

iv) Sketches of different types of fool-proofing and ejecting devices used in jigs and fixtures.

v) Sketches of plastic injection moulding die and blow moulding die.

vi) Sketches of progressive die, bending die and drawing die.

vii) Two assignments on calculation of cutting forces and shear angle based on Merchant's circle.

viii) Report on Visit to press shop for study of presses.

4. **Suggested scheme for question paper design for conducting internal assessment examination**: (Duration: 45 minutes)

Questions to be set as per Bloom's Taxonomy				
	Distribution of Theory Marks			
	Level 1 (Remember)	**Level 2 (understand)**	**Level 3 (Apply & above)**	**Total**
Class Test - 1	4	8	8	20
Class Test - 2	4	8	8	20

5. Suggested Scheme for End Semester Examination [duration 3 hours]

A: Multiple Choice Type Questions (Carrying 1 mark each)				
Group	**Unit**	**To be Set**	**To be Answered**	**Total Marks**
A1	1 & 2	8	10	10 x 01 = **10**
A2	3 & 4	7		
	Total:	**15**	**10**	**10**
B: Fill-in the Blank Type Questions (Carrying 1 mark each)				
Group	**Unit**	**To be Set**	**To be Answered**	**Total Marks**
B1	1 & 2	8	10	10 x 01 = **10**
B2	3 & 4	7		
	Total:	**15**	**10**	**10**
C: Very Short Answer Type Questions (Carrying 1 mark each)				
Group	**Unit**	**To be Set**	**To be Answered**	**Total Marks**
C1	1 & 2	8	10	10 x 01 = **10**
C2	3 & 4	7		
	Total:	**15**	**10**	**10**

			Sub-Total [A+B+C]:	**30**
D: Short Answer Type Questions (Carrying 2 marks each)				
Group	**Unit**	**To be Set**	**To be Answered**	**Total Marks**
D1	1 & 2	5	06	06 x 02 = **12**
D2	3 & 4	5		
	Total:	**10**	**06**	**12**
E: Subjective Type Questions (Carrying 6 marks each)				
Group	**Unit**	**To be Set**	**To be Answered**	**Total Marks**
E1	1 & 2	5	03	06 x 03 = **18**
E2	3 & 4	4		
	Total:	**09**	**03**	**18**
			Sub-Total [D+E]:	**30**
			Total [A+B+C+D+E]:	**60**

6. Rubrics for the Assessment of Students Activity: (20 marks)

Sl No.	Performance Indicators
1	Originality of completing the assigned task
2	Presentation Skill
3	In Time submission of Assignment report / micro-project task
4	Viva-voce

7. Suggested Learning Resources:

Sl. No.	Title of Book	Author	Publication
1	Jigs and Fixtures	P. H. Joshi	Tata McGraw Hill
2	Press Tools	P. H. Joshi	Tata McGraw Hill
3	Fundamental of tool design	A.S.T.M.E.	Prentice-Hall of India
4	Production Technology	H.M.T.	Tata McGraw Hill
5	Tool Design	Donaldson Anglin	Tata McGraw Hill
6	Introduction to jig and tool design	M.H.A.Kempster	Viva Publication

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Name of the Course: Diploma in Mechanical Engineering			
Category: Programme Core	**Semester : Fourth**		
Code no. : MEPC 204	**Theory : 100** Marks		
Course Title: Manufacturing Processes-II	**Examination Scheme:**		
Duration :17 weeks(Total class hour/week = 3)	**External Assessment**		
	End Semester Examination		**60 marks**
	Internal Assessment		
Total lecture class/week : 3	Class test	20	**40 marks**
	Assignment &viva voce	10	
Credit : 3	Class attendance	10	
	Total marks		**100**
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.			

1. **Course Outcomes (COs):**
The theory, practical experiences and relevant soft skills associated with this subject are to be taught and implemented, so that the student demonstrates the following industry oriented course outcomes:

a) Understand the basic of machine tools and identify different machining processes to be performed for the given job.
b) Plan, estimate and produce jobs by using drilling, shaping and milling machines.
c) Understand the basic of gear cutting methods and can be able to produce spur gear by using amilling machine.
d) Understand the basic concept of grinding, coding of grinding wheel and can be able to select specific grinding wheel for the given job.
e) Understand the importance of surface finish and related surface finishing methods.
f) Understand the fundamental concept of powder metallurgy and its application.

2. **Theory Components:**
The following topics / subtopics should be taught and assessed in order to develop unit outcomes for achieving the identified course outcomes.

Unit	Topics and Sub-topics	Teaching Hours
Unit: 1 Drilling	1.1 Basic concept on drilling and boring operations. 1.2 Classification of drilling machines. 1.3 Basic parts and their functions of pillar drilling machine & radial drilling machine. 1.4 Specifications of drilling machines. 1.5 Types of drills and reamers. 1.6 Twist drill nomenclature. 1.7 Drilling machine operations: Drilling, boring, reaming, counter boring, countersinking, chamfering, Spot facing, Trepanning and deep hole drilling. 1.8 Cutting parameters and machining time calculation in respect of drilling (simple numerical).	**08**
Unit: 2 Shaping and planning	2.1 Basic concept on shaping and planning operations. 2.2 Classification of shaping machines and planning machines. 2.3 Basic parts and their functions of standard shaper & standard double housing planner. 2.4 Specification of shaping machines and planning machines. 2.5 Shaping machine operations: Machining horizontal surface, machining vertical surface, machining angular surface, cutting slots, grooves and keyways, machining irregular surface, machining splines. 2.6 Cutting parameters and machining time calculation in respect of shaping	**08**

	horizontal surface (simple numerical).	
Unit: 3 Milling	3.1 Basic concept on milling (up milling, down milling). 3.2 Classification of milling machines. 3.3 Basic parts and their functions of plain milling machine and universal milling machine. 3.4 Specification of milling machines. 3.5 Types of milling cutters. 3.6 Nomenclature of plain milling cutter. 3.7 Milling machine operations: Plain milling, face milling, side milling, straddle milling, angular milling, gang milling, form milling, end milling, milling keyways, grooves and slots. 3.8 Cutting parameters and machining time calculation for plain milling operation (simple numerical).	**08**
Unit: 4 Gear cutting	4.1 Gear cutting on milling machine: Basic concept of indexing, working mechanism of universal dividing head, indexing methods (simple numerical on plain or simple indexing). 4.2 Gear cutting by generation method: Process, advantages and disadvantages of gear shaping and gear hobbing.	**04**
Unit: 5 Grinding	5.1 Basic concept of grinding. 5.2 Classification of grinding machines. 5.3 Basic parts and their functions of plain centre type grinding machine. 5.4 Types of grinding: Cylindrical, surface, centre less grinding and plunge-cut grinding. 5.5 Elements of grinding wheel: abrasive, bond, grit, grade, & structure. 5.6 Shapes and size of a grinding wheel. 5.7 Coding of grinding wheel. 5.8 Factors of selecting grinding wheels. 5.9 Balancing, truing & dressing of grinding wheel.	**08**
Unit: 6 Super Finishing Processes	6.1 Basic concept and objective of super finishing process. 6.2 Process and application of honing, lapping, burnishing, buffing and polishing.	**03**
Unit: 7 Powder Metallurgy	7.1 Basic concept of powder metallurgy. 7.2 Basic steps of powder metallurgy: Powder production, compaction, sintering, secondary and other finishing operations. 7.3 Advantages, disadvantages and application of powder metallurgy (porous bearings and sintered carbides).	**06**
	Total Lecture Classes (Sub Total):	**45**
	No. of classes required for conducting Internal Assessment:	**06**
	Grand Total :	**51**

Note:
For specification of different machine tools, concern faculty members may consult with the following IS Codes:

PROFORMA FOR PURCHASE SPECIFICATION FOR MACHINE TOOLS	
MILLING MACHINE WITH TABLE OF VARIABLE HEIGHT WITH VERTICAL SPINDLE	IS: 6893 (Part 5) – 1987
BENCH/PILLAR TYPE DRILLING MACHINES	IS: 6893 (Part 6) – 1985
SURFACE GRINDERS WITH HORIZONTAL AXIS	IS: 6893 (Part 9) – 1990
HORIZONTAL BORING AND MILLING MACHINES (TABLE TYPE)	IS: 6893 (Part 12) – 1992
RADIAL DRILLING MACHINES	IS: 6893 (Part 3) – 1988
HORIZONTAL / UNIVERSAL KNEE-TYPE MILLING MACHINES	IS: 6893 (Part 2) – 1987

3. Suggested Home Assignments/ Student Activities: (Any Four)

Other than classroom and laboratory learning, following are the suggested student related co-curricular activities which can be undertaken to accelerate the attainment of the various outcomes in the course:

a) Prepare a comparative study on gang drilling machine and multiple spindle-drilling machine in respect of their construction and application in drilling jobs.
b) Prepare a chart showing the nomenclature of a double fluted twist drill for display and demonstration purpose.
c) Prepare a working model of crank and slotted link mechanism generally being used in shaping machine for display and demonstration purpose.
d) Prepare a report on estimation of machining time required in a shaping machine for a requirement of flat surface generation in a given job as specified by the subject teacher.
e) Prepare a chart showing diagram of various milling cutters and their application in various milling operations for display and demonstration purpose.

f) Prepare a step wise chart showing the process of machining a T-slot in a suitable milling machine for display and demonstration purpose.
g) Prepare a step wise report with necessary calculations on machining a helical gear having specific module, helix angle and number of teeth (as specified by the subject teacher) with the help of a suitable milling machine and dividing head.
h) Prepare a suitable chart by which student may explain any coding of a grinding wheel.
i) Prepare a report on latest developments in unique application of powder metallurgy which may not be achievable by any other manufacturing processes.
j) Prepare a report on contribution of powder metallurgy in development of cutting tool used in machining.

Note:
A suggested list of home assignments / student activities is given here. Similar home assignments / student activities could be added by the concerned faculty member also. Four **(04)** home assignments / student activities are to be undertaken by an individual student that needs to be assigned to him / her by the concern faculty member during the course. The execution of such home assignments / student activities may be done by an individual student or by a group of students as per discretion of the concern faculty member. Students should prepare and submit report for each of their assignment / activity.

4. Suggested Scheme for Question Paper Design for Conducting Internal Assessment:(Duration: 45 Minutes)

Questions to be set as per Bloom's Taxonomy				
Internal Assessment	**Distribution of Theory Marks:**			
	Level 1 (Remember)	**Level 2** (Understand)	**Level 3** (Apply & above)	**Total**
Class Test: 1	4	8	8	20
Class Test: 2	4	8	8	20

5. Suggested Scheme for End Semester Examination :(Duration: 3 hours)

A: Multiple Choice Type Questions (Carrying 1 mark each)				
Group	**Unit**	**To be Set**	**To be Answered**	**Total Marks**
A1	1 & 2	06	10	10 x 01 = **10**
A2	3 & 4	04		
A3	5, 6 & 7	05		
	Total:	**15**	**10**	**10**
B: Fill-in the Blank Type Questions (Carrying 1 mark each)				
Group	**Unit**	**To be Set**	**To be Answered**	**Total Marks**
B1	1 & 2	06	10	10 x 01 = **10**
B2	3 & 4	04		
B3	5, 6 & 7	05		
	Total:	**15**	**10**	**10**
C: Very Short Answer Type Questions (Carrying 1 mark each)				
Group	**Unit**	**To be Set**	**To be Answered**	**Total Marks**
C1	1 & 2	06	10	10 x 01 = **10**
C2	3 & 4	04		
C3	5, 6 & 7	05		
	Total:	**15**	**10**	**10**
			Sub-Total [A+B+C]:	**30**
D: Short Answer Type Questions (Carrying 2 marks each)				
Group	**Unit**	**To be Set**	**To be Answered**	**Total Marks**
D1	1 & 2	04	06	06 x 02 = **12**
D2	3 & 4	02		
D3	5, 6 & 7	04		
	Total:	**10**	**06**	**12**
E: Subjective Type Questions (Carrying 6 marks each)				
Group	**Unit**	**To be Set**	**To be Answered**	**Total Marks**
E1	1 & 2	03	03	06 x 03 = **18**
E2	3 & 4	02		
E3	5, 6 & 7	04		
	Total:	**09**	**03**	**18**
			Sub-Total [D+E]:	**30**
			Total [A+B+C+D+E]:	**60**

6. Rubrics for the Assessment of Student's Activity:

Sl. No.	Performance Indicators
1	Originality of completing the Assigned task / micro-project work
2	Presentation Skill
3	In time submission of assignment work / micro-project work
4	Viva voce

7. Suggested Learning Resources:

Sl. No.	Title of Book	Author	Publication
01	Elements of workshop Technology – Volume I & II.	S. K. Hajra Chowdhury, Bose, Roy	Media Promoters and Publishers limited, Mumbai.
02	A Course in Workshop Technology - Volume I & II.	B.S.Raghuwanshi	Dhanpat Rai Publications, New Delhi.
03	Manufacturing Processes.	Kalpakjian & Schemid	Pearson Education, New Delhi.
04	Manufacturing Technology – Volume I & II.	P. N. Rao	Tata McGraw-Hill, New Delhi.
05	Manufacturing Science.	Amitabh Ghosh, Mallik	East-West Press Pvt. Ltd., New Delhi.
06	Materials and Processes in Manufacturing.	DeGarmo	Wiley India Pvt. Ltd., New Delhi.
07	Machining & Machine Tool.	A.B. Chattopadhyay	Wiley India Pvt. Ltd., New Delhi.
08	Workshop Technology - Volume I, II & III.	W.A.J. Chapman	Viva Books (p) Ltd.
09	Powder Metallurgy- Science, Technology and Application.	P. C. Angelo and R. Subramanian	Prentice-Hall of India Pvt. Ltd. New Delhi.
10	Powder Metallurgy.	Anil Kumar Sinha	Dhanpat Rai Publication Pvt. Ltd. New Delhi.

8. Suggested Learning Websites:

a) ELS web-portal of WBSCTE
b) https://nptel.ac.in
c) https://www.nitttrchd.ac.in
d) https://swayam.gov.in
e) https://play.google.com/store/apps/details?id=com.mhrd.ndl
f) https://www.youtube.com/watch?v=j6rGuSFGCbE&list=PLkyVnO47pDX80flvlTAs2rEVckV853Z1R&index=2 : Surface Grinding
g) https://www.youtube.com/watch?v=WOqOv8O54R8&list=PLkyVnO47pDX80flvlTAs2rEVckV853Z1R&index=3 : Shaper
h) https://www.youtube.com/watch?v=aeOaAZRwpfY : Milling M/C
i) https://www.youtube.com/watch?v=SvlWaeq94dA&list=RDCMUCQUIiUbuOa09-FTwoZrgO_w&index=3 : Milling Cutter
j) https://www.youtube.com/watch?v=a-GkDjXGJI0 : Indexing
k) https://www.youtube.com/watch?v=rRW-mNLIPxA&list=RDCMUCQUIiUbuOa09-FTwoZrgO_w&index=14 : Types of Gear
l) https://www.youtube.com/watch?v=Uc6b1g8SHV0 : Spur Gear cutting using Milling M/C
m) https://www.youtube.com/watch?v=XLEzaT4hNYk : Gear Hobbing
n) https://www.youtube.com/watch?v=OjyH6qIMgLI : Gear Shaping
o) https://www.youtube.com/watch?v=_Yy3jZu4PXE : Gear finishing
p) https://www.youtube.com/watch?v=BCy6OYj917o : Surface finishing

WEST BENGAL STATE COUNCIL OF TECHNICAL & VOCATIONAL EDUCATION AND SKILL DEVELOPMENT
[A Statutory Body under West Bengal Act XXVI of 2013]
(Formerly West Bengal State Council of Technical Education)
"Karigori Bhavan", 4th Floor, Plot No. B/7, Action Area-III, New Town, Rajarhat, Kolkata-700160

Name of the Course: Diploma in Mechanical Engineering			
Category: Programme Core	**Semester : Fourth**		
Code no. : MEPC 206	**Theory : 100** Marks		
Course Title : Thermal Engineering - II	**Examination Scheme:**		
Duration :17 weeks (total hours per week = 3)	**External Assessment**		
	End Semester Examination		**60 marks**
	Internal Assessment		
Total lecture class/week : 3	Class test	20	**40 marks**
	Assignment &viva voce	10	
Credit : 3	Class attendance	10	
	Total marks		**100**
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.			

1. Course outcomes (COs):

After completion of this Course, the student will be able to

a) Understand Fundamental Differences Between Carnot Gas Power Cycle and Carnot Vapour Power Cycle.
b) Understand different steam cycles applicable to steam power plant.
c) Know the purpose of steam condenser used in steam power plant.
d) Understand the working principles of different types of air compressors used in industry.
e) Know the advantages of multistage air compressor.
f) Understand the working principle of different types of refrigeration systems.
g) Know the working principle and use of different types of heat exchangers in industry.
h) Understand the working principle and use of different types of nozzles and diffusers in steam turbines used in steam power plant.

2. Theory Components:

The following topics/subtopics should be taught and assessed in order to develop unit outcomes for achieving the course outcomes to attain the identified competency.

UNIT	Topics & Sub-topics	Teaching Hour
Unit 1: Steam Power Cycles	1.1. Reversible Process/Reversible Cycle. 1.2. Carnot Gas Power Cycle and Carnot Vapour Power Cycle with representation of the same on P-V & T-S diagrams. 1.3. Deduction of Thermal Efficiency of Carnot Power Cycle (Simple numerical on Carnot Power Cycle).Impracticability of Carnot Cycle in practical application. 1.4. Rankine Cycle with & without feed pump and representation of the same on P-V, T-S & H-S diagrams. (Simple numerical on Rankine Cycle) 1.5. Comparison between Carnot Cycle and Rankine Cycle. 1.6. Definition of Thermal Efficiency, Work Ratio, Heat rate and Specific Steam Consumption. 1.7. Basic Principle, representation on P-V, T-S & H-S diagrams, labeled schematic flow diagram and utility of the following cycles: (No numerical) • Simple Reheat Cycle. • Simple Regenerative Cycle. • Actual Reheat-Regenerative Cycle.	10

Unit 2: **Steam Condenser**	2.1. Working Principle and Purpose of using Steam Condenser in Power Plant 2.2. Classification of Steam Condensers. 2.3. Comparison between Surface Condenser and Jet Condenser. 2.4. Dalton's Law of Partial Pressure as applicable to Steam Condenser. 2.5. Definition of Condenser Vacuum, Vacuum Efficiency and Condenser Efficiency. (No numerical) 2.6. Sources of Air Leakage in Steam Condenser. Effect of Air Leakage. 2.7. Working Principle and Purpose of using Cooling Tower 2.8. Classification (Natural Draught and Mechanical Draught) of Cooling Towers. 2.9. Labeled schematic flow diagram of Cooling Water Circulation of a Surface Condenser with and without Cooling Tower.	08
Unit 3: **Air Compressor**	3.1 Uses of Compressed Air 3.2 Working Principle and Classification of Air Compressors. 3.3 Definition of Compression Ratio, Compressor Capacity, Free Air Delivery and Swept volume. **Reciprocating air compressor:** 3.4 Construction and Working Principle of Single Stage and Two Stage Air Compressor. 3.5 Volumetric Efficiency, Isothermal Efficiency & Mechanical Efficiency. (Simple numerical on single stage compressor) 3.6 Advantages of Multi Staging over single stage. **Rotary Air Compressor:** 3.7 Working Principle of Screw, Lobe, Vane, Centrifugal and Axial Flow Compressors. (No numerical) 3.8 Comparison of Reciprocating Compressor and Rotary Compressor. 3.9 Application Areas of Reciprocating Compressor and Rotary Compressor. 3.10Purification Methods of compressed Air to remove Oil, Moisture and Dust.	09
Unit 4: **Refrigeration & Air Conditioning**	4.1. Definition of Refrigeration, Ton of Refrigeration (Unit of Refrigeration) and Coefficient of Performance (COP) of Refrigerator & Heat Pump. 4.2. Refrigerant and its desirable properties. **Air Refrigeration:** 4.3. Basic Principle, representation on P-V & T-S diagrams, labeled schematic flow diagram of Bell Coleman Cycle (Reversed Joule Cycle) (Simple numerical). **Vapour Compression Refrigeration:** 4.4. Basic Principle, representation on P-H & T-S diagrams, labeled schematic flow diagram and function of components of Ideal Vapour Compression Refrigeration Cycle. (No numerical) 4.5. Basic concept of Psychrometry including the following: Dry air & Moist air, Saturated air & Unsaturated air. Dry-bulb temperature, Wet-bulb temperature, Dew-point temperature and Psychrometer, Relative Humidity, Specific Humidity and Degree of saturation. Partial Pressure of Air & Vapour and Enthalpy of Moist Air. Psychrometric Chart. Different Psychrometric Processes (No numerical) 4.6 Basic concept of Air-Conditioning (with reference to human comfort) 4.7 Classification of Air-Conditioning system	09
Unit 5: **Basics of Heat Transfer**	5.1. Introduction to Heat Transfer 5.2. Explanation of Three Basic Modes of Heat Transfer (Conduction, Convection and Radiation). 5.3. Fourier's Law of heat conduction, Thermal Conductivity and concept of Thermal Resistance. 5.4. Heat Transfer through Plane Homogeneous Wall, Heat Transfer through Composite Wall, (Simple numerical). 5.5. Stefan-Boltzmann Law of heat radiation with explanation of terms with unit. (No numerical) 5.6. Definition and inter relation of Absorptivity, Reflectivity and Transmissivity 5.7. Concept of Black and Grey Bodies. 5.8. Classification and working principle of Heat exchanger (a) based on flow arrangement (parallel flow, counter flow & cross flow) (b) based on constructional features (Shell & Tube and Plate Type Heat Exchangers).	09

	5.9. Basic concept of logarithmic mean temperature difference (LMTD)	
	Sub Total : Total Lecture Classes	45
	No. of classes required for conducting Internal Assessment examination	6
	Grand Total :	51

3. Suggested Home Assignments/Students' Activities: (any Four)

a) Draw P-V & T-S diagram for both Rankine Cycle and Modified Rankine Cycle. Derive their efficiencies and explain the difference.
b) Explain the purpose of Condenser and Cooling Tower in a Power Plant. Also draw a labelled schematic flow diagram of Cooling Water Circulation of a Surface Condenser with Cooling Tower.
c) Draw schematic diagram of a multi-stage/compound compressor and discuss its practical advantages over single stage compressor. Also draw a single P-V diagram to show working process for the both types of compressors.
d) Determine Volumetric Efficiency, Isothermal Efficiency & Mechanical Efficiency of a single stage reciprocating air compressor.
e) Discuss the purpose of each component of a vapour compression refrigeration system. Justify the desirable properties of a refrigerant (at least five properties).
f) Determination of temperature at the end of a composite wall.
g) Choose different materials which have more absorptivity, more reflectivity and more transmissivity. Describe their area of applications and respective advantages.
h) Describe, with figure, different types of Nozzles and Diffusers. Identify the areas of application for different types of nozzles and diffusers.

4. Suggested scheme for question paper design for conducting internal assessment examination :(Duration: 45 minutes)

Questions to be set as per Bloom's Taxonomy				
	Distribution of Theory Marks			
	Level 1 (Remember)	**Level 2 (understand)**	**Level 3 (Apply & above)**	**Total**
Class Test - 1	4	8	8	20
Class Test - 2	4	8	8	20

5. Suggested Scheme for End Semester Examination:[duration 3 hours]

A: Multiple Choice Type Questions (Carrying 1 mark each)				
Group	**Unit**	**To be Set**	**To be Answered**	**Total Marks**
A1	1 & 2	**07**	10	10 x 01 = **10**
A2	3, 4 & **5**	**08**		
	Total:	**15**	**10**	**10**
B: Fill-in the Blank Type Questions (Carrying 1 mark each)				
Group	**Unit**	**To be Set**	**To be Answered**	**Total Marks**
B1	1 & 2	**07**	10	10 x 01 = **10**
B2	3, 4 & **5**	**08**		
	Total:	**15**	**10**	**10**
C: Very Short Answer Type Questions (Carrying 1 mark each)				
Group	**Unit**	**To be Set**	**To be Answered**	**Total Marks**
C1	1 & 2	**07**	10	10 x 01 = **10**
C2	3, 4 & **5**	**08**		
	Total:	**15**	**10**	**10**
			Sub-Total [A+B+C]:	**30**
D: Short Answer Type Questions (Carrying 2 marks each)				
Group	**Unit**	**To be Set**	**To be Answered**	**Total Marks**
D1	1 & 2	04	06	06 x 02 = **12**
D2	3, 4 & **5**	**06**		
	Total:	**10**	**06**	**12**
E: Subjective Type Questions(Carrying 6 marks each)				
Group	**Unit**	**To be Set**	**To be Answered**	**Total Marks**
E1	1 & 2	04	03	06 x 03 = **18**
E2	3, 4 & **5**	**05**		

Total:	**09**	**03**	**18**
		Sub-Total [D+E]:	**30**
		Total [A+B+C+D+E]:	**60**

6. Rubrics for the Assessment of Students Activity: (20 marks)

Sl. No.	Performance Indicators	Weightage in %	
1	In time submission of home assignment or submission of report after conducting site visit/ industry visit/ micro-project / market survey / internet search on specific topic, preparation of chart, creation of innovative model etc.		40
2	Viva voce or present seminar on submitted report :		60
2a	Communication skill	10	
2b	Technical interpretation skill	10	
2c	Answering / Conclusion with justification	40	
		Total:	100

7. Suggested Learning Resources:

Sl. No.	Title of Book	Author	Publication
1	A Course in Thermal Engineering.	V.M. Domkundwar	Dhanpat Rai & Co.
2	Engineering Thermodynamics (Principles & Practices)	D.S.Kumar	S.K. Kataria& Sons
3	A text book of Thermal Engineering.	R. S. Khurmi	S. Chand & Co.
4	A Course in Thermal Engineering.	P. L. Ballaney	Khanna Publishers
5	Power Plant Engineering	R. K. Rajput	Laxmi Publications (P) Ltd.

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Name of the Course: Diploma in Mechanical Engineering			
Category: Programme Core	**Semester : Fourth**		
Code no. : MEPC208	**Theory : 100** Marks		
Course Title : Engineering Metrology	**Examination Scheme:**		
Duration :17 weeks (total hours per week =3)	**External Assessment**		
	End Semester Examination		**60 marks**
	Internal Assessment		
Total lecture class/week : 3	Class test	20	**40 marks**
	Assignment &viva voce	10	
Credit : 3	Class attendance	10	
	Total marks		**100**
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.			

1. Course outcomes (COs):

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

a. Classify the different types of measurements used in inspection & compare them.
b. Explain the objectives of metrology and measurements.
c. Understand the importance of manufacturing components to specified sizes.
d. Utilize the principle of limit gauging and its importance in inspection in industries.
e. Select appropriate instrument(s) for specific purpose/measurement.
f. Measure physical quantity.
g.Measure and adjust errors of measurement.

2. Theory Components:

The following topics/subtopics should be taught and assessed in order to develop unit outcomes for achieving the course outcomes:

Unit	Topics and Sub-topics	Approx. Teaching Hours
Unit-1: Limits, Fits and Tolerances	1.1 Introduction, Principle of interchangeability. 1.2. Tolerances, Classification of Tolerance, Fits, Classification of Fits, General Terminology used in the system of Limits and Fits (IS: 919-1993), 1.3 Allowance, Clearance, Interference, Hole Basis and Shaft Basis systems. 1.4 Selection of Fits, Numerical problems on Limits of Size and Tolerances. 1.5 Taylor's Principle, 1.6 Plain Plug Gauge (IS:3484-1966), Plain Ring Gauge (IS:3485-1966), Snap Gauge (IS:3477-1973): Construction and applications	**05**
Unit-2: Linear Metrology	2.1. Introduction, Line standard and End standard. 2.2 Construction, Working Principle , Method of reading, Least Count, Use and Ranges available of Vernier Caliper, Vernier Depth Gauge & Vernier Height Gauge. 2.3 Construction, Working Principle, Method of reading, Least Count, Use and Ranges available of Outside Micrometer (Plain / Vernier), Inside Micrometer (Plain / Vernier). 2.4 Method of Reading and Use of Feeler Gauge. 2.5 Slip Gauges: category, use & selection of Slip Gauges for setting a particular dimension.	**08**

Unit-3: Angular Metrology	3.1Introduction, Instruments for Angular Measurements. 3.2. Construction, Working Principle, Least Count, Use and Ranges available of Universal Bevel Protractor, Sine Bar. 3.3 Working Principle and Use of Spirit Level, Clinometer. 3.4 Working Principle of Angle Gauges (with numerical on setting of Angle Gauges).	**06**
Unit-4: Comparators	4.1 Definition, Classification and Use of Comparators. 4.2 Construction and Working Principle of Mechanical Comparator (Dial Indicator,). 4.3Working Principle of Pneumatic Comparator, Electrical Comparator, Optical Comparator. 4.4 Characteristics of a good comparator,	**06**
Unit-5: Metrology of Screw Threads	5.1 Terminology of Screw Thread - Major Diameter, Minor Diameter, Effective Diameter, Pitch & Thread Angle 5.2 Working Principle and Use of Floating Carriage Micrometer, Screw Thread Micrometer, Two-Wire method. 5.3 Construction and Use of Thread Gauges (such as Plug Gauge, Ring Gauge and Snap Gauge).	**06**
Unit-6: Metrology of Gears	6.1. Gear Terminology. 6.2 Errors in Spur Gears. 6.3 Measurement of Tooth Thickness by Gear Tooth Vernier Caliper. 6.4 Measurement of Pitch. 6.5 Measurement of Backlash.	**07**
Unit-7: Metrology of Surface Finish	7.1 Types of Surface Texture, Surface Characteristics (Terminology as per IS:3073 – 1967). 7.2 Direction of Lay, Sources of Lay and its significance. 7.3 Evaluation of Average Value of Surface Roughness by – Centre Line Average method (CLA), Root Mean Square method (RMS), Ten Point Height method. 7.4 Various Techniques for Qualitative analysis for Surface Roughness. 7.5 Working Principle of Stylus Probe type instrument.	**07**
Sub Total : Total Lecture Classes		**45**
No. of classes required for conducting Internal Assessment examination		**6**
Grand Total :		**51**

3. Suggested Home Assignments/Students' Activities: (any four)

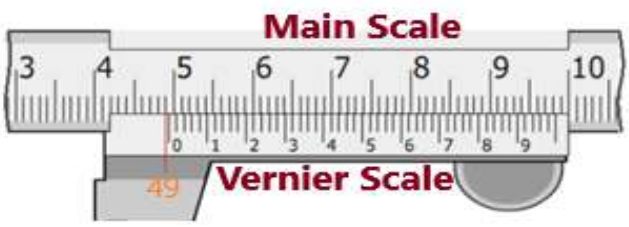
i) Compile a exhaustive chart of measuring instruments and gauges that are commonly used in production for inspection purpose. Chart must contain name of instrument/gauge, specification (range, least count etc), maker and use.

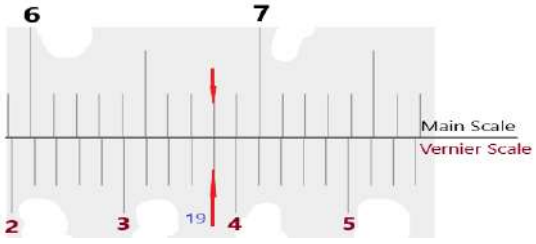
ii) Calculate the limits, tolerances, and allowances on a 25 mm shaft and hole pair designated as H7/g6 to get a precision fit. The fundamental tolerance is to be calculated by the following equation: $= 0.45\sqrt[3]{D} + 0.001D$. The following data are given – a) Upper deviation of shaft = $-2.5D^{0.34}$, b) $IT7 = 16i$, c) $IT6 = 10i$, d) 25 mm falls in the diameter step of (18 – 30) mm.

iii)During inspection of shaft diameter, the reading taken by an outside micrometer was 25.03 mm. But the said instrument contained a positive error of 0.04 mm. If the error is rectified, what will be exact value of measurement? Show that measurement with the help of a neat sketch.

iv)An angle of $35^0\,12'\,12''$ is to be measured with the help of the following standard angle gauges: (1^0, 3^0, 9^0,27^0, 41^0); ($1'$, $3'$, $9'$, $27'$); ($3''$, $6''$, $18''$, $30''$). What will be the minimum number of angle gauges required to obtain the above angle? Illustrate the arrangement of angle gauges with the help of a neat sketch.

v)





Observe the above figures of a vernier caliper carefully and fill the blank spaces with key words and specific numerical values.

It is seen that .....division of..... scale has coincided with the ..... scale and '0' graduation of .....scale just crosses .....graduation of ..... scale.

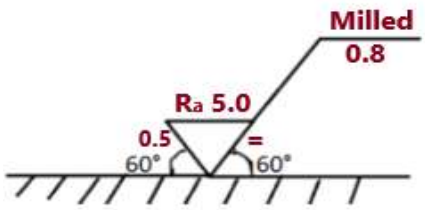
So, main scale reading = ... divisions = (..... x .....) = ...mm

Vernier scale reading = (..... x L.C.) = (..... x .....) = ... mm

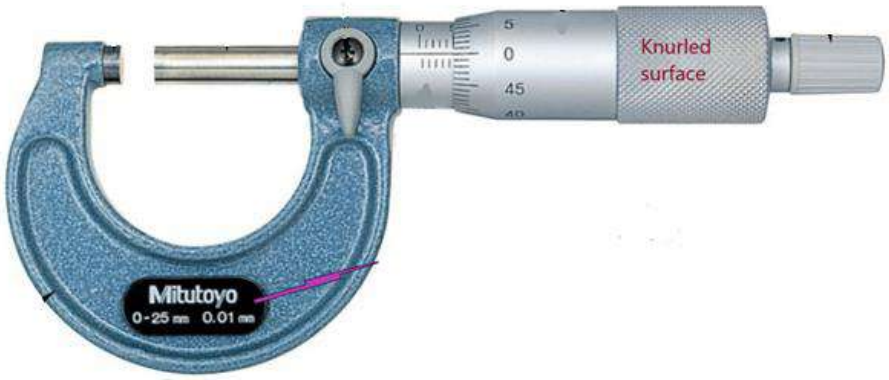
Therefore, total reading = [..... + ...] = ... mm

vi) Illustrate the various surface characteristics with the help of a neat sketch.

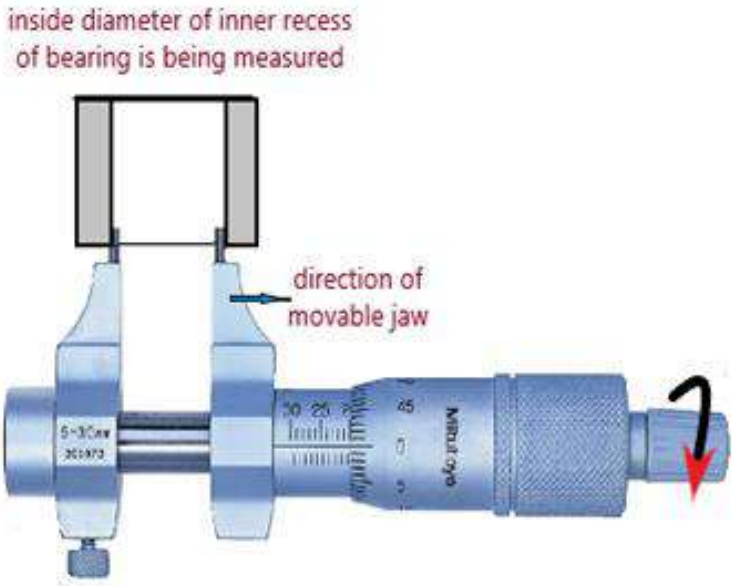
vii) What does the following figure indicate regarding statements and symbols used for surface texture?



viii) Figure illustrating an outside micrometer, in which a linear dimension is set. Observe carefully and write that dimension. Also write the functions of ratchet stop and locking screw.



ix) Figure illustrating an inside micrometer which measures inside diameter of inner recess of bearing. Observe carefully and write that dimension.



x)There is a sample object for linear measurement whose external dimension is being shown in the drawing as 18.25 mm. There are three instruments available for this purpose – outside micrometer (L.C.- 0.01 mm), vernier calliper (L.C.- 0.02 mm) and vernier micrometer (L.C. = 0.001 mm). Which instrument will serve the purpose? Justify your answer.

xi)Slip gauges have to be built up to a height of 27.125 mm using the 103-gauge set. Give the selection of slip gauges if wear blocks of 1.5 mm thickness are to be used at the bottom and top of the stack.

Range available for 103 pieces Slip gauge set: 1.005 mm (available blocks – 01 piece); 1.01mm to 1.49 mm in steps of 0.01 mm (available blocks – 49 pieces); 0.5mm to 24.5 mm in steps of 0.5 mm (available blocks – 49 pieces); and 25 mm to 100 mm in steps of 25 mm (available blocks – 04 pieces);

4. **Suggested scheme for question paper design for conducting internal assessment examination**: (Duration: 45 minutes)

Questions to be set as per Bloom's Taxonomy				
	Distribution of Theory Marks			
	Level 1 (Remember)	**Level 2 (understand)**	**Level 3 (Apply & above)**	**Total**
Class Test - 1	4	8	8	20
Class Test - 2	4	8	8	20

5. Suggested Scheme for End Semester Examination [duration 3 hours]:

A: Multiple Choice Type Questions (Carrying 1 mark each)				
Group	**Unit**	**To be Set**	**To be Answered**	**Total Marks**
A1	1,2& 3	5	10	10 x 01 = **10**
A2	4&5	5		
A3	6&7	5		
	Total:	**15**	**10**	**10**
B: Fill-in the Blank Type Questions (Carrying 1 mark each)				
Group	**Unit**	**To be Set**	**To be Answered**	**Total Marks**
B1	1,2 & 3	5	10	10 x 01 = **10**
B2	4 & 5	5		
B3	6 & 7	5		
	Total:	**15**	**10**	**10**
C: Very Short Answer Type Questions (Carrying 1 mark each)				
Group	**Unit**	**To be Set**	**To be Answered**	**Total Marks**
C1	1,2 & 3	5	10	10 x 01 = **10**
C2	4 & 5	5		
C3	6 & 7	5		
	Total:	**15**	**10**	**10**
			Sub-Total [A+B+C]:	**30**
D: Short Answer Type Questions (Carrying 2 marks each)				
Group	**Unit**	**To be Set**	**To be Answered**	**Total Marks**
D1	1,2 & 3	3	06	06 x 02 = **12**
D2	4 & 5	3		
D3	6 & 7	4		
	Total:	**10**	**06**	**12**
E: Subjective Type Questions (Carrying 6 marks each)				
Group	**Unit**	**To be Set**	**To be Answered**	**Total Marks**
E1	1,2 & 3	3	03	06 x 03 = **18**
E2	4 & 5	3		
E3	6 & 7	3		
	Total:	**09**	**03**	**18**
			Sub-Total [D+E]:	**30**
			Total [A+B+C+D+E]:	**60**

6. Rubrics for the Assessment of Students Activity: (20 marks)

Sl No.	**Performance Indicators**
1	Originality of completing the assigned task
2	Presentation Skill
3	In Time submission of Assignment report / micro-project task

4	Viva-voce

7. Suggested Learning Resources:

Sl. No.	Title of Book	Author	Publication
1	Metrology & Measurement	Anand K Bewoor Vinay A Kulkarni	McGraw Hill Education(I) Pvt. Ltd.
2	Engineering Metrology and Measurements	N.V.Raghavendra L.Krishnamurthy	Oxford University Press
3	A text book of Metrology	M. Mahajan	Dhanpat Rai & Sons
4	A text book of Engineering Metrology	I. C. Gupta	Dhanpat Rai & Sons
5	Mechanical Measurement & Instrumentation	R. K. Rajput	S. K. Kataria & Sons

a) https://www.youtube.com/watch?v=WYeNQfGrejM **:** Vernier Caliper

b) https://www.youtube.com/watch?v=vMgKQegeV24 : Dial Gauge and Vernier Micrometer

c) https://www.youtube.com/watch?v=LuqcRuZ2AoU&t=4s **:** Vernier Height Gauge

d) **https://www.youtube.com/watch?v=OKmaqUN3UBg&t=2s** : Thread Gauge, Spirit Level

e) https://www.youtube.com/watch?v=stasLtabxlk&t=8s**:** Combination Set, Slip Gauges ,Sine Bar

f) https://www.youtube.com/watch?v=fpArMwSxYdo&t=2s **:** Gear Vernier

g) https://www.youtube.com/watch?v=f_A5PwEQ9kQ&t=2s **:** Co-ordinate Measuring Machine (CMM)

h) https://www.youtube.com/watch?v=DC5u_SvO8r4: Floating Carriage Micrometer (2 – Wire Method)

i) https://www.youtube.com/watch?v=YG1E75puQdQ **:** Surface Roughness Tester 1

j) https://www.youtube.com/watch?v=GrhtjZjDmUs **:** Surface Roughness Tester 2

k) https://www.youtube.com/watch?v=AaK1xtUPIpE**:** Surface Roughness Tester 3

l) https://www.youtube.com/watch?v=ooRo9NDV6kg **:** Surface Roughness Tester 4 (Hindi)

m) https://www.youtube.com/watch?v=hdhCXr6j_-Y **:** Surface Roughness – Texture

n) https://www.youtube.com/watch?v=WnKXj61YKKA **:** Surface Roughness - Parameter

Metrology Book: in Bengali:

https://drive.google.com/file/d/1i2F9sNQaHJBUzFr3UZ1pJQ2BjdKiKc7j/view

Metrology Book in English:

https://drive.google.com/file/d/1N1iKy8CSP6nGLTSGNzc8ClMJAbJmkqwV/view

WEST BENGAL STATE COUNCIL OF TECHNICAL & VOCATIONAL EDUCATION AND SKILL DEVELOPMENT
[A Statutory Body under West Bengal Act XXVI of 2013]
(Formerly West Bengal State Council of Technical Education)
"Karigori Bhavan", 4th Floor, Plot No. B/7, Action Area-III, New Town, Rajarhat, Kolkata-700160

Name of the Course: Diploma in Mechanical Engineering			
Category: Programme Core	**Semester : Fourth**		
Code no. : MEPC210	**Practical : 100** Marks		
Course Title : Computer Aided Machine Drawing Practice	**Sessional Examination Scheme:**		
Duration : 17 weeks (3 hours per week)	**External Assessment** (End Semester Sessional Examination)		
	Assignment on the day of viva voce	20	**40 marks**
	Viva voce (before Board of Examiners)	20	
	Internal Assessment		
Total practical class/week: 3	Submission of drawing sheets (in scheduled time)	40	**60 marks**
	Class performance & attendance	10	
Credit: 1.5	Viva voce (after submission of drawing sheets)	10	
	Total marks		**100**
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.			

1. Course Outcomes (COs):

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

CO1: Understand the use computer aided drafting commands

CO2: Draw the two dimensional views of different machine elements related to mechanical engineering including keys, couplings, pulley, gaskets, non return valve etc.

CO3: Draw 3D modeling of different elements.

2. Theory Components:

Unit	Unit Outcomes	Topics	Teaching Hours
01	1a) Start a new drawing. 1b) Open an existing drawing.	**Introduction to CAD software**: Starting a drawing: Open drawings Create drawings Co-ordinate systems: Absolute co-ordinate system, Relative co-ordinate system - Direct distance method Saving a drawing.	**02**
02	2a) Select a part/ full of a drawn object by various selection methods for erasing. 2b) Move a drawn object from one place to other convenient place.	**Opening an existing file:** Concept of Object – Object selection methods: Pick by box, Window selection, Crossing selection, All, Fence, Last, Previous, Add, Remove – Erasing objects OOPS command, UNDO / REDO commands, ZOOM command, PAN command, Panning in real time, Setting units, Object snap.	**02**
03	3a) Draw the various figures by applying different 'DRAW' commands. 3b) Apply the knowledge of 'EDITING' commands. 3c) Draw the various figures by applying the knowledge of various drawing aids such as	**DRAW Commands:** Drawing of LINE, CIRCLE, ARC, RECTANGLE, ELLIPSE, POLYGON, POLYLINE, DONUT, and MULTILINE. **EDITING Commands:** MOVE ,COPY , OFFSET , ROTATE , SCALE , STRETCH , LENGTHEN,TRIM , EXTEND , BREAK , CHAMFER , FILLET	**05**

	'Layers", "Object Properties". 3d) Write single line/multiline text with special characters. 3e) Edit existing text and its style. 3f) Create hatching on sectional drawings.	, ARRAY , MIRROR,MEASURE , DIVIDE , EXPLODE , MATCHPROP, Editing with grips: PEDIT. **DRAWING AIDS:** Layers – Layer Properties Manager dialog box – Object Properties LTSCALE Factor, Auto Tracking, REDRAW, REGEN. **Creating BLOCKS:** **Creating TEXT:** Creating single line text – Drawing special characters – Creating multiline text – Editing text – Text style. **HATCHING:** Basics of HATCHING – Boundary Hatch Options: Quick tab, Advance tab – Hatching around Text, Traces, Attributes, Shapes and Solids –Editing Hatch Boundary.	
04	4a) Apply the knowledge of putting dimensions after drawing and writing text with various styles. 4b) Apply the knowledge of editing the existing dimensions and text.	**Basic DIMENSIONING:** Fundamental dimensioning terms: Dimension lines, dimension text, arrowheads, extension lines, leaders, centre marks and centerlines, alternate units – Associative dimensions – Dimensioning methods –Drawing leader, Editing dimensions by stretching – Editing dimensions by trimming & extending – Editing dimensions, Editing dimension text: Updating dimensions, Creating and restoring dimension styles.	**02**
05	5a) Print a drawn object.	**Printing of Drawings**	**01**
06	6a) Generate solid model by using by extruding/revolving/addition/subtraction/inter section of surface. 6b) Rotate the drawn solid model.	**Generation of 3D Surface & Solid Model**: Primitive surface & solid (plane, block, sphere, cone, torus, spring, spiral). Generation of 3 D Model Practice by Extrude, Revolve surface. Operations: Add, Subtract, Intersection. Transformation features: Rotation, Mirror. Extraction of 2D from 3D model: Front View, Side view, Top view, Isometric view, Sectional view, Dimensioning.	**03**
Sub Total: **Theoretical classes**			**15 Hours**

3. Suggested assignments for continuous assessment:

From the following suggested assignments at least eight sheets are to be attempted on A-4size paper (to scale drawing by using requisite drawing commands as specified in the theory components and following First angle method of projection) for the attainment of COs of MEPC210:

Sheet No.	Practical Outcomes (PrOs)	Unit No.	Approx Hours required	Marks per sheet
Sheet No. -1 At least four problems are to be drawn. (Refer Annexure- 1)	1a. Draw the various figures by applying 'Line' command. 1b. Apply various features of 'Basic Dimensioning' on the drawn figures.	3 & 4	**02**	**5**
Sheet No. -2 At least four problems are to be drawn. (Refer Annexure- 2)	2a. Draw the various figures by applying 'Circle' command. 2b. Apply various features of 'Basic Dimensioning' on the drawn figures.	2, 3 & 4	**04**	**5**
Sheet No. -3 At least three	3a. Draw the various figures by applying 'Arc' command. 3b. Apply various features of 'Basic Dimensioning' on the	2, 3 & 4	**04**	**5**

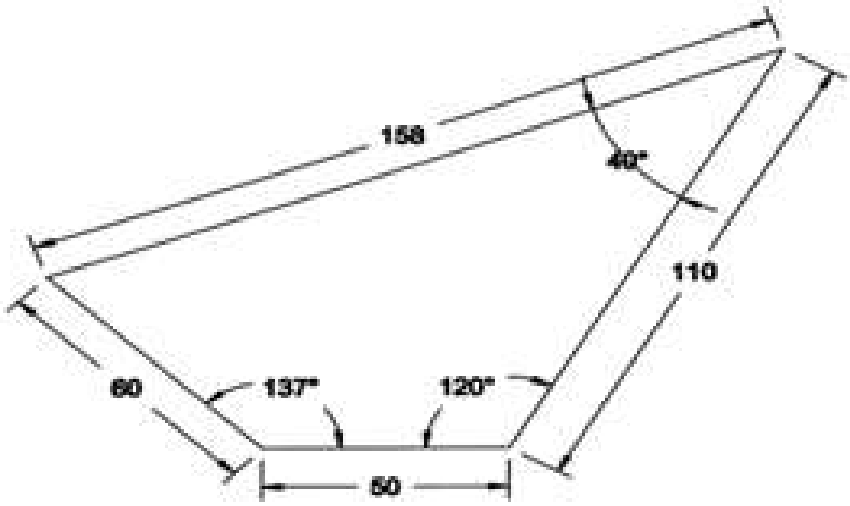
problems are to be drawn. (Refer Annexure- 3)	drawn figures.			
Sheet No. -4 At least one problem of full / half sectional assembled views is to be drawn. (Refer Annexure- 4)	4a. Draw full/half sectional front view and top view / side view of an assembled machine drawing. 4b. Apply various features of 'Basic Dimensioning' on the drawn figures.	2, 3 & 4	**04**	**5**
Sheet No. -5 Sectional (full / half) assembled views of flange coupling is to be drawn. (Refer Annexure- 5)	5a. Draw full/half sectional front view and top view / side view of an assembled machine drawing. 5b. Apply various features of 'Basic Dimensioning' on the drawn figures.	2, 3 & 4	**04**	**5**
Sheet No. -6 Part drawings from given assembled sectional views to be prepared. (Refer Annexure- 6)	6a. Draw detail drawing from an assembled full/half sectional machine drawing. 6b. Apply various features of 'Editing' command and 'Basic Dimensioning' on the drawn figures. .	2, 3 & 4	**06**	**5**
Sheet No. -7 At least two 3D modelling are to be drawn. (Refer Annexure- 7)	7a. Draw 3D surface by using commands such as extrude/revolve/add/subtraction/intersection of surface.	4 & 6	**02**	**5**
Sheet No. -8 At least two 3D modelling are to be drawn. (Refer Annexure- 8)	8a. Draw 3D surface by using commands such as extrude/revolve/add/subtraction/intersection of surface.	4 & 6	**04**	**5**
Sub Total: **Practical classes**			**30 Hours**	**40**
Preparation for ESE			**06 Hours**	
Grand total :			**36 Hours**	

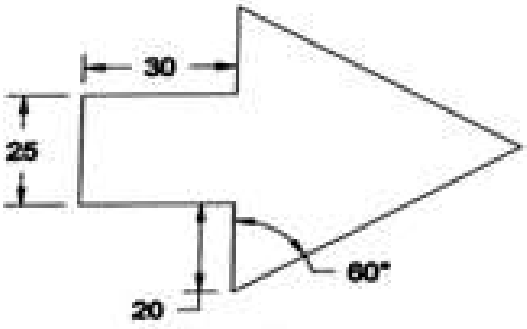
4**. Rubrics for the internal assessment of drawing sheets** [40 marks]:

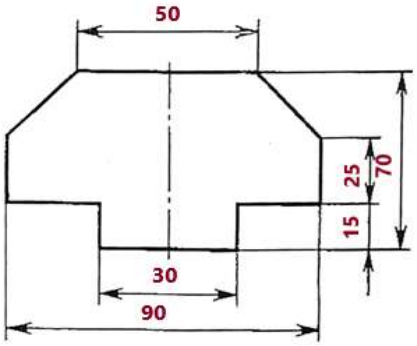
Sl No.	Performance Indicators	Weightage in %
1	For interpretation of problems given by subject teacher	20
2	For proper layout of drawing sheets (maintaining correct types of lines and their thickness)	50
3	For proper dimensioning, symbols of the drawn views	10
4	For neatness & cleanliness of drawing sheets	10
5	For the submission of assigned drawing sheets in time	10
Total		**100**

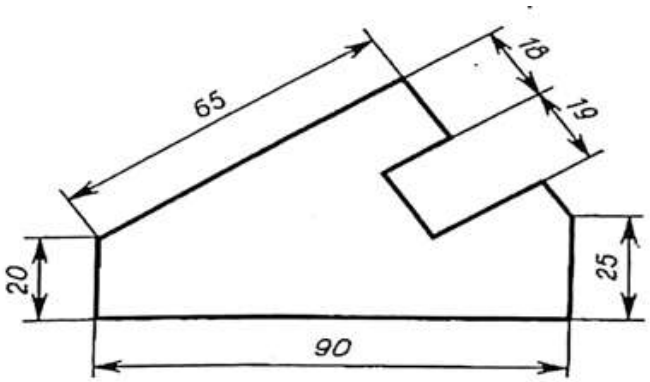
Annexure-1:

(Application of line)



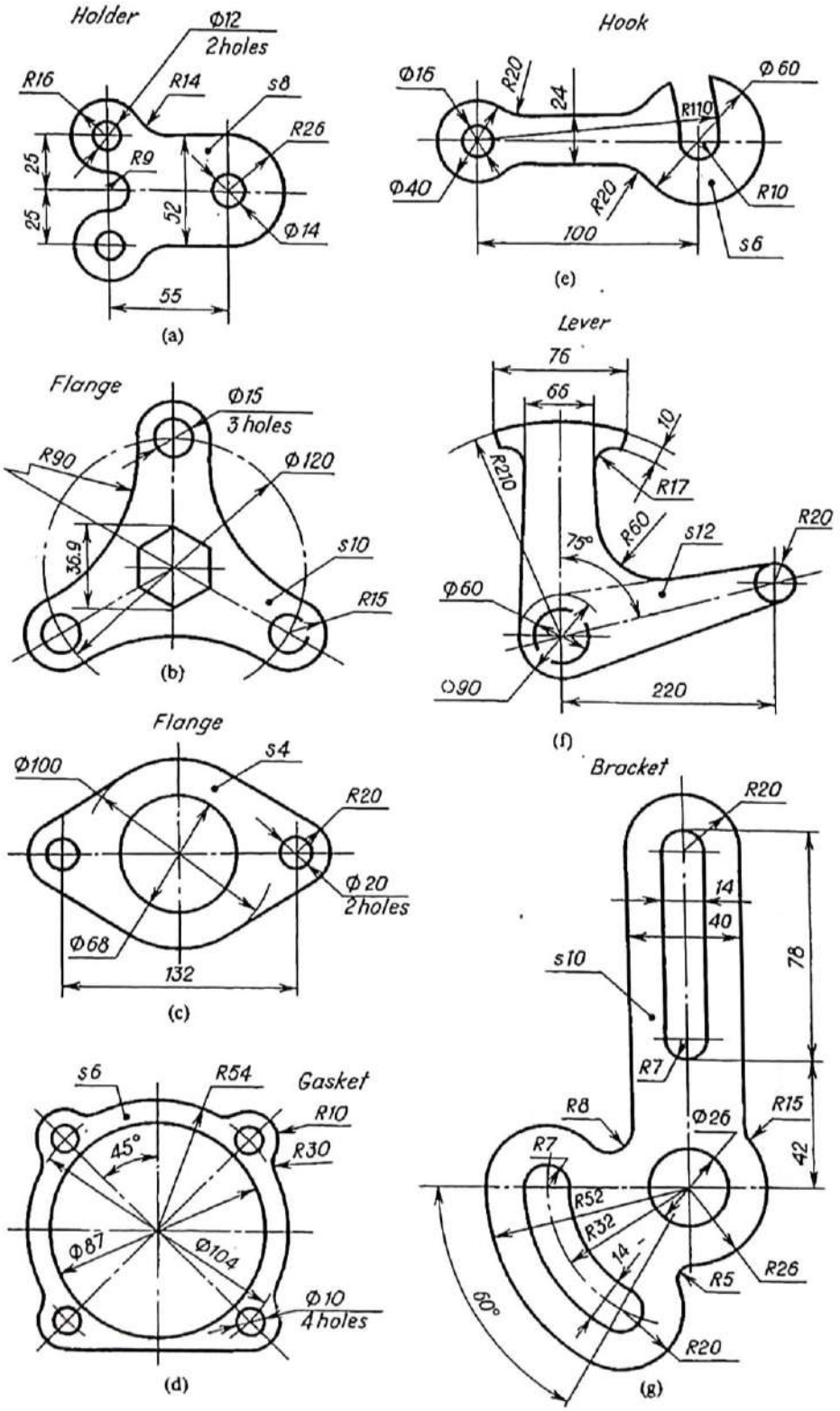






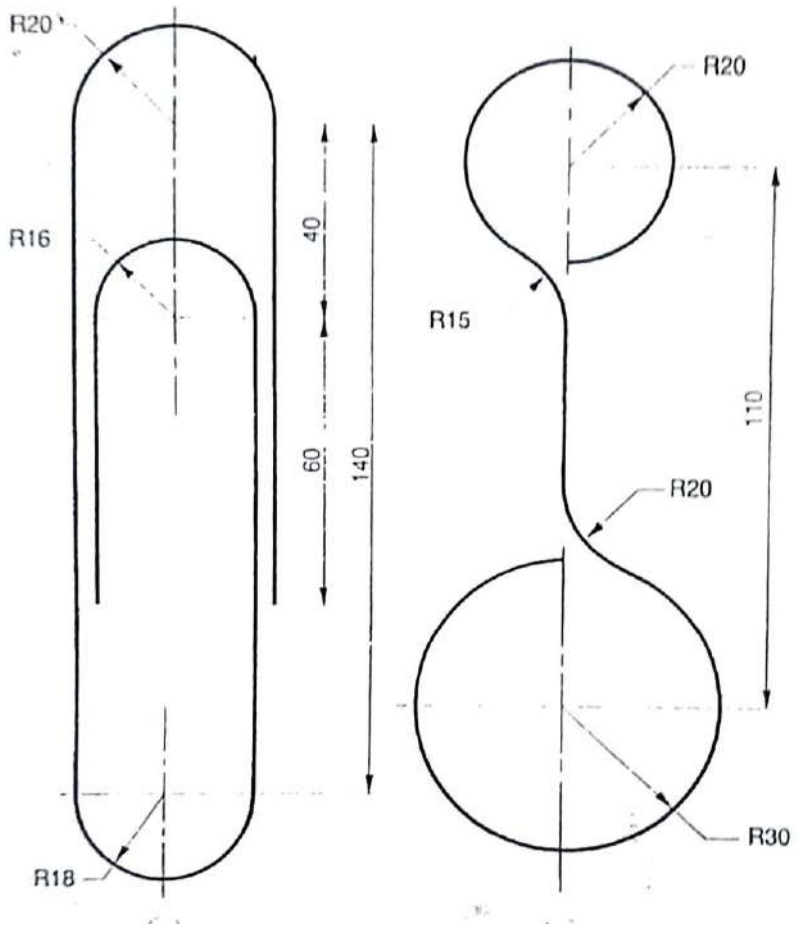
Annexure – 2

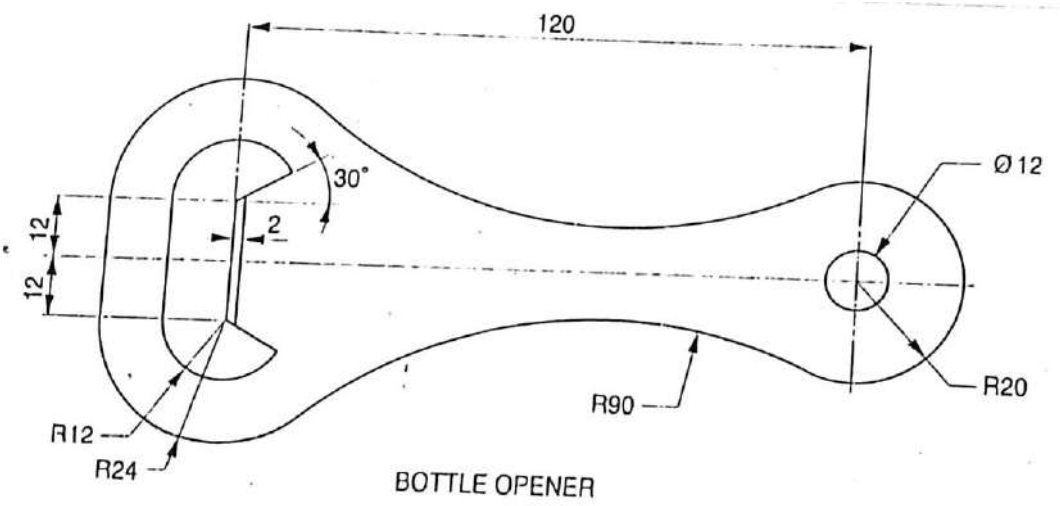
(Application of Circle)



Annexure – 3

(Application of Curves)

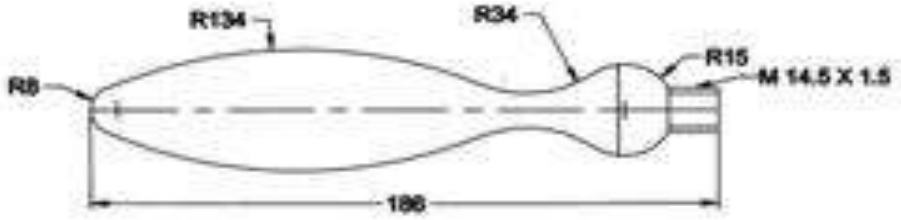


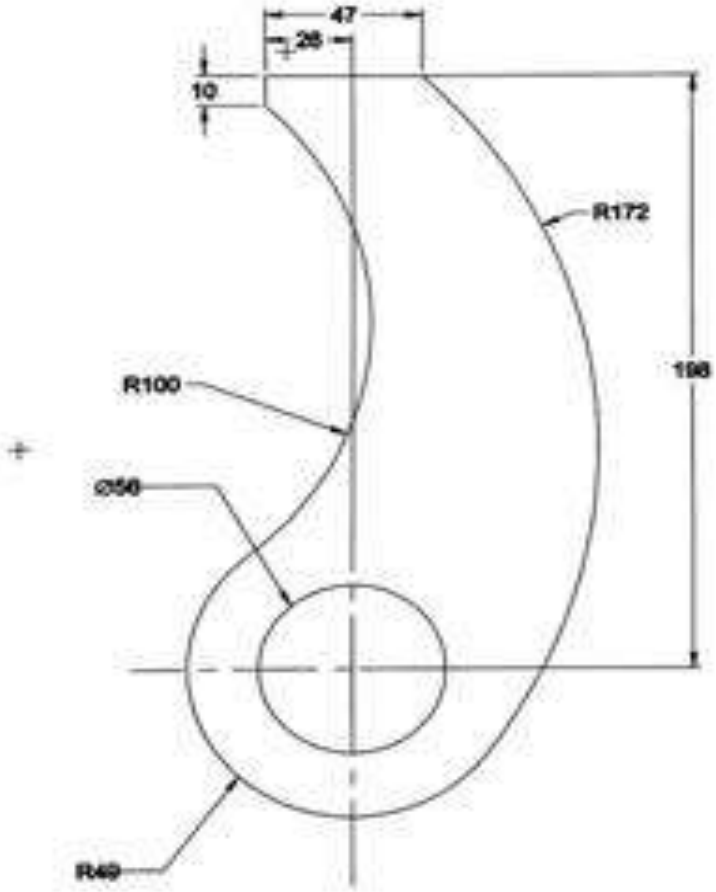


BOTTLE OPENER

Annexure – 3

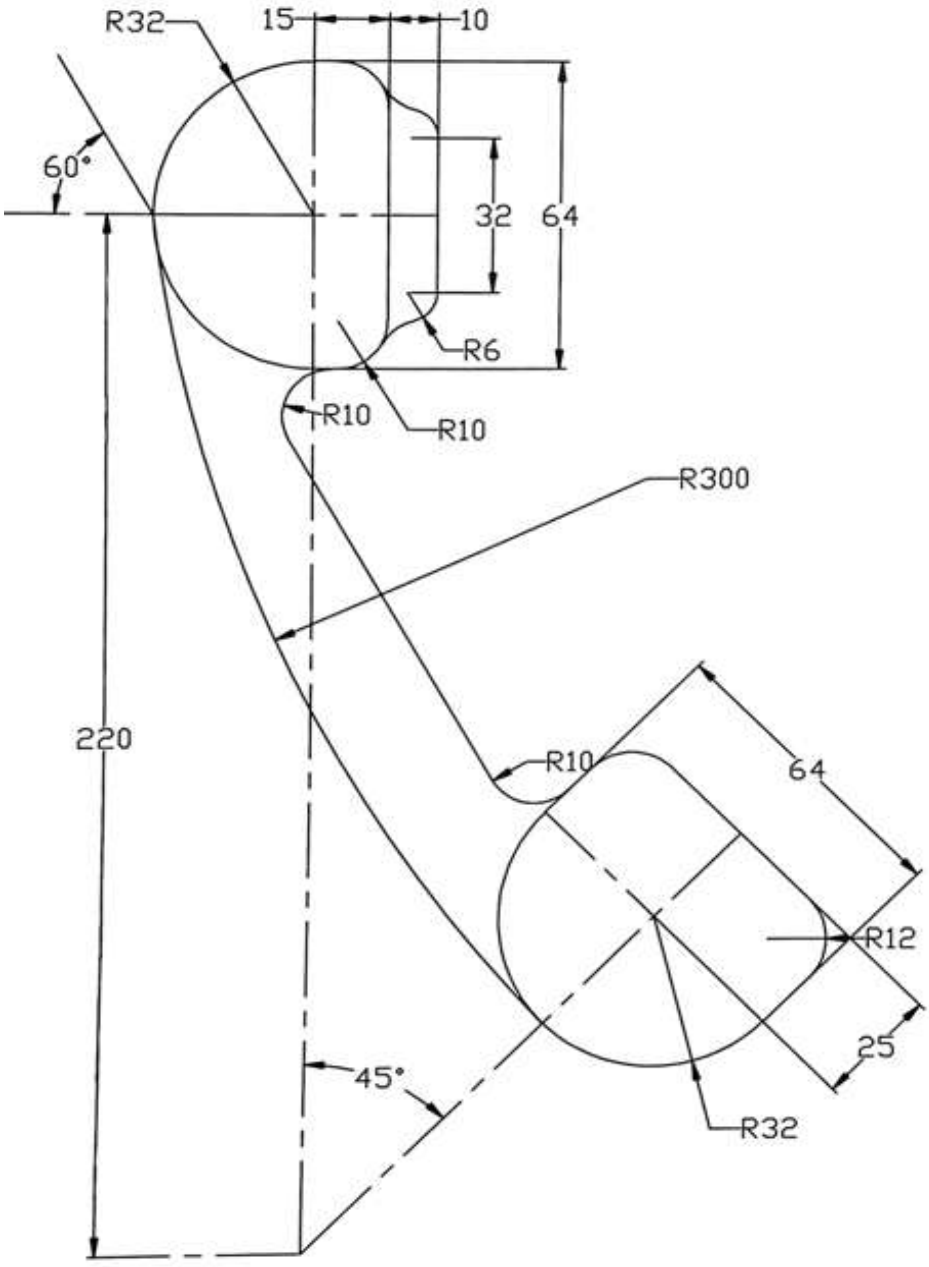
(Application of Curves)





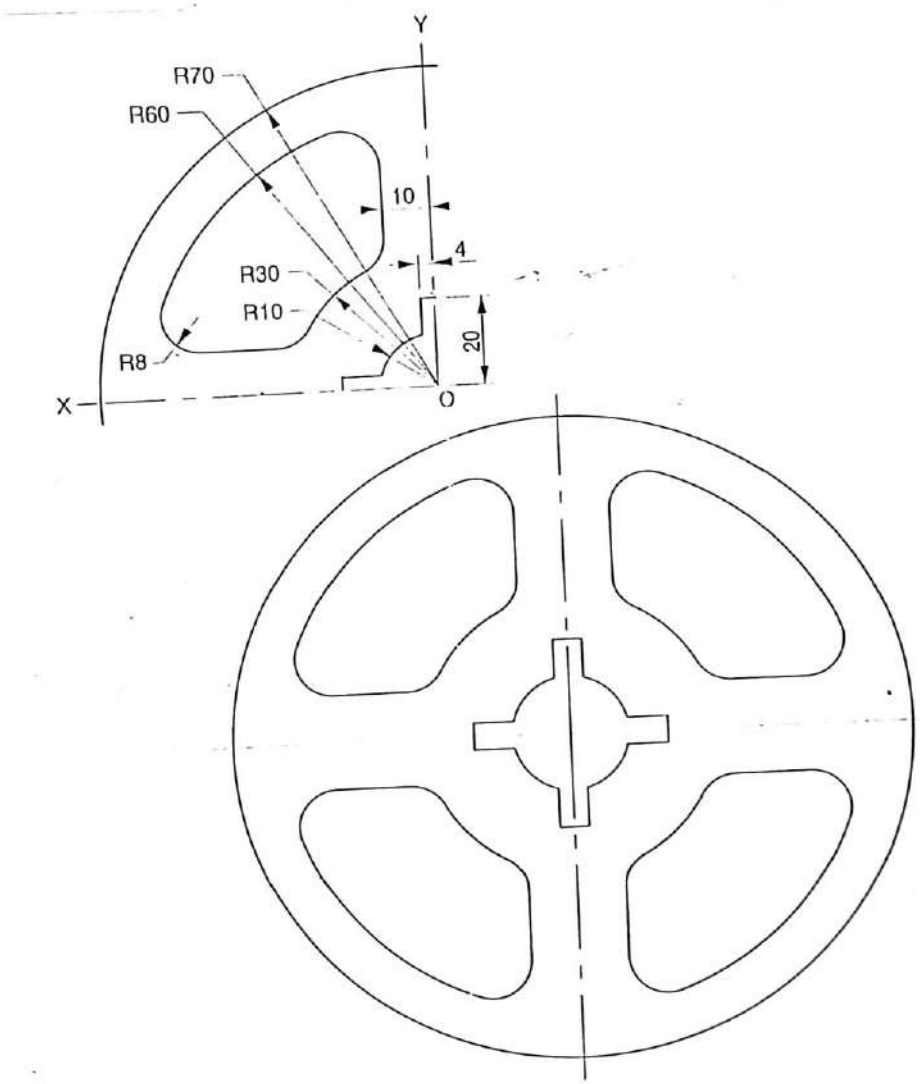
Annexure – 3

(Application of Curves)



Annexure – 3

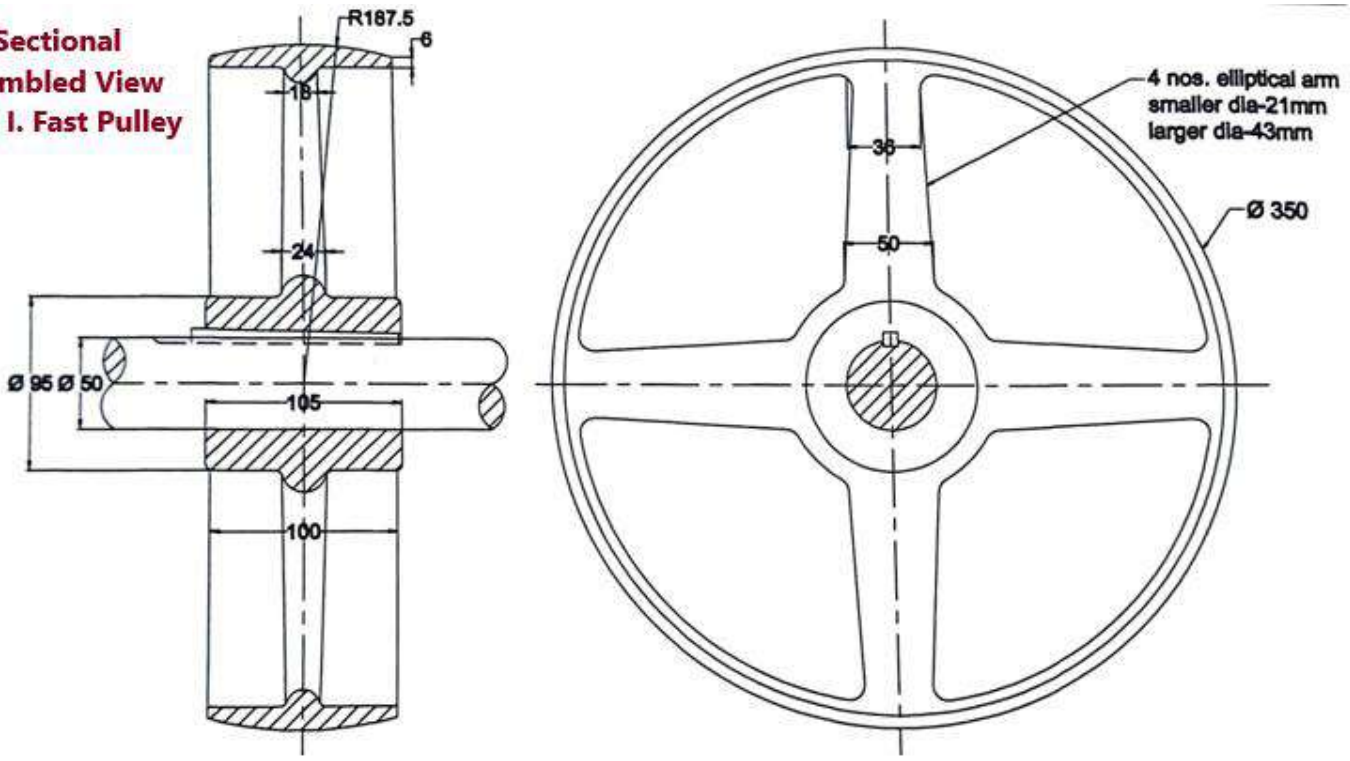
(Application of Curves)



Annexure – 4

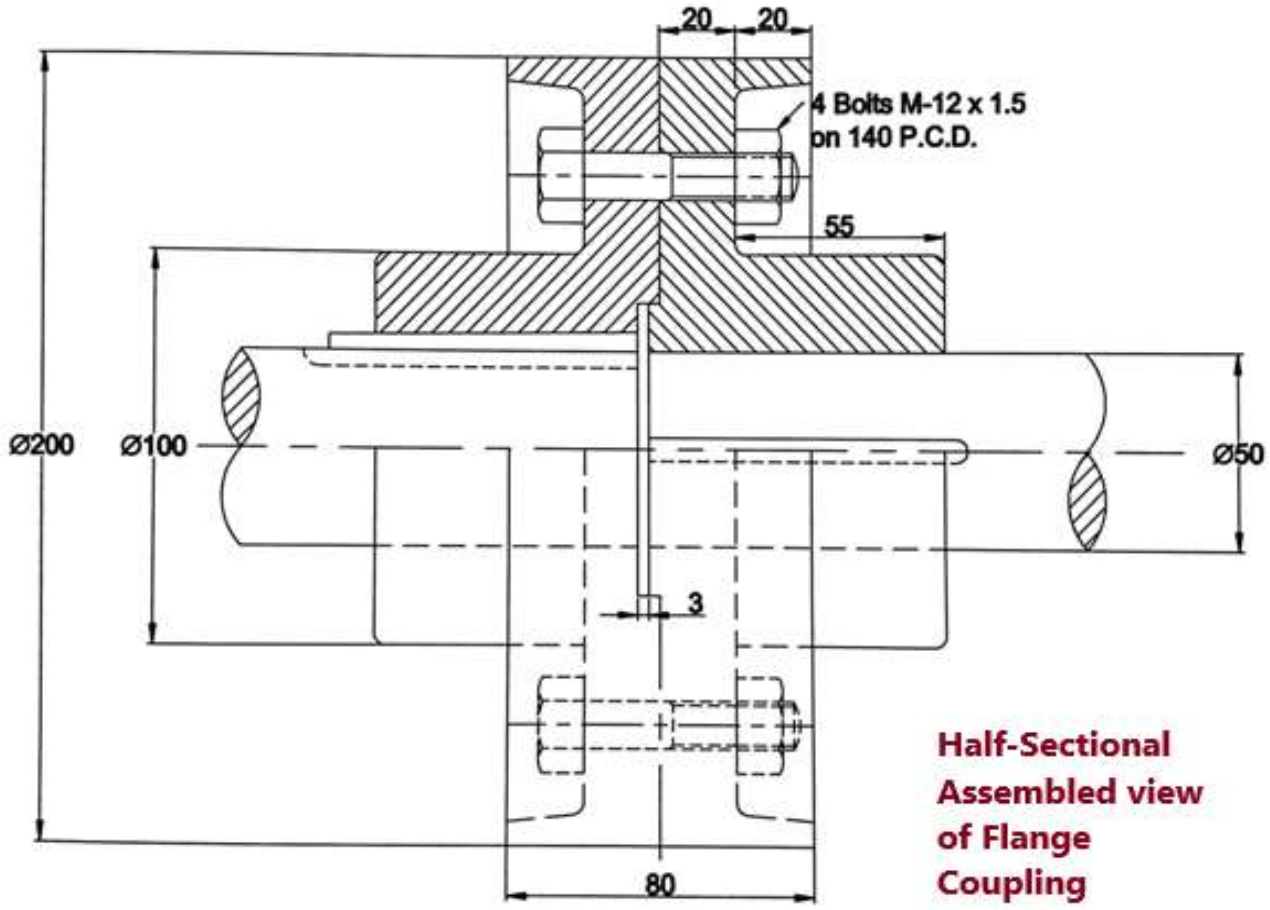
(Assembled View of C. I. Pulley)

Full Sectional Assembled View of C. I. Fast Pulley



Annexure – 5

(Assembled view of Flange Coupling)

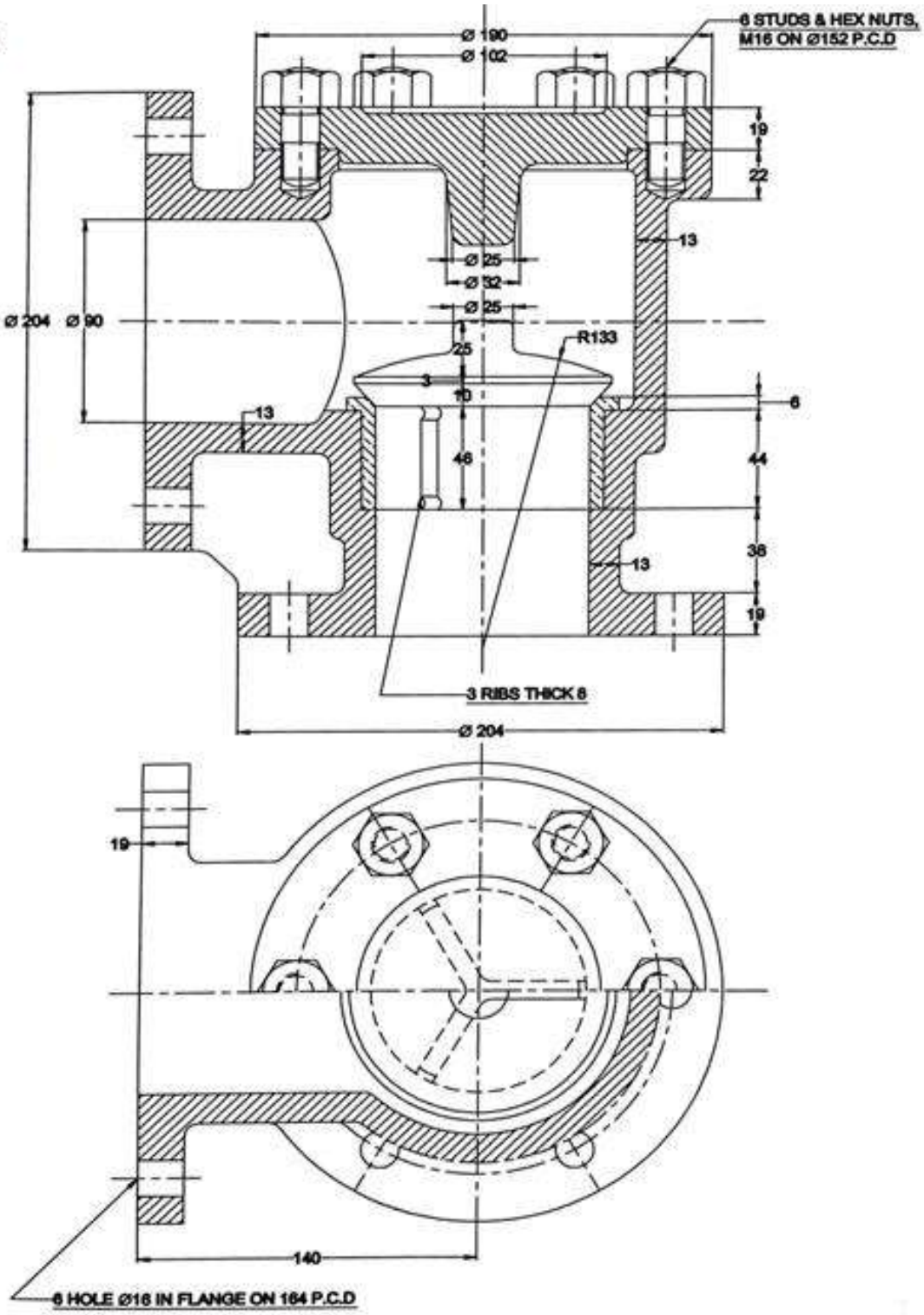


Half-Sectional Assembled view of Flange Coupling

Annexure -6

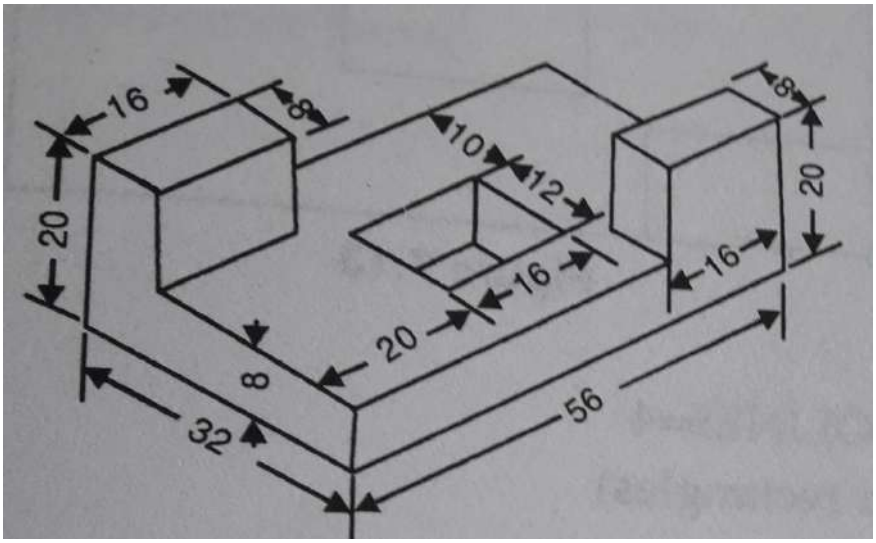
(Assembly to Detailed Sectional Drawing)

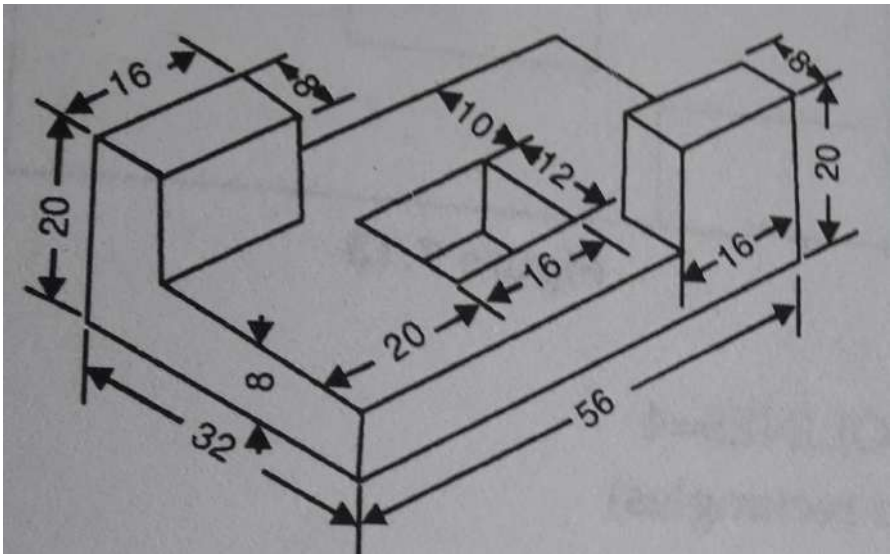
Assembly of Non-Return Valve :

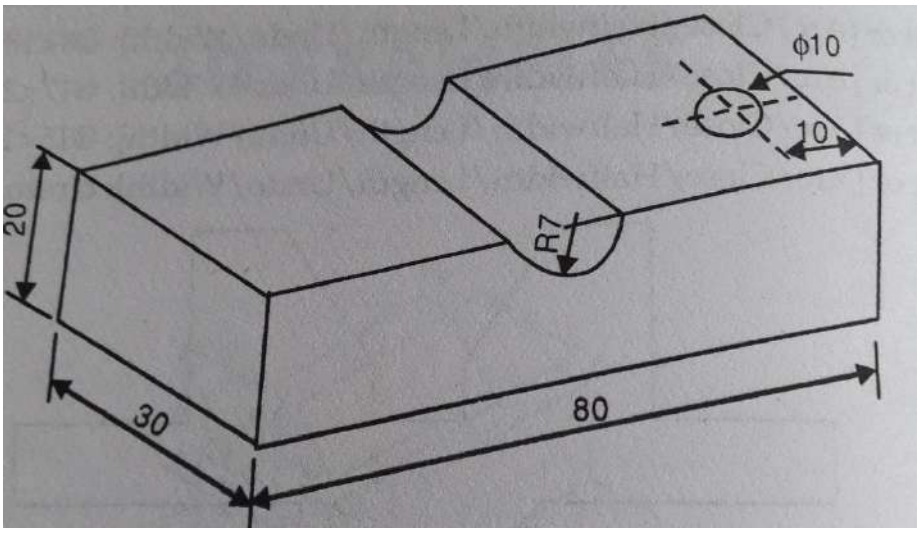


Annexure – 7

(3 D Modeling)



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R7
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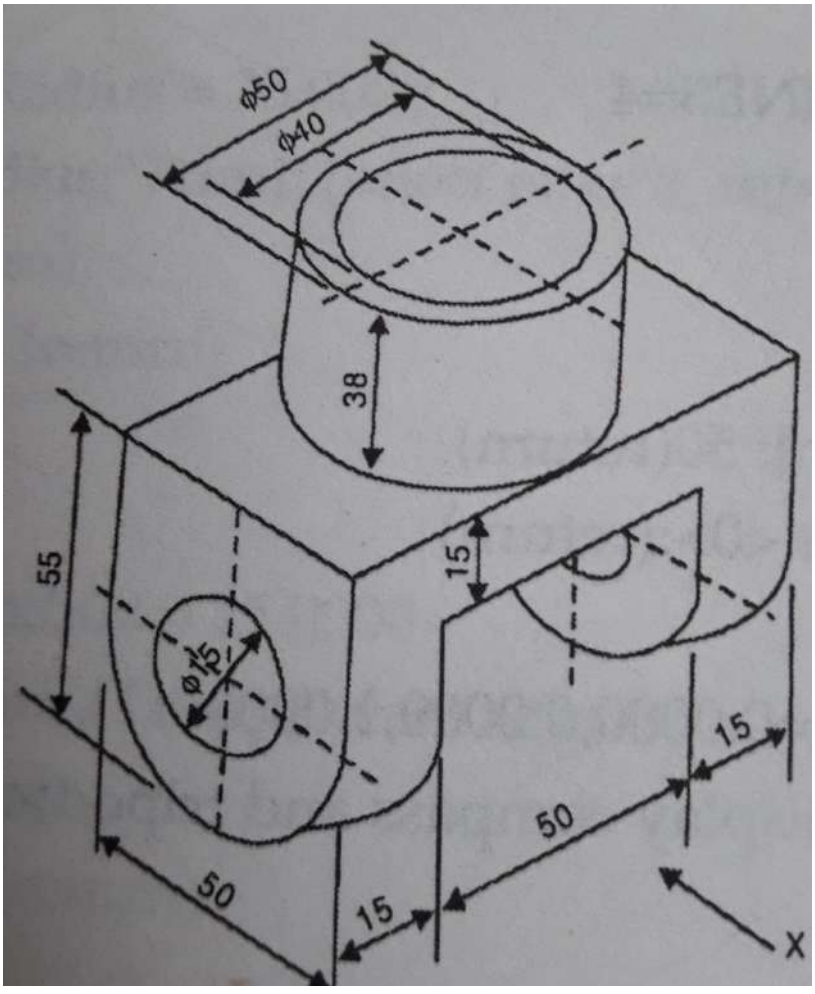
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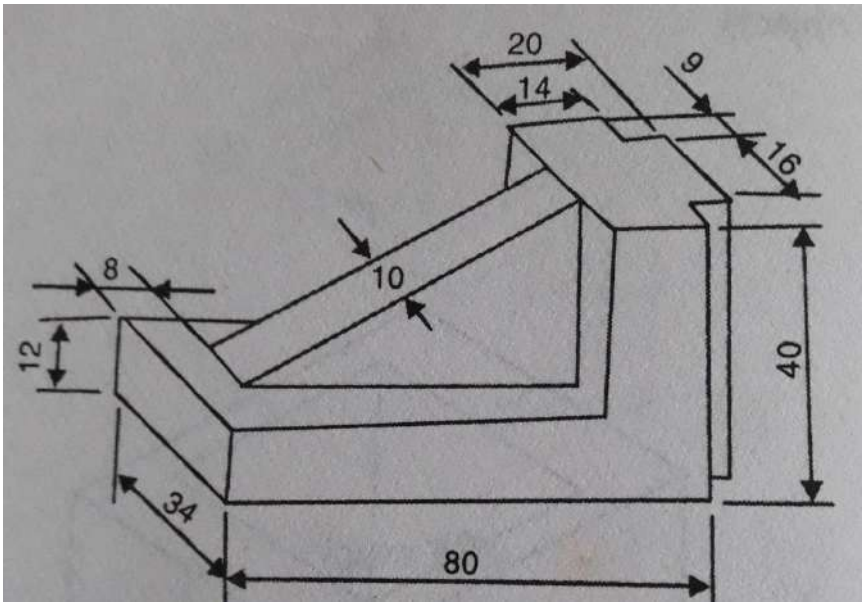
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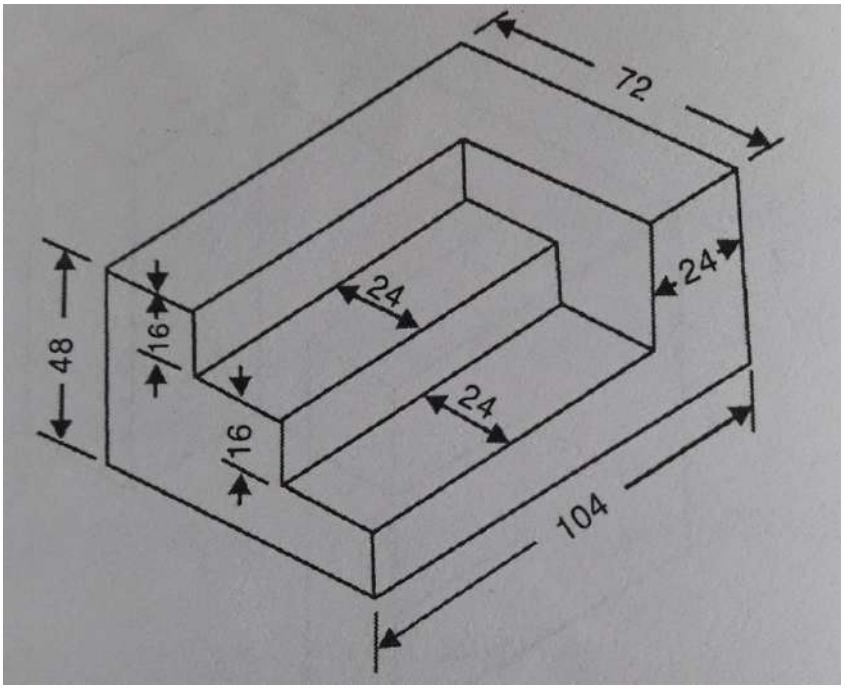
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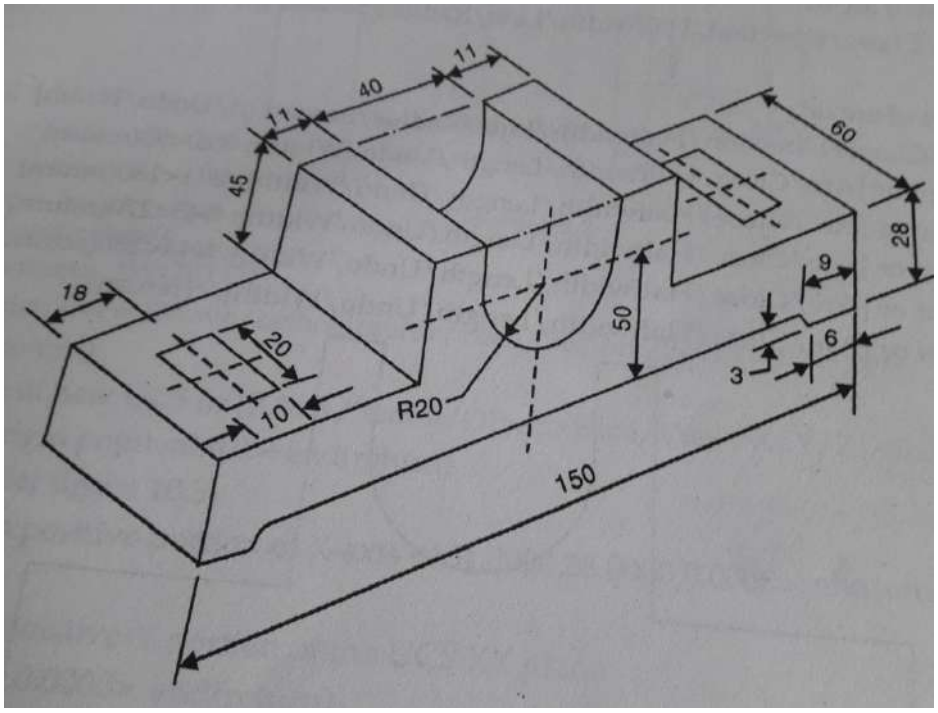
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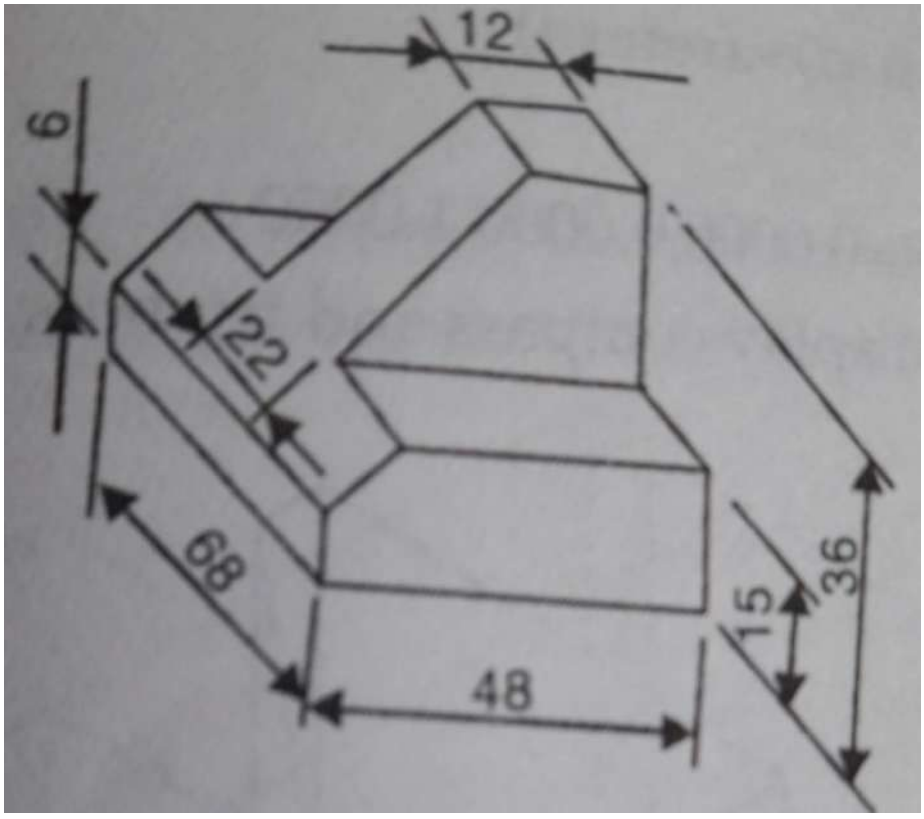
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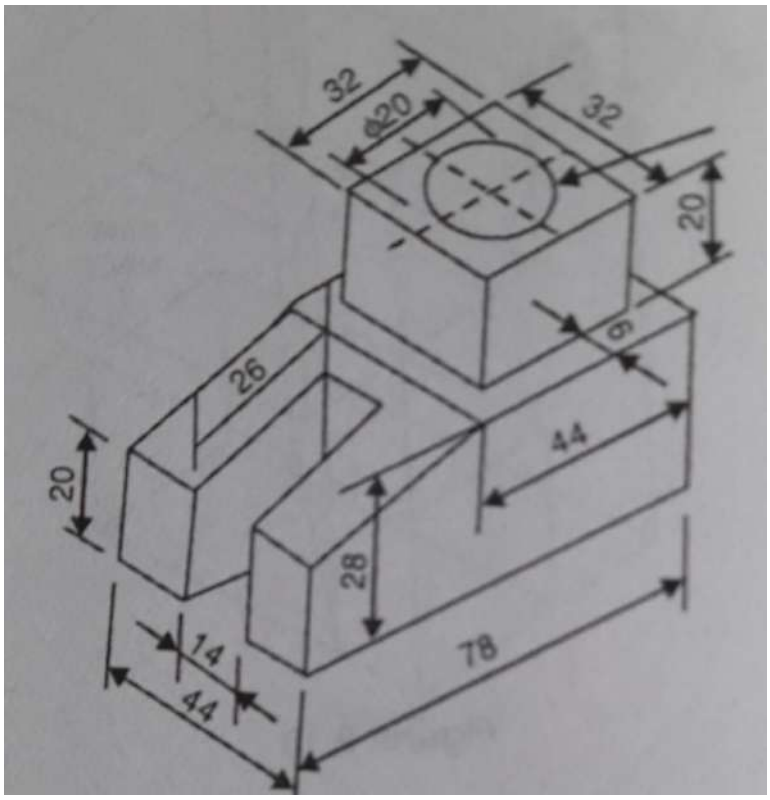
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WEST BENGAL STATE COUNCIL OF TECHNICAL & VOCATIONAL EDUCATION AND SKILL DEVELOPMENT
[A Statutory Body under West Bengal Act XXVI of 2013]
(Formerly West Bengal State Council of Technical Education)
"Karigori Bhavan", 4th Floor, Plot No. B/7, Action Area-III, New Town, Rajarhat, Kolkata-700160

<table>
<tr><td colspan="4">Name of the Course: Diploma in Mechanical Engineering</td></tr>
<tr><td>Category: Programme Core</td><td colspan="3">Semester : Fourth</td></tr>
<tr><td>Code no. : MEPC212</td><td colspan="3">Practical : 100 Marks</td></tr>
<tr><td>Course Title : Thermal Engineering-II Lab</td><td colspan="3">Sessional Examination Scheme:</td></tr>
<tr><td rowspan="6">Duration :17 weeks (total hours per week = 2)</td><td colspan="3">External Assessment
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<tr><td>Assignment on the day of viva voce :</td><td>20</td><td rowspan="2">40 marks</td></tr>
<tr><td>Viva voce (before Board of Examiners) :</td><td>20</td></tr>
<tr><td colspan="3">Internal Assessment</td></tr>
<tr><td>Continuous assessment of class performance and in time submission of assignment</td><td>30</td><td rowspan="3">60 marks</td></tr>
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<tr><td colspan="2">Total marks</td><td>100</td></tr>
<tr><td colspan="4">Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.</td></tr>
</table>

1. Suggested Assignments / Practical for Continuous Assessment:

The list of practical (any Six) to be completed by the students towards attainment of the required competency.

Sl. No.	List of Practical
1	Study the working principle of an evaporative condenser and identify different component of it.
2	Determine the volumetric efficiency of a reciprocating air compressor.
3	Study the working principle of a single stage reciprocating air compressor using a cut section model and identify different component of it.
4	Study the working principle of a rotary air compressor (centrifugal/vane/lobe/screw type) using cut section model and identify different component of it.
5	Draw a labeled schematic chart/diagram of a power plant showing a) water – steam cycle; b) air – coal dust – flue gas path c) condensing unit.
6	Identification of all components of a vapour compression refrigeration system / Domestic Refrigerator and demonstrate its working principle.
7	Determination of Stefan-Boltzmann Constant.
8	Determination of thermal conductivity of a solid metallic rod.
9	Study and compare Shell & Tube type Heat Exchanger and Plate Type Heat Exchangers using cut section model.
10	Identification of all components of a room air-conditioner (window / split type) and demonstrate its working principle.
11	Identification of various components of hermetically sealed compressor and demonstrate its working.

2. Suggested Learning Resources:

Sl. No.	Title of Book	Author	Publication
1	A Course in Thermal Engineering.	V.M. Domkundwar	Dhanpat Rai & Co.
2	Engineering Thermodynamics (Principles & Practices)	D.S.Kumar	S.K. Kataria& Sons
3	A text book of Thermal Engineering.	R. S. Khurmi	S. Chand & Co.
4	A Course in Thermal Engineering.	P. L. Ballaney	Khanna Publishers
5	Power Plant Engineering	R. K. Rajput	Laxmi Publications (P) Ltd.

1. https://www.youtube.com/watch?v=IdPTuwKEfmA : Steam Power Plant – Working Principle

2. https://www.youtube.com/watch?v=gP_087JLsPA : Coal fired Steam Power Plant – Working Principle

3. https://www.youtube.com/watch?v=JfmFftkLbPU : PA Fan

4. https://www.youtube.com/watch?v=qprBmysg8WI : Different type of fans

5.https://www.youtube.com/watch?v=cr5UW5polgE&list=RDCMUCEIAdV2wxng3mMWZQrvuIDA&index=4 :Water circulation in boiler:

6.https://www.youtube.com/watch?v=8u2eC0KlR9o&list=RDCMUCEIAdV2wxng3mMWZQrvuIDA&index=6 : Blow down:

7. Thermal Power Plant working / how electricity is generated/how does a thermal power plant work - YouTube

8. WATER CIRCULATIONIN BOILER // WATER CHEMISTRY // BOE EXAM PREPARATION - YouTube

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Name of the Course: Diploma in Mechanical Engineering			
Category: Programme Core	**Semester : Fourth**		
Code no. : MEPC214	**Practical : 100** Marks		
Course Title : Engineering Metrology & Mechanical Measurement Lab	**Sessional Examination Scheme:**		
Duration :17 weeks(total hours per week = 2)	**External Assessment** (End Semester Sessional Examination)		
	Assignment on the day of viva voce :	20	**40 marks**
	Viva voce (before Board of Examiners) :	20	
	Internal Assessment		
Total lecture class/week : 2	Continuous assessment of class performance and in time submission of assignment	30	**60 marks**
	Viva voce	20	
Credit : 1	Class attendance	10	
	Total marks		**100**
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.			

1. The experimental works associated with this course will help the students to demonstrate the following industry oriented COs:
CO1: Understand the principle and working of various measuring instruments/gauges.
CO2: Select proper instrument(s) for specific use, calculate the least count.
CO3: Take reading by using the instrument, interpret the observation and results.
CO4: Handle, care and maintain the measuring instruments/gauges in proper way.

2. Suggested Assignments / Practical for Continuous Assessment:
The list of practical (any Six) to be completed by the students towards attainment of the required competency:

Sl.No.	**List of Practical**
1.	Identification and study of surface plate & spirit level and measurement of flatness of surface plate by using spirit level.
2.	Identification and study of floating carriage micrometer and measurement of various diameters of an unknown screw thread by using it.
3.	Identification, study of various gauges (feeler gauge, screw pitch gauge, radius & fillet gauge, plug gauge, plate gauge etc) and checking limits of sizes of given samples by using them.
4.	Study and angular measurement of given tapered jobs by using bevel protractor.
5.	Study and external linear measurement of given jobs by using outside vernier micrometer.
6.	Study and measurement of unknown bore diameter of given hollow jobs by using inside

	micrometer/dial bore indicator.
7.	Study and linear measurement (internal/external) of given jobs by using vernier caliper/ vernier height gauge.
8.	Measurement of unknown angle, testing squareness & flatness, and finding out centre of given jobs by using combination set.
9.	Testing of circularity/roundness and parallelism of given test specimens by using dial indicator as a mechanical comparator for comparison with the given standards.
10.	Study and measurement of unknown angle of given test specimen by using Sine bar in combination with slip gauges.
11.	Measurement of various tooth elements of given spur gear specimen using gear tooth vernier caliper.
12.	Measurement of DBT & WBT of moist air by using sling psychrometer, motion of air by using anemometer, and determination of other properties of the same air by using psychrometric chart.
13.	Calibration of thermistor/ thermocouple / pyrometer
14.	Calibration of LVDT transducer for measuring displacement.
15.	Measurement of speed of the shaft using tachometer/ inductive pick-up / stroboscope.

2. **Rubrics for the internal assessment of Laboratory practice** [30 marks]:

Sl No.	Performance Indicators	Weightage in %
1	Awareness about the significance of particular test	15
2	Understanding working principle of set up	15
3	Preparation of experimental set up	20
4	Setting and operation	20
5	Observations and recording	10
6	Interpretation of result and conclusion	10
7	Answer to sample questions	5
8	Submission of report in time	5
Total		**100**

3. Reference Books:

Sl. No.	Title of the Book	Name of the Author(s)	Name of the Publishers
1.	Metrology & Measurement	Anand K Bewoor Vinay A Kulkarni	McGraw Hill Education(I) Pvt. Ltd.
2.	Engineering Metrology and Measurements	N.V.Raghavendra L.Krishnamurthy	Oxford University Press
3.	A text book of Metrology	M. Mahajan	Dhanpat Rai & Sons
4.	Mechanical Measurement & Instrumentation	R. K. Rajput	S. K. Kataria & Sons

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Name of the Course: Diploma in Mechanical Engineering			
Category: Programme Core	**Semester : Fourth**		
Code no. : MEPC216	**Practical : 100** Marks		
Course Title: Manufacturing Processes-II Practice	**Sessional Examination Scheme:**		
Duration : 17 weeks (2 hours per week)	**External Assessment** (End Semester Sessional Examination)		
	Assignment on the day of viva voce :	20	**40 marks**
	Viva voce (before Board of Examiners) :	20	
	Internal Assessment		
Total lecture class/week : 2	Continuous assessment of class performance and in time submission of Assignment	30	**60 marks**
	Viva voce	20	
Credit : 1	Class attendance	10	
	Total marks		**100**
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.			
Pre requisite: Knowledge of Manufacturing Process-I[**C**ode No.: MEPC207] and Manufacturing Process-II[**C**ode No.:MEPC204]			

1. **Course Outcomes (COs):**
   The theory, practical experiences and relevant soft skills associated with this subject are to be taught and implemented, so that the student demonstrates the following industry oriented course outcomes:
   - **a)** Ability to develop a job by interpreting a given drawing in a machine tool (drilling machine, shaping machine, milling machine, grinding machine) involving identifications of operations, assessment of sequence of operations to be performed, selection of tools and equipments, setup of machine, job, tool(s) as required and skill of operating the machine tool (as developed by practicing).
   - **b)** Ability to interpret cutting tool geometry and ability to suggest the correct cutting tool(s) to be used in a specific machine tool and specific operation.
   - **c)** Ability to use the welding setup(s) (MIG, TIG) for preparing weld joint(s) involving selection of hand tools, equipments & safety items, setup of machine (based on adopted welding process), assessment of welding position, assessment & execution of preparatory work as required and skill of performing the welding (as developed by practicing on the welding set up).

2. **Suggested Assignments / Practical for Continuous Assessment:**
   The list of practical to be completed by the students towards attainment of the required competency:

Sl. No.	List of Practical	Unit No. with Subject Code	Minimum Hours
01	Study of drilling Machine & identify different basic parts, drives, feed mechanism, types of drill, drill holding devices, work holding devices, setting of work & drill and operate drill machine without work.	01 [MEPC204]	04
02	Practice on making a job involving drilling operation of different diameter hole at different location, reaming operation at a particular hole, counter sinking operation at particular hole and / or any other operations as assigned by the concern teacher by using a drill machine.	01 [MEPC204]	04
03	Study of shaping machine & Identify different basic parts, drives, clapper	02	04

	box, crank & slotted mechanism, feed mechanism, adjustment of length & position of stroke, work holding devices, tool holding devices, tools used, setting of tool & work and operate the machine without work.	[MEPC204]	**[Mandatory]**
04	Practice on making a job involving different shaping operations like flat surface machining, slot cutting, inclined surface machining (For example: V block) and / or any other operations as assigned by the concern teacher by using a shaping machine.	02 [MEPC204]	04
05	Detailed study and measurement of kinematic structure of slotted link mechanism of ram reciprocation for finding out the stroke length and quick return ratio at a given setting of a shaping machine.	02 [MEPC204]	04
06	Study of milling machine & identify different basic parts, drives, cutter holding devices, milling cutters, work holding devices, dividing head, other milling attachments and operate milling machine without work.	03 [MEPC204]	04 **[Mandatory]**
07	Practice on making a job involving different milling operations like plain milling, side milling, straddle milling, form milling, keyway and slot milling and / or any other operations as assigned by the concern teacher by using a milling machine.	03 [MEPC204]	04
08	Practice on making a spur gear of given module by using milling machine and dividing head.	04 [MEPC204]	04
09	Study and presentation of tool nomenclature of double fluted twist drill and plain milling cutter.	01/03 [MEPC204]	04
10	Study of grinding machine & identify different basic parts, drives, wheel mounting process, truing & dressing of grinding wheel and practice on making a job involving flat surface grinding or cylindrical surface grinding with closed tolerances by using the same machine tool.	05 [MEPC204]	04
11	Study and presentation of kinematic structure of all gear head stock and /or head stock with cone pulley and back gear arrangement and /or apron mechanism of a Lathe.	04 [MEPC207]	04
12	Study of different equipments of MIG and / or TIG welding set-up, hand tools used, safety items used, connection details, types of welding joints (Lap, Butt, Tee, Corner and Edge joints etc.), different welding positions (Horizontal, Vertical and Overhead positions etc.) and practice on edge preparation, tag welding and stitch welding.	06 [MEPC207]	04

Note:

A suggested list of practical is given in the above table. At least **06 (Six)** practical need to be performed out of which the practical marked as **'[Mandatory]'** are compulsory, so that the student achieves the desired level of competency as generally required by the industry.

3. **Suggested Scheme for Internal Assessment**: [Total Marks: 60]

Involvement	**Total Marks**
Continuous assessment of class performance and in time submission of Assignments	30
Viva Voce on to the Engineering Practice at the end of the semester	20
Class attendance	10
Total Internal Assessment:	**60**
Pass criterion for Internal Assessment = 24 Marks [Minimum]	

4. **Suggested Scheme for End Semester Examination**:[Total Marks: 40]

Involvement	**Total Marks**
Assignment on the day of End Semester Exam.	20
Viva Voce on to the Engineering Practice on the day of End Semester Exam.	20
Total External Assessment:	**40**
Pass criterion for Internal Assessment = 16 Marks [Minimum]	

5. **Rubrics for the internal assessment of Laboratory Practice:**

The 'Process and Product' related skills associated with each practical work are to be assessed according to a suggested sample as given below:

Sl. No.	Performance Indicators
01	Preparing job/component drawing and process Plan
02	Setting up of machine, tool and job
03	Operating machine /executing production process to produce the component
04	Inspecting the component during production process using measuring instruments
05	Submission of job and workshop report in time
06	Viva voce

During conducting such Practical (laboratory / field based) work, the following social Skills / attitudes which are Affective Domain Outcomes (ADOs) are to be developed through the experiences:

- Follow the safety practices.
- Practice good housekeeping.
- Demonstrate working as a leader / team member.
- Maintain tools and equipment in good working condition.
- Follow ethical practice.

6. References:

Sl. No.	Title of Book	Author	Publication
1	Elements of workshop Technology – Volume I & II	S. K. Hajra Chowdhury, Bose, Roy	Media Promoters and Publishers Limited, Mumbai.
2	A Course in Workshop Technology - Volume I & II	B.S.Raghuwanshi	Dhanpat Rai Publications, New Delhi.
3	Manufacturing Technology - Volume I & II	P. N. Rao	Tata McGraw-Hill, New Delhi.
4	Manufacturing Science	Amitabh Ghosh, Mallik	East-West Press Pvt. Ltd. New Delhi.
5	Manufacturing Processes	KALPAKJIAN & SCHMID	Pearson Education, New Delhi.
6	Materials and Processes in Manufacturing	DeGarmo	Wiley.
7	Machining & Machine Tool	A.B. Chattopadhyay	Wiley.
8	Workshop Technology - Volume I , II & III	W.A.J. Chapman	Viva Books (p) Ltd.

7. Suggested Learning Websites:

a. https://nptel.ac.in
b. www.thelibraryofmanufacturing.com
c. https://www.nitttrchd.ac.in

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Name of the Course: Diploma in Mechanical Engineering			
Category: Minor Project	**Semester : Fourth**		
Code no.: PR202	**Practical : 100** Marks		
Course Title: Minor Project	**Sessional Examination Scheme:**		
Duration : 17 weeks (3 hours per week)	**External Assessment** (End Semester Sessional Examination)		
	Evaluation of Minor Project Reports	20	**40 marks**
	Viva Voce (before Board of Examiners	20	
	Internal Assessment		
Total practical class/week: 3	Continuous assessment of class performance and in time submission of reports on minor projects	30	**60 marks**
	Seminar Presentation and Viva Voce	20	
Credit: 1.5	Class attendance	10	
	Total marks		**100**
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.			

1. Course Outcomes (COs):

In order to cultivate the systematic methodology for problem solving using acquired technical knowledge & skills, the student should be able to demonstrate the following industry oriented course outcomes:

- **a)** Identify, analyze & define the problem statement.
- **b)** Generate alternative solutions for the identified problem.
- **c)** Compare & select feasible solutions from alternatives generated.
- **d)** Execution (design, develop, manufacture & operate equipment/program), data recording, analyze and generate conclusion to the problem statement.

2. Suggested Minor Projects for Continuous Assessment:

The list of minor projects to be completed by the students towards attainment of the required competency. **Three (03)** minor projects **(one from each group)** are to be undertaken by an individual student:

Group: A	
Sl. No.	**List of Minor Projects**
01	Experimentally determine and present the power transmitted by a belt drive mechanism (or any other drive mechanism) using rope brake dynamometer (or any other suitable dynamometer).
02	Experimentally determine different values of radius of rotation and corresponding controlling force at various speed of a Porter Governor (or any other type Governor) and present the performance curve (controlling force vs radius of rotation) of the same with the help of a suitable Governor Test Set-up.
03	Present the profiles (at least two) of radial cam drawn with proper scale for a given follower (knife-edge and roller follower) with and without offset to obtain the desired follower motion.
04	Present with suitable drawing or working model the important kinematic data and transmission ratios of the following types of gear train: a) simple gear train (tumbler gears for feed reversing mechanism), b) compound gear train (all geared head stock in Lathe), c) reverted gear train (back gear mechanism in Lathe), d) epicyclic gear train (differential).
05	Prepare a working model of a disc connecting rod slider mechanism and present the velocity of the point / points of the said working model by using suitable method as specified by the concern teacher.

Group: B	
01	Trial on water cooler test rig and determine the following- a) capacity of the plant, b) actual COP of the plant, c) efficiency of the plant.
02	Trial on air-conditioning test rig and execute the following psychrometric processes - a) cooling and dehumidification, b) heating and humidification. Measure the outputs for each process, plotting the process curves on psychometric chart and determine the RH, humidity ratio & specific enthalpy of processed air.
03	Design the air-conditioning system (which includes RSHF, mass of air supplied to the room in kg/hour, mass of recirculated air in kg/hour, Ton of cooling coil, ADP of cooling coil) of a smart classroom or computer-laboratory of your institute on the basis of various data as provided by the concern teacher.
04	Study of various controls of a refrigeration unit such as thermostat, overload protector, solenoid valve, low pressure / high pressure cut out.
05	Identification components and their functions of a hermetically sealed compressor used in domestic refrigerator.
Group: C	
01	Present a detailed report comprising with sequential activities associated with the installation and commissioning of a machine tool in a machine shop.
02	Prepare and present an assembly of machine drawing (for example, Plummer block), to be drawn with the help of Auto CAD software where dimensions of actual components of the assembly are to be taken through measurement by using suitable measuring instruments or from the detailed component drawing of the assembly as provided by the concern teacher.
03	Prepare and present hollow 3D surface model made with cut boards of the intersecting solids (prism with prism or cylinder with cylinder or prism with cylinder, where the axes are perpendicular to each other and intersecting) to demonstrate the curves of intersection of surfaces of the solids.
04	Prepare and present the Speedvs. Torque characteristics curve of a given DC Shunt / Series motor, by involving the following: a) selection of suitable measuring devises or meters, b) making proper connections as per diagram, c) checking the connections, d) run the motor and e) recording the meter-readings as required for plotting the curve.
05	Prepare and present a list and type of fire extinguisher, location of fire extinguisher, instructions of handling the fire extinguisher and labeled escape route plan of your classroom or any laboratory in case of fire hazards. Also prepare and present posters on fire safety for awareness of the other students.
06	Prepare and present a report on measurement of force or / and displacement by a strain gauge and plotting the characteristic curve.

Note:

A suggested list of minor projects is given in the above table. The concerned faculty member may add similar minor projects also. **Three (03)** minor projects **(one from each group)** are to be undertaken by an individual student that needs to be assigned to him / her at the beginning of the semester. The execution of such minor projects may be done by an individual student or by a group of students as per discretion of the concern faculty member. The duration of minor projects should not be less than **18 (eighteen)** student engagement hours during the course. The student will have to maintain dated work diary consisting of individual contribution in assigned minor project works. The student will have to submit reports on their assigned minor projects to the concern faculty in time and will give a seminar presentation on their assigned minor projects in front of a Board of Examiners at the time of end semester internal assessment.

3. **Suggested Scheme for Internal Assessment:** [Total Marks: 60]

Involvement	Total Marks
Continuous assessment of performance, contribution and in time submission of minor projects.	30
Seminar Presentation and Viva Voce on to the minor projects at the end of the semester.	20
Class attendance.	10
Total Internal Assessment:	**60**
Pass criterion for Internal Assessment = 24 Marks [Minimum]	

4. **Suggested Scheme for End Semester Examination: [**Total Marks: 40]

Involvement	Total Marks
Evaluation of minor project reports on the day of End Semester Exam.	20
Viva Voce on to the minor projects on the day of End Semester Exam.	20
Total External Assessment:	**40**
Pass criterion for Internal Assessment = 16 Marks [Minimum]	

5. Rubrics for the internal assessment of Minor Projects:

The 'Process and Product' related skills associated with each minor project work are to be assessed according to a suggested sample as given below:

Sl. No.	Performance Indicators
01	Identify, analyze & define the problem statement.
02	Generate alternative solutions for the identified problem.
03	Compare & select feasible solutions from alternatives generated.
04	Execution (design, develop, manufacture & operate equipment / program), data recording, analyze and generate conclusion to the problem statement.
05	Submission of minor projects reports in time.
06	Viva voce

During conducting such minor project work (laboratory / field based), the following social Skills / attitudes which are Affective Domain Outcomes (ADOs) are to be developed through the experiences:

- Follow the safety practices.
- Practice good housekeeping.
- Demonstrate working as a leader / team member.
- Maintain tools and equipment in good working condition.
- Follow ethical practice.

CURRICULUM STRUCTURE FOR PART-III (SEMESTER 5) OF THE FULL-TIME DIPLOMA COURSES IN MECHANICAL ENGINEERING

BRANCH: **MECHANICAL ENGINEERING**				**SEMESTER 5**						
SL No	**Category**	**Code No**	**Course Title**	**L**	**P**	**Total Class per week**	**Credit**	**Full marks**	**Internal Marks**	**ESE Marks**
1	**Program Core**	**MEPC301**	**Power Engineering**	**3**		**3**	**3**	**100**	**40**	**60**
2	**Program Core**	**MEPC303**	**Advanced Manufacturing Processes**	**3**		**3**	**3**	**100**	**40**	**60**
3	**Program Core**	**MEPC309**	**Fluid Mechanics and Machinery**	**3**		**3**	**3**	**100**	**40**	**60**
4	**Program Elective**	**MEPE301**	**Program Elective (withoutLab)**	**2**		**2**	**2**	**100**	**40**	**60**
5	**Program Elective**	**MEPE303**	**Program Elective (with Lab)**	**2**		**2**	**2**	**100**	**40**	**60**
6	**Program Core**	**MEPC311**	**Power Engineering Lab**		**2**	**2**	**1**	**100**	**60**	**40**
7	**Program Core**	**MEPC313**	**Advance Manufacturing Processes Lab**		**2**	**2**	**1**	**100**	**60**	**40**
8	**Program Core**	**MEPC315**	**Fluid Mechanics and Machinery Lab**		**2**	**2**	**1**	**100**	**60**	**40**
9	**Program Elective**	**MEPE305**	**Program Elective Lab (for Sl. No. 5)**		**2**	**2**	**1**	**100**	**60**	**40**
10	**Major Project**	**PR301**	**Major Project**		**2**	**2**	**1**	**100**	**60**	**40**
11	**Internship**	**SI301**	**Internship - II**	**-**	**-**		**1**	**100**	**100**	**0**
			Total	**13**	**10**	**23**	**19**	**1100**	**600**	**500**

STUDENT CONTACT HOURS PER WEEK: 26 hours (Lecture-16 hours; Practical-10 hours)
Theory and Practical Period of 60 minutes each.
FULL MARKS-1100 (Internal Marks-600; ESE Marks-500)
L-Lecture, P-Practical, ESE- End Semester Examination

Credit Distribution	**Credit**
Program Core	12
Program Elective	5
Project	1
Internship 2	1
Total	19

Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately in each subject.

Program Elective (without Lab)		**Total Credit**
1. Power Plant Engineering (Sub code: **MEPE301/1**)	Any one	2
2. Material Handling System (Sub code: **MEPE301/2**)		
Program Elective (with Lab)		
1. Computer Aided Design & Manufacturing (Sub code: **MEPE303/1**)	Any one	3
2. Automobile Engineering (Sub code: **MEPE303/2**)		

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Name of the Course: Diploma in Mechanical Engineering	
Category: Programme Core	**Semester : Fifth**
Code no. : MEPC301	**Full Marks : 100**
Course Title : Power Engineering	**Examination Scheme :** (i) **External Assessment : 60** marks (End Semester Examination) (ii) **Internal Assessment: 40** marks [Class test : 20 marks Assignment / viva voce : 10 marks Class attendance : 10 marks]
Duration : 17 weeks (total hours per week = 3)	
Total lecture class/week : 3	
Credit : 3	
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.	

1. Course outcomes (COs):

After completion of this course, the student will be able to -

a) Identify different component of IC engine and differentiate between diesel engine and petrol engine.
b) Calculate various performance characteristics of IC Engines.
c) Understand the working principle and use of different types of nozzles and diffusers in steam turbines used in steam power plant.
d) Describe construction and working of various types of Steam Turbines.
e) Identify different components of gas turbine and jet engines.
f) UnderstandworkingofHydraulicTurbinesandtheirapplicationinactualpowergeneration.

2. Theory Components:

The following topics/subtopics should be taught and assessed in order for achieving the course outcomes to attain the identified competency.

Unit	Topics & Sub-topics	Teaching Hour
UNIT 1: **Internal Combustion Engine**	1.1. Basic working principles, representation on P-V & T-S diagrams of Otto cycle, Diesel cycle and dual combustion cycle and deduction of thermal efficiency of Otto cycle & Diesel cycle. (simple numerical) 1.2. Introduction and classification of I.C. engines. 1.3. Working principle, construction with function of components and comparison of two-stroke and four-stroke I. C. engines (petrol and diesel engine). 1.4. Hypothetical & actual indicator diagram of two-stroke and four-stroke I. C. engine (petrol and diesel engine).	**14**

	1.5. Valve timing diagram of two-stroke and four-stroke engines (petrol and diesel engine). 1.6. Brief description on firing-order of multi-cylinder I.C. engine, pre-ignition, detonation, knocking, scavenging, supercharging, turbo-charging, simple carburettor, M.P.F.I. 1.7. Basic concept of governing of I.C engine. 1.8. Purpose of lubrication of I.C. engine and cooling of I.C engine. 1.9. Performance of I.C engine – indicator power, brake power, Morse test, mechanical efficiency, thermal efficiency, specific fuel consumption and heat balance sheet. (simple numerical).	
UNIT 2: **Nozzle/Diffuser and Steam Turbine**	NOZZLE **/** DIFFUSER: 2.1. Working principle and classification of steam nozzles & diffusers. 2.2. Application areas for steam nozzles & diffusers. 2.3. Continuity equation, sonic velocity and concept of Mach number. 2.4. Steady flow energy equation for flow through steam nozzles. (simple numerical). 2.5. Concept of critical pressure and critical pressure ratio (no deduction). STEAM TURBINE: 2.6. Introduction and classification of steam turbines. 2.7. Constructions and working principles of simple impulse turbine and simple impulse-reaction turbine. 2.8. Velocity diagrams, work done, power and efficiency of simple impulse turbine. (simple numerical using graphical method only). 2.9. Concept on compounding of steam turbine. 2.10. Concept on governing of steam turbine.	**11**
UNIT 3: **Gas Turbine and Jet Propulsion**	GAS TURBINE: 3.1 Basic principle, representation on P-V & T-S diagrams and deduction of thermal efficiency of Brayton or Joule cycle. (no numerical). 3.2 Classification of gas turbine. 3.3 Applications areas of gas turbine. 3.4 Schematic flow diagram and description of closed cycle & open cycle gas turbines. 3.5 Methods to improve thermal efficiency of gas turbine (regeneration, inter-cooling, reheating; representation on T-S diagram). JET PROPULSION: 3.6 Jet propulsion – Basic working principles of turbojet, turbo propeller & ram jet. 3.7 Rocket propulsion- solid propellants and liquid propellants.	**10**

	3.8 Components & working principle of liquid propellants rocket engine.	
UNIT 4: **Hydraulic Turbines**	4.1. Introduction and classification of hydraulic turbines. 4.2. Construction and working principle of Pelton wheel, Francis and Kaplan turbine. 4.3. Velocity diagrams, work done, power and efficiency of Pelton wheel & Francis turbine. (Simple numerical). 4.4. Basic concept of governing of turbine. 4.5. Concept on specific speed and selection of turbine based on head and discharge available. 4.6. Schematic layout and description of hydroelectric power plant.	**10**
Sub Total : Total Lecture Classes		**45**
No. of classes required for conducting Internal Assessment examination		**6**
Grand Total:		**51**

3. Suggested Home Assignments/Students' Activities: (any Four)

a) Determine the thermal efficiencies of Otto cycle, Diesel cycle and dual combustion cycle (simple numerical).
b) Describe the valve-timing diagram of four-stroke diesel and petrol engine.
c) Describe the valve-timing diagram of two-stroke diesel and petrol engine.
d) Describe with schematic diagram of different types of lubrication system used in IC engine.
e) Describe with schematic diagram of a forced circulation cooling system used in a multi-cylinder I.C. Engine.
f) Describe Morse test to determine efficiency of a multi-cylinder IC engine.
g) Describe with figure, different types of nozzles and diffusers. Identify the areas of application for different types of nozzles and diffusers.
h) Determine work done, power and efficiency of a simple impulse turbine using graphical method only.
i) Draw the P-V & T-S diagrams of Brayton cycle and describe it.
j) Describe with schematic diagrams of turbojet, turbo propeller & ram jet.
k) Comparative discussion among Pelton wheel, Francis and Kaplan turbine.
l) Describe with schematic layout of hydroelectric power plant.

4. Suggested scheme for question paper design for conducting internal assessment examination:
(Duration: 45 minutes)

Questions to be set as per Bloom's Taxonomy				
	Distribution of Theory Marks			
	Level 1 (Remember)	Level 2 (Understand)	Level 3 (Apply & above)	Total
Class Test - 1	4	8	8	20

Class Test - 2	4	8	8	20

5. Suggested scheme for End Semester Examination: [Duration 2.5 hours]

Multiple Choice Type Questions (Carrying 1 mark each)				
Group	Unit	To be Set	To be Answered	Total Marks
A	1 & 2	15	20	20 x 01 = 2**0**
	3 & 4	10		
	Total:	**25**	**20**	**20**
Subjective Type Questions (Carrying 8 marks each)				
Group	Unit	To be Set	To be Answered	Total Marks
B	1 & 2	05	05	05 x 08 = **40**
C	3 & 4	04		
	Sub Total: (B + C):	**09**	**05**	**40**
			Total [A+B+C]:	**60**

6. Rubrics for the Assessment of Students Activity: (20 marks)

Sl. No.	**Performance Indicators**	**Weightage in %**	
1	In time submission of home assignment or submission of report after conducting site visit/ industry visit/ micro-project / market survey / internet search on specific topic, preparation of chart, creation of innovative model etc.		40
2	Viva voce or present seminar on submitted report.		60
2a	Communication skill	10	
2b	Technical interpretation skill	10	
2c	Answering / Conclusion with justification	40	
		Total:	100

7. Suggested Learning Resources:

Sl. No.	**Title of Book**	**Author**	**Publication**
1	A Course in Thermal Engineering.	V.M. Domkundwar	Dhanpat Rai & Co.
2	Engineering Thermodynamics (Principles & Practices)	D.S.Kumar	S.K. Kataria& Sons
3	A text book of Thermal Engineering.	R. S. Khurmi	S. Chand & Co.
4	A Course in Thermal Engineering.	P. L. Ballaney	Khanna Publishers
5	Power Plant Engineering	R. K. Rajput	Laxmi Publications (P) Ltd.

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Name of the Course: **Diploma in Mechanical Engineering**	
Category: Programme Core	**Semester : Fifth**
Code no.: MEPC303	**Full Marks : 100**
Course Title: Advanced Manufacturing Processes	**Examination Scheme:**
Duration : 17 weeks(Total class hour/week = 3)	(i) **External Assessment**: **60** marks (End Semester Examination)
Total lecture class/week: 3	(ii) **Internal Assessment**:**40** marks [Class Test : 20 marks Assignment/ viva voce: 10 marks Class attendance : 10 marks]
Credit : 3	
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.	

1. **Course Outcomes (COs):**
   The theory, practical experiences and relevant soft skills associated with this subject are to be taught and implemented, so that the student demonstrates the following industry oriented course outcomes:
   a) Student should be able to understand the fundamental concept, demonstrate the necessity, classification, mechanism of material removal, working principal and identify the specific application of Non-traditional Machining Processes.
   b) Student should be able to demonstrate the utility and select suitable Jig and /or Fixture for making a product economically.
   c) Student should be able to understand the basic concept of NC /CNC along with its utility and demonstrate the sequential processes /steps (along with part programming) to be followed to produce a specific job with the help of CNC Machine Tool.
   d) Student should be able to understand the basic concept, objective, identify the types of layout, basic components along with their function and demonstrate the advantages & disadvantages of Flexible Manufacturing System.

2. **Theory Components:**
   The following topics / subtopics should be taught and assessed in order to develop unit outcomes for achieving the identified course outcomes.

Unit	Topics and Sub-topics	Teaching Hours
UNIT: 1 **Introduction to Non-traditional Machining**	1.1 Basic concept of non-traditional machining. 1.2 Necessity of non traditional machining. 1.3 Classification of non traditional machining processes. 1.4 Advantages, limitations and field of applications of non-traditional machining. 1.5 Comparison among traditional and non-traditional machining.	**04**
UNIT: 2	2.1 Mechanism of material removal, working principle, setup,	**10**

Non-traditional Machining Processes	process parameters, advantages, limitations and applications of Ultrasonic Machining (USM). 2.2 Mechanism of material removal, working principle, setup, process parameters, advantages, limitations and applications of Electrical Discharge Machining (EDM) and Wire-EDM. 2.3 Mechanism of material removal, working principle, setup, process parameters, advantages, limitations and applications of Electrochemical Machining (ECM). 2.4 Mechanism of material removal, working principle, setup, process parameters, advantages, limitations and applications of Electron Beam Machining (EBM) and Laser Beam Machining (LBM).	
UNIT: 3 **Jigs and Fixtures**	3.1 Basic concept, difference and benefits of jig and fixtures. 3.2 Basic components of jig and fixture. 3.3 Concept of degree of freedom, locating and clamping. 3.4 3-2-1 principle of locating. 3.5 Types and applications of locators and clamping devises. 3.6 Types of jig and fixture. 3.7 General principles of jig and fixture design.	**08**
UNIT: 4 **CNC Machine Tools**	4.1 Basic concept of NC & CNC, applications of NC / CNC in manufacturing. 4.2 Basic concept of CNC turning centre and CNC machining centre. 4.3 Advantages and disadvantages of CNC machine tools. 4.4 Classification of CNC machine tools (Based on function, motion type, control loops, number of axis and power supply). 4.5 Basic components of CNC machine tools and their functions. 4.6 Function and application of the following components of CNC system: stepper motor, servo motor, encoders (rotary and linear encoder), recirculating ball screw, automatic tool changer, tool magazine. 4.7 Work holding methods for CNC machining centre (name of the devices and their applications). 4.8 Steps to be followed for machining a job in a CNC machine tool.	**10**
UNIT: 5 **CNC Part Programming**	5.1 Concept of part programming. 5.2 Structure of part programming. 5.3 Concept of reference point (machine zero, program zero, part zero). 5.4 Axis identification of CNC turning centre & CNC machining centre. 5.5 CNC codes for manual part programming: commonly used word address codes, G-codes and M-codes. 5.6 Part programming for CNC turning centre using different codes with or without fixed cycles (Canned cycle) to perform a job involving one or more of the following operations: turning, step turning, taper turning, facing, external thread cutting and	**08**

	parting off. 5.7 Part programming for CNC machining centre considering cutter radius compensation, ramp on/off motion, tool offset and using different codes with or without fixed cycles (Canned cycles) for generating different milled surface. 5.8 CNC part program verification.	
UNIT: 6 **Flexible Manufacturing System (FMS)**	6.1 Concept of flexible manufacturing system (FMS). 6.2 Basic components and their purpose of FMS (different workstations, automated material handling & storage system, computer control system). 6.3 Objectives of FMS. 6.4 Advantages & disadvantages of FMS.	**05**
Total Lecture Classes (Sub Total):		**45**
No. of classes required for conducting Internal Assessment:		**06**
Grand Total :		**51**

3. Suggested Home Assignments/ Student Activities:(Any Four)

Other than classroom and laboratory learning, following are the suggested student related co-curricular activities which can be undertaken to accelerate the attainment of the various outcomes in the course:

Note:

A suggested list of home assignments / student activities is given here. Similar home assignments / student activities could be added by the concerned faculty member also. Four (04) home assignments / student activities are to be undertaken by an individual student that needs to be assigned to him / her by the concern faculty member during the course. The execution of such home assignments / student activities may be done by an individual student or by a group of students as per discretion of the concern faculty member. Students should prepare and submit report for each of their assignment / activity.

a) Prepare a comparative study on traditional and non-traditional machining processes.
b) Prepare a chart containing the labelled machining setup of Electric Discharge Machining process showing all of its components and their functions.
c) Prepare a chart containing the labelled machining setup of Electrochemical Machining process showing all of its components and their functions.
d) Prepare a report on Acoustic Head as used in Ultrasonic Machining process explaining the mechanism of vibration generation of required frequency and amplitude as suitable for machining.
e) Prepare a comparative study on Electron Beam Machining and Laser Beam Machining processes.
f) Prepare a report on 3-2-1 principle of locating as used in designing of jig or fixture.
g) Prepare a chart containing the labelled diagrams of different types of jig and their specific application in manufacturing.
h) Prepare a comparative study on CNC machine tool and traditional machine tool.
i) Prepare a chart containing the labelled diagram of a CNC turning centre showing all of its components and their functions.
j) Prepare a chart containing the labelled diagram of a CNC machining centre showing all of its components and their functions.
k) Prepare a chart containing commonly used word address codes, G-codes, M-codes and their interpretation as used in manual part programming of CNC machine tool.

l) Prepare a part programming for CNC turning centre using different codes with or without fixed cycles for a specific job as assigned by the subject teacher.
m) Prepare a part programming for CNC machining centre using different codes with or without fixed cycles for a specific job as assigned by the subject teacher.
n) Prepare a report on different types of lay out used in flexible manufacturing system.

4. Suggested Scheme for Question Paper Design for Conducting Internal Assessment:
(Duration: 45 Minutes)

Questions to be set as per Bloom's Taxonomy				
Internal Assessment	Distribution of Theory Marks:			
	Level 1 (Remember)	Level 2 (Understand)	Level 3 (Apply & above)	Total
Class Test: 1	4	8	8	20
Class Test: 2	4	8	8	20

5. Suggested Scheme for End Semester Examination:(Duration: 2.5 hours)

Multiple Choice Type Questions (Carrying 1 mark each)				
Group	Unit	To be Set	To be Answered	Total Marks
A	1 & 2	08	20	20 x 01 = **20**
	3 & 4	10		
	5 & 6	07		
	Total:	**25**	**20**	**20**
Subjective Type Questions (Carrying 8 marks each)				
Group	Unit	To be Set	To be Answered	Total Marks
B	1 & 2	03	05	05 x 08 = **40**
C	3 & 4	04		
D	5 &6	02		
	Sub-Total [B+C+D]:	**09**	**05**	**40**
			Total [A+B+C+D]:	**60**

6. Rubrics for the assessment of students' activity:

Sl. No.	**Performance Indicators**
1	Originality of completing the Assigned task / micro-project work
2	Presentation Skill
3	In time submission of assignment work / micro-project work
4	Viva voce

7. Suggested Learning Resources:

Sl. No.	**Title of Book**	**Author**	**Publication**

01	Advanced Machining Processes, Non-traditional and Hybrid Machining Processes	Hassan El-Hofy	McGraw-Hill
02	Elements of workshop Technology – Volume I & II.	S. K. Hajra Chowdhury, Bose, Roy	Media Promoters and Publishers limited, Mumbai.
03	A Textbook of Manufacturing Technology (Manufacturing Processes)	R.K. RAJPUT	Laxmi Publications (P) Ltd.
04	A Course in Workshop Technology - Volume I & II.	B.S.Raghuwanshi	Dhanpat Rai Publications, New Delhi.
05	Manufacturing Processes.	Kalpakjian & Schemid	Pearson Education, New Delhi.
06	Manufacturing Technology – Volume I & II.	P. N. Rao	Tata McGraw-Hill, New Delhi.
07	CAD/CAM Principals and Applications	P. N. Rao	Tata McGraw-Hill, New Delhi.
08	Manufacturing Science.	Amitabh Ghosh, Mallik	East-West Press Pvt. Ltd., New Delhi.
09	Materials and Processes in Manufacturing.	DeGarmo	Wiley India Pvt. Ltd., New Delhi.
10	Machining & Machine Tool.	A.B. Chattopadhyay	Wiley India Pvt. Ltd., New Delhi.
11	CNC programming Handbook-Third edition	Peter Smid	Industrial Press Inc.
12	CNC Machining Handbook - Building, Programming, and Implementation	Alan Over	Tata McGraw-Hill, New Delhi.

8. Suggested Learning Websites:

a) ELS web-portal of WBSCTE

b) Fundamentals of CNC Machining, AUTODESK CAM, A Practical guide for beginners, Desk Copy, Document Number: 060711

c) https://nptel.ac.in

d) https://www.nitttrchd.ac.in

e) https://swayam.gov.in

f) https://www.mechanicalbooster.com

g) https://www.machinedesign.com

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Name of the Course: **Diploma in Mechanical Engineering**	
Category: Programme Core	**Semester : Fifth**
Code no.: MEPC309	**Full Marks : 100**
Course Title: Fluid Mechanics and Machinery	**Examination Scheme:**
Duration : 17 weeks(Total class hour/week = 3)	(i) **External Assessment**: **60** marks (End Semester Examination)
Total lecture class/week: 3	
Credit : 3	(ii) **Internal Assessment**:**40** marks [Class Test : 20 marks Assignment/ viva voce: 10 marks Class attendance : 10 marks]
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.	

1. **Course Outcomes (Cos):**
   - i) Interpret the various types fluid properties and relation between them
   - ii) Measure pressure of fluid
   - iii) Identify various types of flow,
   - iv) Interpret the concept of continuity equation and Bernoulli's theorem
   - v) Measure of fluid velocity using pitot tube and discharge using orifice mete, venturimeter.
   - vi) Interpret the principle of flow through pipes and measure the frictional loss in pipe flow
   - vii) Determine the impact of jet on different types of fixed and moving jets
   - viii) Describe the construction and working and use of centrifugal and reciprocating pumps.
   - ix) Solve problems on various performance parameters of pumps
   - x) Plot TGL & HGL (velocity and pressure profiles) for fluid flow.
   - xi) Concept of flow measuring devices and velocity measuring devices
   - xii) Select the proper pump, given the required flow rate and pressure rise,

2. **Theory Components:**
   The following topics / subtopics should be taught and assessed in order to develop unit outcomes for achieving the identified course outcomes.

Unit	Topics& Sub-topics	Teaching Hours

UNIT: 1 **Properties of Fluid**	1.1 Concept of fluid. 1.2 Properties of fluid - Density, Specific gravity, Specific Weight, Specific Volume, simple numerical. 1.3 Concept of viscosity, Newton's law of viscosity, Dynamic Viscosity, Kinematic viscosity, simple numerical. 1.4 Types of fluid- Ideal fluid, real fluid (Newtonian & Non-Newtonian by graphical representation). 1.5 Concept of cohesion, adhesion, surface tension & capillarity. 1.6 Concept of Vapour Pressure& Compressibility.	**04**
UNIT: 2 **Fluid Pressure & Pressure Measurement**	2.1 Fluid pressure, pressure head, pressure intensity, simple numerical. 2.2 Concept of atmospheric pressure, gauge pressure, vacuum pressure, absolute pressure, simple numerical. 2.3 Measurement of pressure using simple, inclined and differential manometers, Burdon pressure gauge, simple numerical on manometer. 2.4 Concept of total pressure on immersed surfaces (having flat vertical and flat inclined planes), centre of pressure, pressure distribution diagram; simple numerical.	**08**
UNIT: 3 **Fluid Flow**	3.1 Types of fluid flow: steady-unsteady, uniform-non uniform, streamline, path line and streak line, laminar-turbulent. 3.2 Continuity equation. 3.3 Bernoulli's theorem – potential head, pressure head & kinetic head. 3.4 Venturimeter – construction, principle of working, coefficient of discharge, derivation for discharge through venturimeter. 3.5 Orifice meter – Construction, Principle of working, hydraulic coefficients and discharge through orifice meter (no derivation). 3.6 Pitot tube – construction, principle of working, velocity measurement. **Note:** Numerical on continuity equation, venturimeter, orifice meter, and pitot tube.	**08**
UNIT: 4 **Flow through Pipes**	4.1 Laminar, turbulent flows& Reynolds number. 4.2 Darcy's equation and Chezy's equation for frictional losses. No deduction; simple numerical. 4.3 Minor losses in pipes, simple numerical. 4.4 Concept of hydraulic gradient line and total gradient line.	**05**
UNIT: 5 **Impact of jet**	5.1 Impact of jet on fixed vertical flat plate, moving vertical flat plate, simple numerical. 5.2 Impact of jet on curved vanes with special reference to turbines & pumps, simple numerical.	**06**
UNIT: 6	Centrifugal Pump:	**14**

Hydraulic Pumps	6.1 Construction, working principle and applications. 6.2 Types of casings and impellers. 6.3 Concept of multistaging. 6.4 Priming and its methods. 6.5 Concept of manometric head, work done, manometric efficiency, overall efficiency, NPSH, cavitation. 6.6 Submersible pump and Jet pump – construction and working principle and application. Reciprocating Pump: 6.7 Construction, working principle and applications of single and double acting reciprocating pumps. 6.8 Concept of slip, negative slip, cavitation and separation 6.9 Use of air vessel. 6.10 Indicator diagram with effect of acceleration head & frictional head.	
	Sub Total : Total Lecture Classes	**45**
No. of classes required for conducting Internal Assessment Examination		**06**
	Grand Total :	**51**

3. Suggested List of Assignments/Tutorial: (any five)

1. Numerical on manometers, total pressure & centre of pressure.
2. Numerical on viscosity, Newton laws of viscosity.
3. Numerical on venturimeter, orifice meter, pitot tube.
4. Draw HGL and TEL for flow through pipe having different diameter.
5. Simple Numerical on work done and efficiency on impact of jet.
6. Numerical on calculations of overall efficiency andpower required to drive centrifugal pumps.
7. List different types of pumps and their use.
8. Selection of pump as per requirement for a given head and capacity
9. Numerical on major and minor loss calculations in pipe flow

4. Suggested scheme for question paper design for conducting Internal Assessment Examination: (Duration: 45 minutes)

Questions to be set as per Bloom's Taxonomy				
	Distribution of Theory Marks			
	Level 1 (Remember)	Level 2 (Understand)	Level 3 (Apply & above)	Total
Class Test -1	4	8	8	20
Class Test -2	4	8	8	20

5. Suggested Scheme for End Semester Examination: [Duration2.5 hours]

Multiple Choice Type Questions (Carrying 1 mark each)				
Group	Unit	To be Set	To be Answered	Total Marks
A	1&2	05	20	20x01=**20**
	3&4	05		
	5& 6	05		
	Total:	**25**	**20**	**20**
Subjective Type Questions (Carrying 8 marks each)				
Group	Unit	To be Set	To be Answered	Total Marks
B	1 & 2	03	05	05 x 08 = **40**
C	3 & 4	03		
D	5 & 6	03		
	Sub-Total [B+C+D]:	**09**	**05**	**40**
			Total [A+B+C+D]:	**60**

6. Suggested Learning Resources:

Sl. No.	Title of Book	Author	Publication
1	Fluid Mechanics & Hydraulic Machines	R.D. Bansal	Laxmi Publication
2	Fluid Mechanics & Hydraulic Machines	R.K.Rajput	S. Chand
3	Fluid Mechanics & Hydraulic Machines	Jagadishlal	Metropolitan Book Company
4	Fluid Mechanics & Hydraulic Machines	S. Pati	Tata McGraw Hill
5	Fluid Mechanics & Hydraulic Machines	D.S.Kumar	S.K. Kataria

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Name of the Course: Diploma in Mechanical Engineering	
Category: Programme Elective	**Semester : Fifth**
Code no. : MEPE301/1	**Full Marks : 100**
Course Title : Power Plant Engineering	**Examination Scheme :** (iii) **External Assessment : 60** marks (End Semester Examination) (iv) **Internal Assessment: 40** marks [Class test : 20 marks Assignment / viva voce : 10 marks Class attendance : 10 marks]
Duration :17 weeks (Total class hours per week = 2)	
Total lecture class/week : 2	
Credit : 2	
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.	

1. Course Outcomes (COs):

After completion of this course, the student will be able to-

i. Get concept of power scenario in India and World.
ii. Draw the layouts of different types of power plants.
iii. Select suitable location for any type of power plant.
iv. Explain the hazards associated with all types of power plants.
v. Describe the working principal of different types of conventional as well as non-conventional power generation systems.
vi. Identify and describe the function of major electrical components associated with any power plant.
vii. Explain the basic economics associated with power plant.

2. Theory Components:

The following topics/subtopics should be taught and assessed for achieving the course outcomes to attain the identified competency.

Unit	Topics & Sub-topics	Teaching Hour
UNIT 1: **Introduction to Power Plant**	1.1. Basic concept of power plant. 1.2. Power scenario in India and World. 1.3. Classification of power plants. 1.4. Future trends in power generation. 1.5. General criteria for selection of site for different type of power plant.	**3**
UNIT 2: **Steam Power**	2.1 Layout of steam power plant. 2.2 High pressure (sub-critical & super critical boilers) –	

Plant	concept and characteristics. 2.2 Construction and working of Loeffler boiler and Volex boiler. 2.3 Coal handling system – from coal delivered at power station to feeding the coal into the furnace. 2.4 Ash handling system–layout of ash handling system for bottom ash & fly ash from boiler house to ash pond, electrostatic precipitator. 2.5 Hazards associated with ash disposal and its precautionary measures. 2.6 Pollution associated with steam power plant – air, water and soil pollution.	**7**
UNIT 3: **Diesel Engine Power Plant**	3.1 Advantages and disadvantages of diesel engine power plant. 3.2 Application of diesel engine power plant. 3.3 Types of diesel engine used for power plant. 3.4 General layout of diesel engine power plant. 3.5 Air intake system, exhaust gas system and fuel system (only layout and brief description). 3.6 Pollution associated with diesel engine power plant and its environmental effects and control.	**4**
UNIT 4: **Gas Turbine Power Plant**	4.1 General layout of gas turbine power plant. 4.2 Main components of gas turbine plants and their brief description. 4.2 Fuels used in gas turbine. 4.4 Regenerative and reheat process (only schematic diagram and brief description). 4.5 Environmental impact of gas turbine power plant.	**3**
UNIT 5: **Hydro-electric Power Plant**	5.1. General layout of a hydro-electric power plant and brief description of the function of each major component. 5.2. Classification& selection of hydro-electric power plant (only basic concept).	**2**
UNIT 6: **Nuclear Power Plant**	6.1. Basic concept of nuclear energy. 6.2. General layout of nuclear power plant. 6.3. Brief description of main components of nuclear power plant. 6.4 Safety measures for nuclear power plant and hazards associated with waste disposals.	**4**
UNIT 7: **Non-Conventional Power Generation**	7.1. Introduction to different types of non-conventional energy sources used for power generation. 7.2. Layout and brief description of – Wind power plant, Tidal power plant, Solar power plant and Geothermal power plant. 7.3. Merits and demerits of above mentioned power plants.	**4**
UNIT 8: **Basic Operation and Economics of Power**	8.1. Layout of major electrical component associated with any power plant and their function (no working principle). 8.2. Important terms associated with power- connected load, load curve and load factor.	**3**

Generation	8.3. Economics of power plant selection. 8.4. Factors affecting economics of generation and distribution of power. 8.5. Tariff for electrical energy.	
	Sub Total : Total Lecture Classes	**30**
No. of classes required for conducting Internal Assessment examination		**4**
	Grand Total :	**34**

3. Suggested Home Assignments/Students' Activities: (any Four)

a) Classify the power plants operating in India and make a table for major power plants along with their location, year of establishment and capacity.
b) Make a general layout for a steam power plant and describe briefly the function of each component mentioned in the lay out.
c) Draw a lay out of a Coal Handling System – from coal delivered at power station to feeding the coal into the furnace. Briefly describe the system.
d) List and describe the pollutant generate from steam power plant and their effects on air, water and soil.
e) Describe with schematic diagram of any three types of dust collectors – Settling chamber, Cyclone separators, Fibre filters, Fly ash scrubber and Electrostatic precipitator.
f) Describe the pollution aspect associated with Diesel Engine Power Plant and its environmental effects and control.
g) Draw the general layout of Gas Turbine Power Plant and describe briefly the function of the main components of it.
h) Draw the schematic diagrams of Regenerative process and Reheat process and describe briefly.
i) Draw the general layout of a Hydro-electric Power Plant and briefly describe the function of each major component.
j) Describe the hazards associated with Nuclear Power Plant and safety measures to be followed.
k) Draw the layout and briefly describe (any two) – Wind Power Plant, Tidal Power Plant, Solar Power Plant and Geothermal Power Plant.
l) Draw the layout of major electrical component associated with any power plant and describe their functions.
m) Describe the factors affecting economics of generation and distribution of power from a power plant.

4. **Suggested scheme for question paper design for conducting internal assessment examination** : (Duration: 45 minutes)

Questions to be set as per Bloom's Taxonomy				
	Distribution of Theory Marks			
	Level 1 (Remember)	Level 2 (understand)	Level 3 (Apply & above)	Total
Class Test - 1	4	8	8	20
Class Test - 2	4	8	8	20

5. **Suggested Scheme for End Semester Examination:** [Duration 2.5 hours]

Multiple Choice Type Questions (Carrying 1 mark each)				
Group	Unit	To be Set	To be Answered	Total Marks
A	1 & 2	08	20	20 x 01 = **20**
	3, 4 & 5	09		
	6, 7 & 8	08		
	Total:	**25**	**20**	**20**
Subjective Type Questions (Carrying 8 marks each)				
Group	Unit	To be Set	To be Answered	Total Marks
B	1 & 2	03	05	05 x 08 = **40**
C	3, 4 & 5	03		
D	6, 7 & 8	03		
	Sub-Total [B+C+D]:	**09**	**05**	**40**
			Total [A+B+C+D]:	**60**

6. Rubrics for the Assessment of Students Activity: (20 marks)

Sl. No.	**Performance Indicators**	**Weightage in %**	
1	In time submission of home assignment or submission of report after conducting site visit/ industry visit/ micro-project / market survey / internet search on specific topic, preparation of chart, creation of innovative model etc.		40
2	Viva voce or present seminar on submitted report		60
2a	Communication skill	10	
2b	Technical interpretation skill	10	
2c	Answering / Conclusion with justification	40	
		Total:	100

7. Suggested Learning Resources:

Sl. No.	**Title of Book**	**Author**	**Publication**
1	Power Plant Engineering	G. R. Nagpal	Khanna Publishers
2	A Course in Thermal Engineering.	V.M. Domkundwar	Dhanpat Rai & Co.
3	Power Plant Engineering	Raja, Srivastava and Dwivedi	New Age International Publishers
4	A text book of Thermal Engineering.	R. S. Khurmi	S. Chand & Co.
5	A Course in Thermal Engineering.	P. L. Ballaney	Khanna Publishers
6	Power Plant Engineering	R. K. Rajput	Laxmi Publications (P) Ltd.

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Name of the Course: Diploma in Mechanical Engineering	
Category: Programme Elective	**Semester : Fifth**
Code no. : MEPE301/2	**Full Marks : 100**
Course Title : Material Handling System	**Examination Scheme :** **(i) External Assessment : 60** marks (End Semester Examination) **(ii) Internal Assessment: 40** marks [Class test : 20 marks Assignment / viva voce : 10 marks Class attendance : 10 marks]
Duration :17 weeks (Total class hours per week = 2)	
Total lecture class/week : 2	
Credit : 2	
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.	

1. **Course Outcomes (COs):**
   a. Understand constructional & operational features of various materials handling systems.
   b. Understand different material handling processes used in industries.
   c. Identify, compare & select proper material handling equipment for specified applications.
   d. Appreciate the role of material handling devices in mechanization and automation of industrial process.

2. **Theory Components:**
   The following topics/subtopics should be taught and assessed in order to develop unit outcomes for achieving the identified course outcomes:

Unit	Topics and Sub-topics	Teaching Hours
UNIT 1: **Introduction to Material Handling System**	1.1 Main types of material handling equipments & their applications. 1.2 Types of load to be handled- unit load, bulk load and their designation by code. 1.3 Types of movements; Methods of stacking, loading & unloading systems. 1.4 Principles of material handling systems. 1.5 Modern trends in material handling.	**04**
UNIT 2: **Hoisting Machinery & Equipments**	2.1 Construction, working &applications of different types of hoists such as Portable hand chain hoist and Electric hoists. 2.2 Construction, working& safety arrangement of EOT Cranes. 2.3 Construction, working &applications of Jib Crane and mobile Crane.	**05**

	2.4 Construction, working &applications of Bucket Elevator.	
UNIT 3: **Conveying Machinery**	3.1 Construction, working &applications of Traction type conveyors such as Belt Conveyors and Chain Conveyors. 3.2 Construction, working &applications of Traction less type conveyors such as Screw Conveyors, Hydraulic Conveyors, Pneumatic Conveyors, Vibrating Conveyors.	**06**
UNIT 4: **Surface Transportation Equipment**	4.1 Construction, working& applications of Trackless equipment such as Hand operated trucks, Powered trucks, Fork Lifts, Automatic Guided Vehicle (AGV), and Industrial Trailers.	**04**
Unit 5: **Basic Components of Material Handling System**	5.1 Construction and function of Welded load chains, Steel wire ropes, Eye bolts, Lifting tackles, various types of hooks such as forged, triangular eye hooks. 5.2 Crane grab for unit & piece loads, Grabbing attachment for loose materials, Crane attachment for handling liquids/molten metals. 5.3 Construction & applications of Arresting gear & Brakes. 5.4 Construction & applications of electromagnetic shoe brakes, Control brakes.	**06**
Unit 6: **Selection of Material Handling Equipment**	6.1 Factors affecting choice of material handling equipment such as type of loads, hourly capacity of the unit, direction & length of travel, methods of stocking at initial, final & intermediate points, nature of production process involved, specific load conditions & economics of material handling system.	**05**
	Sub Total : Total Lecture Classes:	**30**
	No. of classes required for conducting Internal Assessment:	**04**
	Grand Total :	**34**

3. Suggested Home Assignments/Students' Activities: (any Four)

i. Write a brief report on modern trends in material handling.
ii. Enlist the essential parts of Bucket Elevator and their function with a suitable diagram.
iii. Enlist the essential parts of Belt Conveyor and their function with a suitable diagram.
iv. Enlist the essential parts of Screw Conveyor and their function with a suitable diagram.
v. Enlist the essential parts of AGV and their function with a suitable diagram.
vi. Write the names and their specific use of different hand Operated trucks used in actual industries.
vii. Enlist the various safety components and their functions used in EOT cranes.
viii. Enlist the various basic components and their functions used in material handling system.

4. Suggested scheme for question paper design for conducting internal assessment examination:
(Duration: 45 minutes)

Questions to be set as per Bloom's Taxonomy

	Distribution of Theory Marks			
	Level 1 (Remember)	Level 2 (understand)	Level 3 (Apply & above)	Total
Class Test - 1	4	8	8	20
Class Test - 2	4	8	8	20

5 Suggested Scheme for End Semester Examination: [Duration 2.5 hours]

Multiple Choice Type Questions (Carrying 1 mark each)				
Group	Unit	To be Set	To be Answered	Total Marks
A	1 & 2	09	20	20 x 01 = **20**
	3 & 4	09		
	5 & 6	07		
	Total:	**25**	**20**	**20**
Subjective Type Questions (Carrying 8 marks each)				
Group	Unit	To be Set	To be Answered	Total Marks
B	1 & 2	03	05	05 x 08 = **40**
C	3 & 4	03		
D	5 & 6	03		
	Sub-Total [B+C+D]:	**09**	**05**	**40**
			Total [A+B+C+D]:	**60**

6 **Rubrics for the Assessment of Students Activity: (20 marks)**

Sl. No.	**Performance Indicators**	**Weightage in %**	
1	In time submission of home assignment or submission of report after conducting site visit/ industry visit/ micro-project / market survey / internet search on specific topic, preparation of chart, creation of innovative model etc.		40
2	Viva voce or present seminar on submitted report		60
2a	Communication skill	10	
2b	Technical interpretation skill	10	
2c	Answering / Conclusion with justification	40	
		Total:	100

7 **Suggested Learning Resources:**

Sl. No.	**Title of Book**	**Author**	**Publication**
1	Introduction to Materials Handling	S. Ray	New Age International (P) Ltd.
2	Mechanical Handling of Materials	T. K. Ray	Asian Books Pvt. Ltd.

3	Material Handling Equipment	M. P. Alexandrov	MIR Publishers, Moscow
4	Material Handling Equipment	R. B. Chowdary & G. R. N. Tagore	Khanna Publishers
5	Material Handling (Principles & Practice)	T. H. Allegri	CBS Publishers, New Delhi

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Name of the Course: Diploma in Mechanical Engineering	
Category: Programme Elective	**Semester : Fifth**
Code no. : MEPE303/1	**Full Marks : 100**
Course Title : Computer Aided Design & Manufacturing	**Examination Scheme :** **(i) External Assessment : 60** marks (End Semester Examination) **(ii) Internal Assessment: 40** marks [Class test : 20 marks Assignment / viva voce : 10 marks Class attendance : 10 marks]
Duration :17 weeks (Total class hours per week = 2)	
Total lecture class/week : 2	
Credit : 2	
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.	

1. Course Outcomes (COs):

CO1 : Understand and develop the geometric models using CAD software.
CO2 : Develop programs for CNC to manufacture industrial components.
CO3: Understand the application of computers in various aspects of manufacturing viz., Design, Proper planning, Manufacturing, Quality control & Material handling system.
CO4 : Understand Flexible manufacturing system.

2. Theory Components:

The following topics / subtopics should be taught and assessed in order to develop unit outcomes for achieving the identified course outcomes.

Unit	Topics and Sub-topics	Teaching Hours
Unit 1: **Introduction to CAD/CAM**	1.1 Computers in industrial manufacturing. 1.2 Basic concept of CAD & CAM with reference to the product cycle in a computerized manufacturing environment and objective of CAD & CAM. 1.3 CAD/CAM hardware: Basic structure, CPU, Memory, Input / Output Devices, Hard-copy devises, Storage devices, Software and system configuration.	**03**
Unit 2: **Geometric Modelling**	2.1 Objective and requirement of geometric modelling. 2.2 Types and comparison of geometric models. 2.3 Geometric construction methods: sweep or extrusion, solid modelling (primitives & Boolean operators), free formed surfaces (classification and basic concept of surfaces only).	**06**

Unit 3: **Introduction to Computer Numerical Control**	3.1 Basic concept of NC, CNC and DNC. 3.2 Advantages and limitations of NC and CNC. 3.3 Application of CNC. 3.4 The coordinate systems in CNC. 3.5 Motion control systems in CNC: point to point, straight line, continuous path (contouring).	**03**
Unit 4: **CNC Programming**	4.1 Part-programming fundamentals. 4.2 Manual part-programming methods: word address format, primary function, miscellaneous functions, program number, tool-length compensation, cutter-radius compensation, canned cycle. 4.3 Part programming for CNC turning centre. 4.4 Part programming for CNC machining centre. 4.5 Concept of computer aided part programming.	**06**
Unit 5: **Group Technology (GT)&Computer Aided Process Planning (CAPP)**	5.1 Concept of group technology. 5.2 Part families. 5.3 Part classification and coding: benefits, classification and coding system (Opitz system, MICLASS system and CODE system). 5.4 Concept to machine cell design 5.5 Benefits of group technology. 5.6 Concept of computer aided process planning(CAPP); 5.7 Concept of retrieval-type CAPP system. 5.8 Concept of generative type CAPP system. 5.9 Benefits of computer aided process planning.	**06**
Unit 6: **Computer Aided Quality Control (CAQC)**	6.1 Concept and objectives of computer aided quality control. 6.2 Contact inspection methods. 6.3 Noncontact inspection methods (optical and non-optical).	**02**
Unit 7: **Flexible Manufacturing System (FMS)**	7.1 Concept of Flexible Manufacturing System (FMS). 7.2 Automated material handling systems of FMS: Automated Guided Vehicles (AGV) and robots (types, advantages and applications only). 7.3 Other basic components of FMS and their purpose (different workstations, automated storage system and computer control system). 7.4 Types of FMS layout. 7.5 Objectives of FMS. 7.6 Advantages & limitations of FMS.	**04**
	Sub Total : Total Lecture Classes:	**30**
	No. of classes required for conducting Internal Assessment:	**04**
	Grand Total :	**34**

3. Suggested Home Assignments/Students' Activities: (any three)

Other than classroom and laboratory learning, following are the suggested student related co-curricular activities which can be undertaken to accelerate the attainment of the various outcomes in the course:

Note:

A suggested list of home assignments / student activities is given here. The concerned faculty member could add similar home assignments / student activities also. Three (03) home assignments / student activities are to be undertaken by an individual student that needs to be assigned to him / her by the concern faculty member during the course. The execution of such home assignments / student activities may be done by an individual student or by a group of students as per discretion of the concern faculty member. Students should prepare and submit report for each of their assignment / activity.

i. List the various software and equipment related to CAD / CAM / FMS / CAQC / CAPP used in various industries.

ii. Prepare a power point presentation on CMM / Application of AVG in material handling system.

iii. Visit industries consisting CAD / CAM / FMS system and submit a report.

iv. Use CNC m/c tool or virtual CNC m/c to make utility product as assigned by faculty member.

v. Develop a CAD model by using any CAD software as assigned by faculty member.

vi. Prepare a complete specification of a CNC machine tool (Turning Centre / Machining Centre) for procurement that would be used in training institute.

4. Suggested scheme for question paper design for conducting internal assessment examination:
(Duration: 45 minutes)

Questions to be set as per Bloom's Taxonomy				
	Distribution of Theory Marks			
	Level 1 (Remember)	Level 2 (understand)	Level 3 (Apply & above)	Total
Class Test - 1	4	8	8	20
Class Test - 2	4	8	8	20

5. Suggested Scheme for End Semester Examination: [duration 2.5 hours]

Multiple Choice Type Questions (Carrying 1 mark each)				
Group	Unit	To be Set	To be Answered	Total Marks
A	1 & 2	09	20	20 x 01 = 20
	3 & 4	08		
	5, 6 & 7	08		
	Total:	**25**	**20**	**20**
Subjective Type Questions (Carrying 8 marks each)				

Group	Unit	To be Set	To be Answered	Total Marks
B	1 & 2	03	05	05 x 08 = **40**
C	3 & 4	03		
D	5, 6 & 7	03		
	Sub-Total [B+C+D]:	**09**	**05**	**40**
			Total [A+B+C+D]:	**60**

6 **Rubrics for the Assessment of Students Activity: (20 marks)**

Sl. No.	**Performance Indicators**	**Weightage in %**	
1	In time submission of home assignment or submission of report after conducting site visit/ industry visit/ micro-project / market survey / internet search on specific topic, preparation of chart, creation of innovative model etc.		40
2	Viva voce or present seminar on submitted report.		60
2a	Communication skill	10	
2b	Technical interpretation skill	10	
2c	Answering / Conclusion with justification	40	
		Total:	100

7 **Suggested Learning Resources:**

Sl. No.	**Title of Book**	**Author**	**Publication**
1	CAD/CAM Principles and Applications	P. N. Rao	Tata-McGraw-Hill
2	CNC Machine	B. S. Pabla & M. Adithan	New Age International(P) Ltd.
3	CAD & CAM Theory and Concepts	K. Sareen & C. Grewal	S. Chand
4	CNC Machine & Automation	J. S. Narang	Dhanpat Rai & Co.
5	Computer Aided Design and Manufacturing	Groover M. P. & Zimmers Jr	Prentice Hall of India

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Name of the Course: Diploma in Mechanical Engineering	
Category: Programme Elective	**Semester : Fifth**
Code no. : MEPE303/2	**Full Marks : 100**
Course Title : Automobile Engineering	**Examination Scheme :** **(i) External Assessment : 60** marks (End Semester Examination) **(ii) Internal Assessment: 40** marks [Class test : 20 marks Assignment / viva voce : 10 marks Class attendance : 10 marks]
Duration :17 weeks (Total class hours per week = 2)	
Total lecture class/week : 2	
Credit : 2	
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.	

1. Course outcomes (COs):

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

a. Identify various systems equipped with a vehicle.
b. Identify the main components of fuel feed systems, cooling & lubrication systems used in automobile.
c. Explain how do transmission gear box and differential gearbox work.
d. Explain the construction and working various systems (such as braking systems, suspension systems, starting system) used in automobile.

2. Theory Components:

The following topics/subtopics should be taught and assessed in order to develop unit outcomes for achieving the course outcomes:

Unit	Topics and Sub-topics	Teaching Hours
UNIT-1: **Introduction**	1.1 Concept and Classification of automobiles. 1.2.Vehicle layout and its types. 1.3 Function of Chassis and frame. 1.4 Nomenclature of car body.	**02**
UNIT-2: **Fuel Feed Systems**	2.1. Layout of S.I.engine fuel feed system and function of each component. 2.2 Requirement of air-fuel ratio, function and types of carburettor, working principle of simple carburettor. 2.3 Circuits of carburettor– float, starting, idling, low speed, high speed & accelerating circuit. 2.4 Types, layout and working of multi-point fuel injection system of petrol engine, advantages and disadvantages.	**06**

	2.5 Layout and working of common rail fuel supply system of diesel engine. 2.6 Layout and working of individual pump fuel supply system of diesel engine. 2.7 Function of fuel injector. 2.8 Use of single orifice and multiple orifice Injector. 2.9 Working of fuel level gauge.	
UNIT-3: **Cooling & Lubrication Systems**	3.1 Necessity of lubrication system and components of automobile need lubrication. 3.2. Layout and working of splash, wet sump, and dry sump type lubrication system. 3.3 Necessity of engine cooling system. 3.4 Layout and working of pump circulation type water cooling system; use of anti-freeze solutions. 3.5 Working of thermostat, oil pressure gauge, and water temperature gauge.	**04**
UNIT-4: **Transmission Systems**	4.1 Necessity and types of clutch. 4.2 Construction and working of single plate friction clutch (both coil spring type & diaphragm type), field of applications. 4.3 Necessity and types of gear box. 4.4 Construction and working of synchromesh gear box, torque converter. 4.5 Necessity & working of propeller shaft & differential. 4.6 Functions of front axle and rear axle.	**05**
UNIT-5: **Control Systems**	5.1 Steering system –Requirement of steering system, layout and working of steering linkage for rigid axle suspension system and independent suspension system, steering ratio. 5.2 Working of rack& pinion type steering gear box and recirculating ball type steering gear box. 5.3 Introduction to power steering. 5.4 Steering geometry –Necessity of camber, caster, toe-in, toe-out, king pin inclination. 5.5 Brake system – construction and working of hydraulic brake and pneumatic brake. 5.6 Comparison of disc brake and drum brake.	**05**
UNIT-6: **Suspension Systems, Wheels & Tyres**	6.1. Necessity of suspension system. 6.2 Construction & working of leaf spring, rigid axle suspension. 6.3 Construction & working of McPherson and Wishbone suspension. 6.4 Construction & working of telescopic type shock absorber. 6.5 Introduction to air suspension. 6.6 Construction of disc wheel& light alloy cast wheel. 6.7 Types of tyres, construction and working of conventional tubed tyre and tubeless tyre, tyre specifications, Factors affecting tyre life.	**05**
UNIT-7: **Starting, Ignition & Charging Systems**	7.1 Function of battery in automobile; Rating of battery. 7.2 Construction & working of self-starter. 7.3 Construction & working of high energy electronic ignition system and capacitive discharge ignition system. 7.4 Construction and working of charging system with alternator. 7.5 Use of microprocessor in automobile control system.	**03**

Sub Total : Total lecture classes	**30**
No. of classes required for conducting Internal Assessment examination	**4**
Grand Total :	**34**

3. Suggested Home Assignments/Students' Activities: (any four)

i) Draw labeled schematic flow diagram of multipoint fuel injection (MPFI) system of petrol engine and write functions of each components.

ii) Draw labeled schematic flow diagram of conventional fuel feed system of petrol engine and write functions of each components.

iii) Draw labeled schematic diagram of differential gearbox and explain its working – a. while taking a turn, b. while moving along a straight path.

iv) Draw labeled schematic flow diagram of common rail type fuel feed system of diesel engine and write functions of each components.

v) Draw labeled schematic flow diagram of individual pump type fuel feed system of diesel engine and write functions of each components.

vi) Draw labeled schematic flow diagram of torque converter and write functions of each components.

vii) Draw labeled schematic flow diagram of telescopic type shock absorber and write functions of each components.

viii) Draw labeled schematic flow diagram of hydraulic braking system and write functions of each components.

ix) Draw labeled schematic flow diagram of pneumatic braking system and write functions of each components.

x) Draw labeled schematic flow diagram of steering linkage for rigid axle suspension system and write functions of each components.

xi) Draw labeled schematic flow diagram of pressure feed lubrication system and write functions of each components.

xii) Draw labeled schematic flow diagram of force-feed water cooling system and write functions of each components.

xiii) Draw labeled schematic flow diagram of synchromesh gearbox and write the methods to obtain various speed of it.

4. **Suggested scheme for question paper design for conducting Internal Assessment examination:**
(Duration: 45 minutes)

Questions to be set as per Bloom's Taxonomy				
	Distribution of Theory Marks			
	Level 1 (Remember)	Level 2 (understand)	Level 3 (Apply & above)	Total
Class Test - 1	4	8	8	20
Class Test - 2	4	8	8	20

5. Suggested Scheme for End Semester Examination [Duration 2.5 hours]

Multiple Choice Type Questions (Carrying 1 mark each)				
Group	Unit	To be Set	To be Answered	Total Marks
A	1, 2& 3	7	20	20 x 01 = **20**
	4&5	5		
	6&7	3		
	Total:	**25**	**20**	**20**
Subjective Type Questions (Carrying 8 marks each)				
Group	Unit	To be Set	To be Answered	Total Marks
B	1, 2& 3	4	05	05 x 08 =**40**
C	4&5	3		
D	6&7	2		
	Sub-Total [B+C+D]:	**09**	**05**	**40**
			Total [A+B+C+D]:	**60**

8 **Rubrics for the Assessment of Students Activity:**

Sl No.	**Performance Indicators**
1	Originality of completing the assigned task
2	Presentation Skill
3	In Time submission of Assignment report / micro-project task
4	Viva-voce

9 **Suggested Learning Resources:**

Sl. No.	**Title of Book**	**Author**	**Publication**
1	Automobile Engineering (Vol.-I and Vol.-II)	Dr. Kirpal Singh	Standard Publication
2	Automobile Engineering	G. B. S. Narang	Khanna Publication
3	Automobile Engineering	R. K. Singal	S. K. Kataria
4	A text book in Automobile Engineering	S. K. Gupta	S. Chand
5	Automobile Mechanics	William Crouse	Tata McGraw-hill

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<table>
<tr><th colspan="4">Name of the Course: Diploma in Mechanical Engineering</th></tr>
<tr><td>Category: Programme Core</td><td colspan="3">Semester: Fifth</td></tr>
<tr><td>Code No.: MEPC311</td><td colspan="3">Full Marks:100</td></tr>
<tr><td rowspan="3">Course Title: Power Engineering Lab</td><td colspan="3">Sessional Examination Scheme:</td></tr>
<tr><td colspan="3">External Assessment
(End Semester Sessional Examination)</td></tr>
<tr><td>Assignment on the day of Viva Voce:</td><td>20</td><td rowspan="2">40 marks</td></tr>
<tr><td rowspan="4">Duration : 17 weeks (2 hours per week)</td><td>Viva Voce (before Board of Examiners):</td><td>20</td></tr>
<tr><td colspan="3">Internal Assessment</td></tr>
<tr><td>Continuous assessment of class performance and in time submission of Assignments:</td><td>30</td><td rowspan="3">60 marks</td></tr>
<tr><td rowspan="2">Total practical classes/week: 2</td><td>Viva Voce:</td><td>20</td></tr>
<tr><td>Class Attendance:</td><td>10</td></tr>
<tr><td>Credit: 1</td><td colspan="2">Total Marks:</td><td>100</td></tr>
<tr><td colspan="4">Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.</td></tr>
</table>

1. **Practical Components:**
   The list of practical to be completed **(**any Five) by the students towards attainment of the required competency.

Sl. No.	List of Practical
1	Study and demonstration of the construction and working of two-stroke IC engine and identify different components of it.
2	Study and demonstration of the construction and working of four-stroke IC engine and identify different components of it.
3	Conduct trial on Petrol Engine Test Rig to find out the Brake Thermal Efficiency and Brake Specific Fuel Consumption.
4	Conduct trial on Diesel Engine Test Rig to find out the Brake Thermal Efficiency and Brake Specific Fuel Consumption.
5	Conduct Morse Test to obtain the approximate Indicated Power of a Multi-cylinder IC Engine.
6	Conduct Valve / Port timing diagram of an IC engine.
7	Study with suitable model of Water Cooling System generally installed in four-stroke I.C. Engine, identify major components of it and demonstrate their functions.

8	Study with suitable model of Lubrication System generally installed in four-stroke I.C. Engine, identify major components of it and demonstrate their functions.
9	Study with suitable model the working of impulse steam turbines.
10	Study with suitable model the working of gas turbine/Turbojet propulsion system.
11	Study with suitable model the working of any type of water turbine.
12	Study of schematic layout of Hydroelectric Power Plant and explain the working principle of it.

3. Suggested Learning Resources:

Sl. No.	Title of Book	Author	Publication
1	A Course in Thermal Engineering	V.M. Domkundwar	Dhanpat Rai & Co.
2	Engineering Thermodynamics (Principles & Practices)	D.S.Kumar	S.K. Kataria& Sons
3	A text book of Thermal Engineering	R. S. Khurmi	S. Chand & Co.
4	A Course in Thermal Engineering	P. L. Ballaney	Khanna Publishers
5	Power Plant Engineering	R. K. Rajput	Laxmi Publications (P) Ltd.
6	Power Plant Engineering	G. R. Nagpal	Khanna Publishers

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Name of the Course: Diploma in Mechanical Engineering			
Category: Programme Core	**Semester: Fifth**		
Code No.: MEPC313	**Full Marks:100**		
Course Title: Advanced Manufacturing Processes Lab	**Sessional Examination Scheme:**		
	External Assessment (End Semester Sessional Examination)		
	Assignment on the day of Viva Voce:	20	**40 marks**
Duration : 17 weeks (2 hours per week)	Viva Voce (before Board of Examiners):	20	
	Internal Assessment		
	Continuous assessment of class performance and in time submission of Assignments:	30	**60 marks**
Total practical classes/week: 2	Viva Voce:	20	
	Class Attendance:	10	
Credit: 1	**Total Marks:**		**100**
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.			
Pre-requisite: Knowledge of Advanced Manufacturing Processes **[Code No.: MEPC303]**.			

1. **Course Outcomes (COs):**

   The theory, practical experiences and relevant soft skills associated with this subject are to be taught and implemented, so that the student demonstrates the following industry oriented course outcomes:

   a) Student should be able to understand the fundamental concept, demonstrate the necessity, working principle and identify the specific application of Non-traditional Machining Processes.
   b) Student should be able to demonstrate the utility and select suitable Jig or Fixture for making a product economically.
   c) Student should be able to understand the basic concept of NC /CNC along with its utility and should be able to produce a specific job with the help of CNC Machine Tool.

2. **Suggested Assignments / Practical for Continuous Assessment:**

   The list of practical to be completed by the students towards attainment of the required competency:

Sl. No.	List of Practical	Unit No. with Subject Code	Minimum Hours
GROUP: A			
01	Prepare a chart showing the working principle and setup of Ultrasonic Machining (USM) for demonstration purpose and also prepare a detailed study report on working principle, setup, process parameters, advantages, limitations and applications of Ultrasonic Machining (USM).	01 & 02 [MEPC303]	04

02	Prepare charts showing the working principle and setup of Electrical Discharge Machining (EDM) and Wire-EDM for demonstration purpose and also prepare a detailed study report on working principle, setup, process parameters, advantages, limitations and applications of Electrical Discharge Machining (EDM) and Wire-EDM.	01 & 02 [MEPC303]	04
03	Prepare a chart showing the working principle and setup of Electrochemical Machining (ECM) for demonstration purpose and also prepare a detailed study report on working principle, setup, process parameters, advantages, limitations and applications of Electrochemical Machining (ECM).	01 & 02 [MEPC303]	04
04	Prepare charts showing the working principle and setup of Electron Beam Machining (EBM) and Laser Beam Machining (LBM) for demonstration purpose and also prepare a detailed study report on working principle, setup, process parameters, advantages, limitations and applications of Electron Beam Machining (EBM) and Laser Beam Machining (LBM).	01 & 02 [MEPC303]	04
GROUP: B			
05	Prepare a suitable Jig for machining holes on standard 100 NB**,** MS Pipe Flange (As per BS-10, Table: D) (three nos. at a time) involving Fitting Shop, Welding Shop and Machine Shop. **(Refer Annexure: 1)**	03 [MEPC303]	04
06	Prepare a model of a specific jig (as assigned by the concern teacher) with a suitable material for demonstration of its basic elements, purpose of each elements and function of the whole setup. **(Refer Annexure: 2)**	03 [MEPC303]	04
GROUP: C			
07	Study of CNC Turning Centre (CNC Lathe) and identify different parts, drives, work holding device etc. and also study all sequential steps are to be followed for machining a job in a CNC Turning Centre.	04 [MEPC303]	04
08	Study of CNC Machining Centre (CNC Milling Machine) and identify different parts, drives, work holding device etc. and also study all sequential steps are to be followed for machining a job in a CNC Machining Centre.	04 [MEPC303]	04
09	Prepare Part Program by using different codes with or without fixed cycles (Canned Cycle) for at least three specific jobs as assigned by the concern teacher, which are to be performed on CNC Turning Centre. **(Refer Annexure: 3)**	04 & 05 [MEPC303]	04
10	Prepare Part Program by using different codes with or without fixed cycles (Canned Cycle) for at least three specific jobs as assigned by the concern teacher, which are to be performed on CNC Machining Centre. **(Refer Annexure: 4)**	04 & 05 [MEPC303]	04
11	Digital Manufacturing or Manufacturing of at least three specific jobs as assigned by the concern teacher by using CNC Turning Centre Simulator (on a virtual platform) or CNC Turning Centre (CNC Lathe). **(Refer Annexure: 3)**	04 & 05 [MEPC303]	04
12	Digital Manufacturing or Manufacturing of at least three specific	04 & 05	04

	jobs as assigned by the concern teacher by using CNC Machining Centre Simulator (on a virtual platform) or CNC Machining Centre (CNC Milling Machine). **(Refer Annexure: 4)**	[MEPC303]	
GENERAL			
13	Prepare a detailed report on Machine Tool installation process as assigned by the concern teacher.	General	04

Note:

- A suggested list of Practical is given in the above table. The concerned faculty member may add similar Practical Assignment also. **Five (05)** practical, among which **at least One (01) from each Group: A, B and C** are need to be performed during the course, so that the student achieves the desired level of competency as generally required by the industry.
- **Annexure: 1** containing the detailed dimensions of **Standard MS Flanges as per BS-10, Table: D** which may be referred during execution of Practical Assignment as listed in Sl. No. 05.
- **Annexure: 2** containing the **diagram of a typical Jig** which may be referred during execution of Practical Assignment as listed in Sl. No. 06. Concern teacher also have full liberty to use similar JIG diagram of their own selection for execution of such Practical Assignment.
- Few simple job diagrams are given in the **Annexure: 3** and **Annexure: 4** which may be executed in **CNC Turning Centre (or CNC Turning Centre Simulator)** and **CNC Machining Centre (or CNC Machining Centre Simulator)** respectively. Concern teacher may refer those diagrams or may use similar job diagram of their own selection during execution of Practical Assignments related to CNC Turning Centre and CNC Machining Centre (as detailed under Group: C).

3. Suggested Scheme for Internal Assessment: [Total Marks: 60]

Involvement	Total Marks
Continuous assessment of class performance and in time submission of Assignments.	30
Viva Voce on to the Engineering Practice at the end of the semester.	20
Class attendance.	10
Total Internal Assessment:	60
Pass criterion for Internal Assessment = 24 Marks [Minimum]	

4. **Suggested Scheme for End Semester Examination:** [Total Marks: 40]

Involvement	Total Marks
Assignment on the day of End Semester Exam.	20
Viva Voce on to the Engineering Practice on the day of End Semester Exam.	20
Total External Assessment:	40
Pass criterion for Internal Assessment = 16 Marks [Minimum]	

5. Rubrics for the internal assessment of Laboratory Practice:

The 'Process and Product' related skills associated with each practical work are to be assessed according to a suggested sample as given below:

Sl. No.	Performance Indicators
01	Preparing job/component drawing and process Plan
02	Setting up of machine, tool and job
03	Operating machine /executing production process to produce the component
04	Inspecting the component during production process using measuring instruments
05	Submission of job and workshop report in time
06	Viva voce

During conducting such Practical (laboratory / field based) work, the following social Skills/attitudes which are Affective Domain Outcomes (ADOs) are to be developed through the experiences:

- Follow the safety practices.
- Practice good housekeeping.
- Demonstrate working as a leader / team member.
- Maintain tools and equipment in good working condition.
- Follow ethical practice.

6. Suggested Learning Resources:

Sl. No.	Title of Book	Author	Publication
01	Advanced Machining Processes, Non-traditional and Hybrid Machining Processes	Hassan El-Hofy	McGraw-Hill
02	Elements of workshop Technology – Volume I & II	S. K. Hajra Chowdhury, Bose, Roy	Media Promoters and Publishers limited, Mumbai.
03	A Textbook of Manufacturing Technology (Manufacturing Processes)	R.K. RAJPUT	Laxmi Publications (P) Ltd.
04	A Course in Workshop Technology - Volume I & II.	B.S.Raghuwanshi	Dhanpat Rai Publications, New Delhi.
05	Manufacturing Processes.	Kalpakjian & Schemid	Pearson Education, New Delhi.
06	Manufacturing Technology – Volume I & II.	P. N. Rao	Tata McGraw-Hill, New Delhi.
07	CAD/CAM Principals and Applications	P. N. Rao	Tata McGraw-Hill, New Delhi.
08	Manufacturing Science.	Amitabh Ghosh, Mallik	East-West Press Pvt. Ltd., New Delhi.
09	Materials and Processes in Manufacturing.	DeGarmo	Wiley India Pvt. Ltd., New Delhi.
10	Machining & Machine Tool.	A.B. Chattopadhyay	Wiley India Pvt. Ltd., New Delhi.
11	CNC programming Handbook-Third edition	Peter Smid	Industrial Press Inc.

12	CNC Machining Handbook - Building, Programming, and Implementation	Alan Over	Tata McGraw-Hill, New Delhi.

7. Suggested Learning Websites:

- ELS web-portal of WBSCTE
- Fundamentals of CNC Machining, AUTODESK CAM, A Practical guide for beginners, Desk Copy, Document Number: 060711
- https://nptel.ac.in
- https://www.nitttrchd.ac.in
- https://swayam.gov.in
- https://www.mechanicalbooster.com
- https://www.machinedesign.com

Annexure: 1

MS Flange Dimensions (BS-10, Table: D):

Figure: MS Flange (BS-10, Table: D)

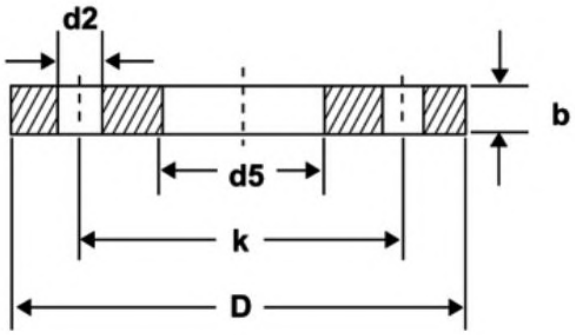

Figure: MS Flange Dimensions

Table D for W. Steam Pressure upto 50 lbs per Sq. Inch (in inchines)						
Nominal	Dia. of Flange	I.D. of Flange	Dia. of Bolt Circle	No. of	Dia. of Bolt	Thickness
Pipe Size	D	d5	k	Holes	d2	b
1/2"	3.3/4"	7/8"	2.5/8"	4	1/2"	3/16"
3/4"	4"	1.3/32"	2.7/8"	4	1/2"	3/16"
1"	4.1/2"	1.23/64"	3.1/4"	4	1/2"	3/16"
1.1/4"	4.3/4"	1.45/64"	3.7/16"	4	1/2"	1/4"
1.1/2"	5.1/4"	1.15/16"	3.7/8"	4	1/2"	1/4"
2"	6"	2.7/16"	4.1/2"	4	5/8"	5/16"
2.1/2	6.1/2"	2.15/16"	5"	4	5/8"	5/16"
3"	7.1/4"	3.37/64"	5.3/4"	4	5/8"	3/8"
3.1/2"	8"	4.5/64"	6.1/2"	4	5/8"	3/8"
4"	8.1/2"	4.37/64"	7"	4	5/8"	3/8"
5"	10"	5.43/64"	8.1/4"	8	5/8"	1/2"
6"	11"	6.23/32"	9.1/4"	8	5/8"	1/2"
7"	12"	7.5/8"	10.1/4"	8	5/8"	1/2"
8'	13.1/4"	8.23/32"	11.1/2"	8	5/8"	1/2"
9"	14.1/2"	9.23/32"	12.3/4"	8	5/8"	/8"
10"	16"	10.7/8"	14"	8	3/4"	5/8">
12"	18"	12.7/8"	16"	12	3/4"	5/8"
14"	20.3/4"	14.9/64"	18.1/2"	12	7/8"	3/4"
16"	22.3/4"	16.5/32"	20.1/2"	12	7/8"	3/4"
18"	25.1/4"	18.3/16"	23"	12	7/8"	7/8"
20"	27.3/4"	20.13/16"	25.1/4"	16	7/8"	1"
24"	32.1/2"	24.1/4"	29.3/4"	16	1"	1.1/8"

All dimensions are in 'inch'

Note: Bolt hole diameters are as follows:

- For 1/2 in and 5/8 in bolts, the bolt hole shall be 1/16 in larger than the bolt diameter.
- For 3/4 in bolts and larger, the bolt hole shall be not more 1/8 in larger than the bolt diameter.

Annexure: 2

Diagram of basic elements of a Jig:

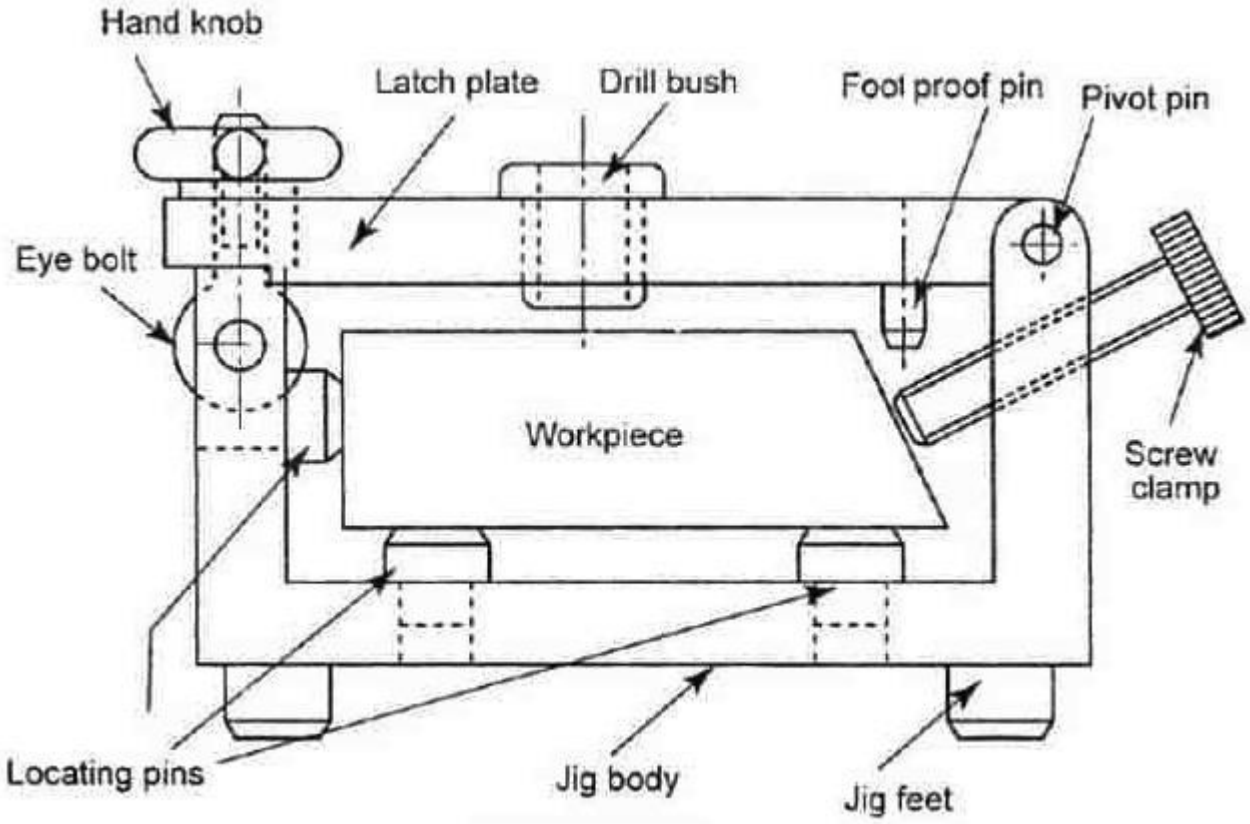

Figure: Basic Elements of JIG

1. Jig body	2. Locators
3. Jig feet	4. Clamps
5. Jig bushing	6. Jig plate or bush plate
7. Fool proof element	

Annexure: 3

Few simple job diagrams which may be executed in CNC Turning Centre (CNC Lathe)

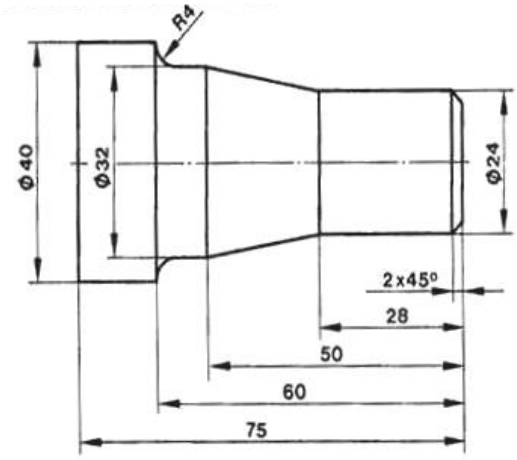

Figure: 01

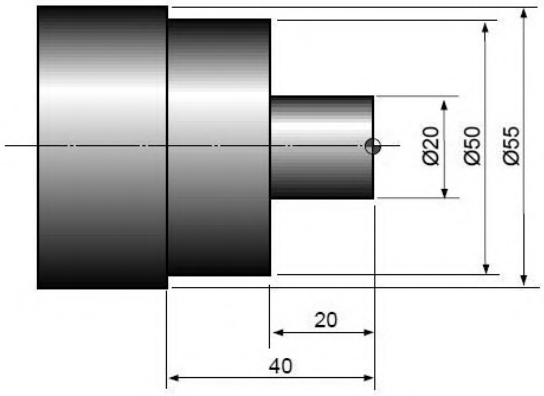

Figure: 02

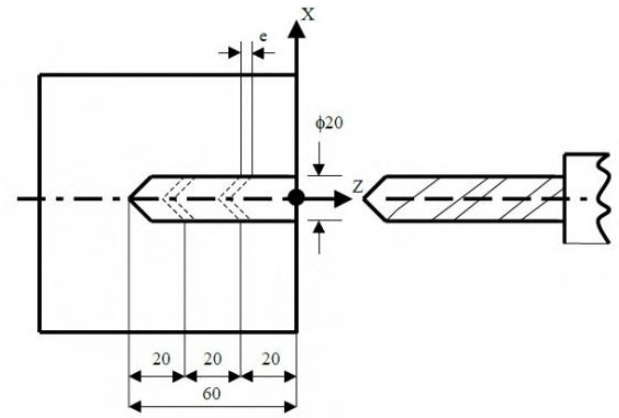

Figure: 03

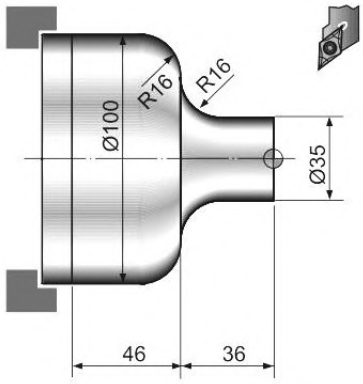

Figure: 04

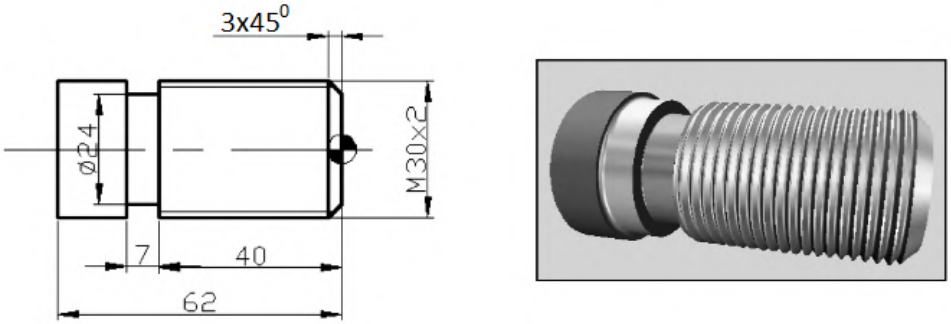

Figure: 05

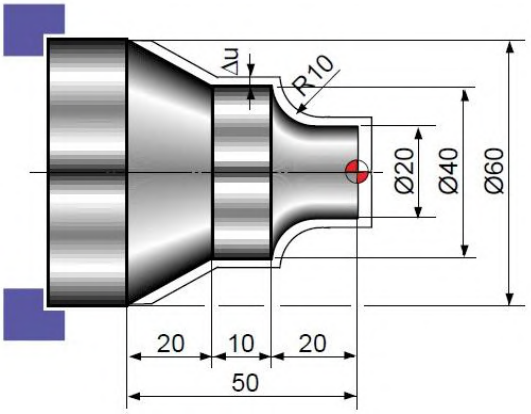

Figure: 06

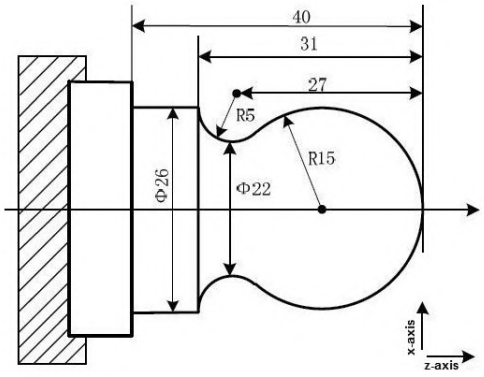

Figure: 07

Annexure: 4

Few simple job diagrams which may be executed in CNC Machining Centre (CNC Milling machine):

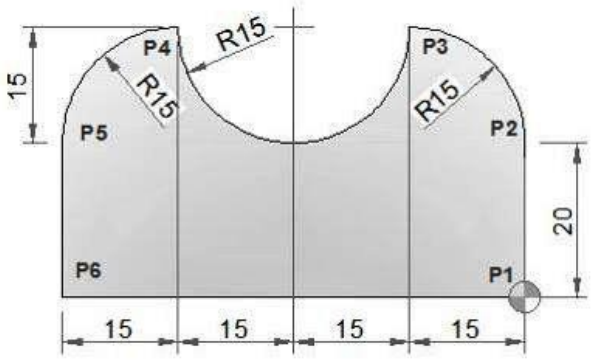

Figure: 01

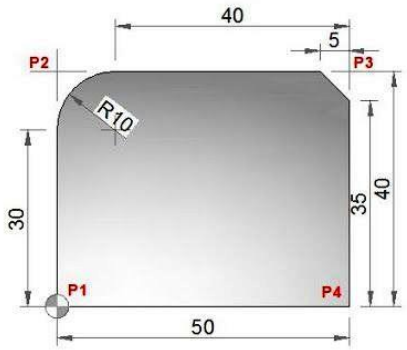

Figure: 02

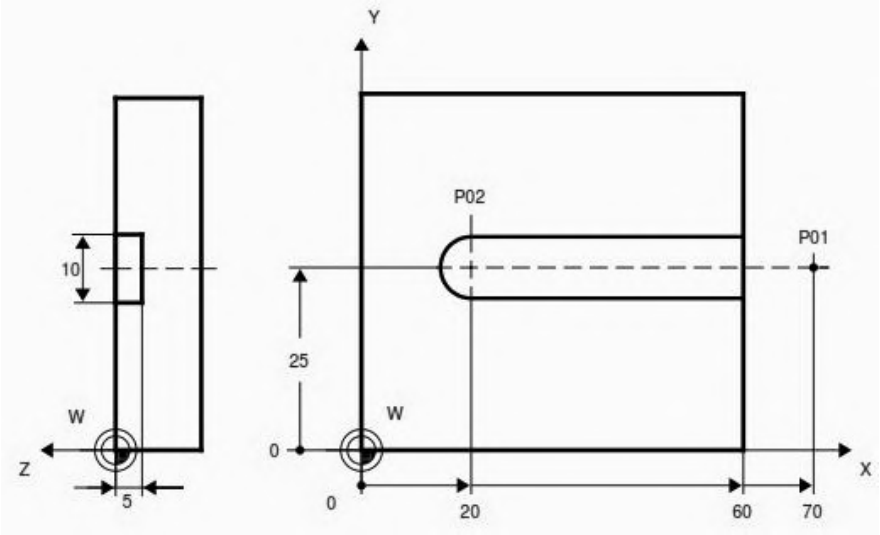

Figure: 03

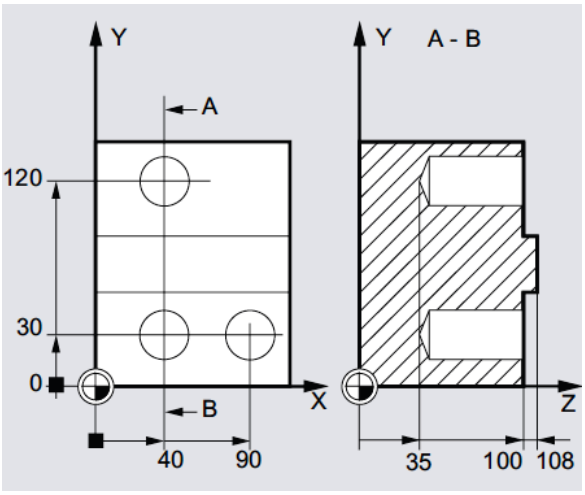

Figure: 04

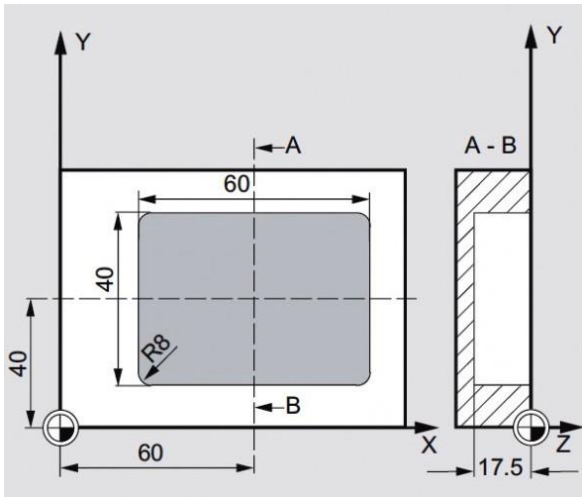

Figure: 05

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WEST BENGAL STATE COUNCIL OF TECHNICAL & VOCATIONAL EDUCATION AND SKILL DEVELOPMENT
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<table>
<tr><td colspan="4">Name of the Course: Diploma in Mechanical Engineering</td></tr>
<tr><td>Category: Programme Core</td><td colspan="3">Semester : Fifth</td></tr>
<tr><td>Code No. : MEPC315</td><td colspan="3">Full Marks: 100</td></tr>
<tr><td>Course Title : Fluid Mechanics and Machinery Lab</td><td colspan="3">Sessional Examination Scheme:</td></tr>
<tr><td rowspan="6">Duration : 17 weeks (total hours per week = 2)</td><td colspan="3">External Assessment
(End Semester Sessional Examination)</td></tr>
<tr><td>Assignment on the day of viva voce :</td><td>20</td><td rowspan="2">40 marks</td></tr>
<tr><td>Viva voce (before Board of Examiners) :</td><td>20</td></tr>
<tr><td colspan="3">Internal Assessment</td></tr>
<tr><td rowspan="3">Total Practical class/week : 2</td><td>Continuous assessment of class performance and submission of assignment (in scheduled time)</td><td>30</td><td rowspan="3">60 marks</td></tr>
<tr><td>Class attendance</td><td>10</td></tr>
<tr><td>Credit: 1</td><td>Viva voce (after submission of lab reports)</td><td>20</td></tr>
<tr><td colspan="2">Total marks</td><td>100</td></tr>
<tr><td colspan="4">Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.</td></tr>
</table>

1.Course Outcomes (COs):

CO1 : Measure various properties such as pressure, velocity, flow rate using various instruments.
CO2 : Calculate different parameters such as co-efficient of friction of pipe flow
CO3 : Understand the need and importance of calibration of pressure gauges.
CO4 : Describe the construction and working of pumps.
CO5 : Test the performance of pumps

2. Suggested Assignments/Practical for Continuous Assessment:

The lists of practical (any Five) are to be completed by the students towards attainment of the required competency:

Sl. No	List of Practical
1	Calibration of Bourdon tube pressure gauge with the help of Dead Weight Pressure gauge.
2	Verification of Bernoulli's Theorem.
3	Determination of Coefficient of Discharge of Venturimeter.
4	Determination of Coefficient of Discharge of orifice meter.

5	Measurement of velocity of flow through pipe with the help of Pitot tube.
6	Measurement of flow of liquid by using Rotameter
7	Determination of coefficient of friction of flow through pipes.
8	Trial on centrifugal pump to determine overall efficiency.

3. Suggested Scheme for Internal Assessment: [Total Marks: 60]

Involvement	Total Marks
Continuous assessment of class performance and in time submission of Assignments.	30
Viva Voce on to the Engineering Practice at the end of the semester.	20
Class attendance.	10
Total Internal Assessment:	60
Pass criterion for Internal Assessment = 24 Marks [Minimum]	

4. Suggested Scheme for End Semester Examination: [Total Marks: 40]

Involvement	Total Marks
Assignment on the day of End Semester Exam.	20
Viva Voce on to the Engineering Practice on the day of End Semester Exam.	20
Total External Assessment:	40
Pass criterion for Internal Assessment = 16 Marks [Minimum]	

5. Suggested Learning Resources:

Sl. No.	Title of Book	Author	Publication
1	Fluid Mechanics and Machinery Laboratory Manual	N. Kumara Swamy	Charotar Publishing House Pvt. Ltd., ANAND 388 001, Ed. 2008

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Name of the Course: Diploma in Mechanical Engineering			
Category: Programme Elective	**Semester : Fifth**		
Code No. : MEPE305/1	**Full Marks: 100**		
Course Title : CAD / CAM Laboratory	**Sessional Examination Scheme:**		
Duration : 17 weeks (total hours per week = 2)	**External Assessment** (End Semester Sessional Examination)		
	Assignment on the day of viva voce :	20	**40 marks**
	Viva voce (before Board of Examiners) :	20	
	Internal Assessment		
Total Practical class/week : 2	Continuous assessment of class performance and submission of assignment (in scheduled time)	30	**60 marks**
	Class attendance	10	
Credit: 1	Viva voce (after submission of lab reports)	20	
	Total marks		**100**
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.			

1. Course outcomes (COs):

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

CO1: Explain the 3D commands and features of CAD software.

CO2: Create 3D solid model and find the mass properties of simple solids.

CO3: Demonstrate the working of CNC turning and milling machine / CNC turning and machining centre simulators.

CO4: Develop and assess the part program using simulation software for Lathe and Milling or execute in CNC turning and machining centre.

2. Suggested Assignments for Continuous Assessment:

Sl. No.	Topics for practice
	Introduction: Part modeling; Datum Plane; constraint; sketch; dimensioning; extrude; revolve; sweep; blend; rib; shell; hole; round; chamfer; copy; mirror; assembly; align.

Part-A	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 .(any three)
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/CNC simulator; (at least two)
	CNC Turning Machine / CNC Turning Simulator: Using Linear and Circular interpolation- Create a part program and produce actual component / digital machining component. 1. Using Stock removal cycle–Create a part program for multiple turning operations &produce component using actual machine of CNC turning simulator. (at least one) 2. Using canned cycle- Create a part program for thread cutting, grooving and produce component using actual machine or turning simulator. (at least one)
	CNC Milling Machine / CNC Machining Centre Simulator : Using Linear interpolation and Circular interpolation–Create a part program for grooving and produce the component using actual machine or CNC machining centre simulator. 1. Using canned cycle-Create a part program for drilling, tapping, counter sinking and produce component using the actual machine or CNC machining centre simulator. (at least one) 2. Using sub-program-Create a part program for mirroring and produce component using the actual machine / CNC machining centre simulator. (at least one)

3. Suggested Scheme for Internal Assessment: [Total Marks: 60]

Involvement	Total Marks
Continuous assessment of class performance and in time submission of reports	30
Viva Voce on to the Engineering Practice at the end of the end of the semester	20
Class attendance	10
Total Internal Assessment	**60**
Pass criterion for the Internal Assessment = 24 Marks [Minimum]	

4. Suggested Scheme for End Semester Examination: [Total Marks: 40]

Involvement	Total Marks
Assignment on the day of End Semester Examination	20
Viva Voce on to the Engineering Practice on the day of End Semester Examination	20
Total ESE Assessment	**40**

5. Reference Books:

Title of the Book	Name of the Author(s)	Name of the Publishers
CNC Machine	B. S. Pabla & M. Adithan	New Age International(P) Ltd.
Computer Aided Design and Manufacturing	Groover M. P. & Zimmers Jr	Prentice Hall of India

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<table>
<tr><td colspan="4">Name of the Course: Diploma in Mechanical Engineering</td></tr>
<tr><td>Category: Program Elective</td><td colspan="3">Semester : Fifth</td></tr>
<tr><td>Code No. : MEPE305/2</td><td colspan="3">Full Marks: 100</td></tr>
<tr><td>Course Title : Automobile Engineering Laboratory</td><td colspan="3">Sessional Examination Scheme:</td></tr>
<tr><td rowspan="5">Duration : 17 weeks (total hours per week = 2)</td><td colspan="3">External Assessment
(End Semester Sessional Examination)</td></tr>
<tr><td>Assignment on the day of viva voce :</td><td>20</td><td rowspan="2">40 marks</td></tr>
<tr><td>Viva voce (before Board of Examiners) :</td><td>20</td></tr>
<tr><td colspan="3">Internal Assessment</td></tr>
<tr><td rowspan="3">Total Practical class/week : 2</td><td>Continuous assessment of class performance and submission of assignment (in scheduled time)</td><td>30</td><td rowspan="3">60 marks</td></tr>
<tr><td>Class attendance</td><td>10</td></tr>
<tr><td rowspan="2">Credit: 1</td><td>Viva voce (after submission of lab reports)</td><td>20</td></tr>
<tr><td colspan="2">Total marks</td><td>100</td></tr>
<tr><td colspan="4">Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.</td></tr>
</table>

1. Course outcomes (COs):

The Practical works associated with this course will help the students to demonstrate the following industry oriented COs:

CO1: Familiarize with the various technical terms and data related with different systems of automobile.
CO2: Illustrate the working of various systems (such as fuel feed system of petrol & diesel engine, transmission, brake, suspension, lubrication, steering etc.) of automobiles.
CO3: Describe the necessity and utility of retrofitting the CNG kits to petrol cars.
CO4: Demonstrate the procedure of battery testing and charging.

2. Suggested Assignments for Continuous Assessment: (Any five practical)

Sl.No.	List of Practical
1.	Study of transmission system, suspension system, braking system, and steering system equipped with medium duty vehicles. (any two)
2.	Prepare a comparative survey report based on technical data (type of clutch used, gearing ratio for forward speeds and reverse speed, final drive, type of steering used, type of suspension used, type of service brake used, tyre size, battery used, capacity of fuel tank, etc) of Indian light-duty diesel vehicles (Mahindra, Tata, Swaraj Mazda, Maruti and Ambassador).
3.	Demonstration of differential gear box.

4.	Demonstration of transmission gear box (preferably synchromesh gearbox) used in medium duty vehicle.
5.	Demonstration of rack & pinion type steering gear box.
6.	Demonstration of braking system (hydraulic / pneumatic) used in light / medium duty vehicle.
7.	Demonstration of rear axle assembly used in light-duty vehicle.
8.	Demonstration of clutch (single plate coil spring / diaphragm spring type) used in light / medium duty vehicle.
9.	Demonstration of crankshaft and cam shaft lubrication system of multi-cylinder engine.
10.	Study of CNG kit retrofitting.
11.	Testing of battery and charging system.

3. Suggested Scheme for Internal Assessment: [Total Marks: 60]

Involvement	Total Marks
Continuous assessment of class performance and in time submission of reports	30
Viva Voce on to the Engineering Practice at the end of the end of the semester	20
Class attendance	10
Total Internal Assessment	**60**
Pass criterion for the Internal Assessment = 24 Marks [Minimum]	

4. Suggested Scheme for End Semester Examination: [Total Marks: 40]

Involvement	Total Marks
Assignment on the day of End Semester Examination	20
Viva Voce on to the Engineering Practice on the day of End Semester Examination	20
Total ESE Assessment	**40**
Pass criterion for the ESE Assessment = 16 Marks [Minimum]	

5. Reference Books:

Sl. No.	Title of the Book	Name of the Author(s)	Name of the Publishers
1	Automobile Engineering (Vol.-I and Vol.-II)	Dr. Kirpal Singh	Standard Publication
2	Automobile Engineering	G. B. S. Narang	Khanna Publication
3	A text book in Automobile Engineering	S. K. Gupta	S. Chand
4	Automobile Mechanics	William Crouse	Tata McGraw-hill

WEST BENGAL STATE COUNCIL OF TECHNICAL & VOCATIONAL EDUCATION AND SKILL DEVELOPMENT
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"Karigori Bhavan", 4th Floor, Plot No. B/7, Action Area-III, New Town, Rajarhat, Kolkata-700160

<table>
<tr><td colspan="4">Name of the Course: Diploma in Mechanical Engineering</td></tr>
<tr><td>Category: Major Project</td><td colspan="3">Semester : Fifth</td></tr>
<tr><td>Code No. : PR301</td><td colspan="3">Full Marks: 100</td></tr>
<tr><td>Course Title : Major Project</td><td colspan="3">Sessional Examination Scheme:</td></tr>
<tr><td rowspan="8">Duration : 17 weeks (total hours per week = 2)</td><td colspan="3">External Assessment
(End Semester Sessional Examination)</td></tr>
<tr><td>Evaluation of progress report of major project</td><td>20</td><td rowspan="2">40 marks</td></tr>
<tr><td>Viva voce (before Board of Examiners)</td><td>20</td></tr>
<tr><td colspan="3">Internal Assessment</td></tr>
<tr><td>Continuous assessment of class performance and in time submission of progress report of major project</td><td>30</td><td rowspan="3">60 marks</td></tr>
<tr><td>Seminar presentation and viva voce</td><td>20</td></tr>
<tr><td>Class attendance</td><td>10</td></tr>
<tr><td colspan="2">Total marks</td><td>100</td></tr>
<tr><td>Total Practical class / week : 2</td><td colspan="3"></td></tr>
<tr><td>Credit: 1</td><td colspan="3"></td></tr>
<tr><td colspan="4">Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.</td></tr>
</table>

1. **Course Outcomes (COs):**
   Depending upon the nature of the projects undertaken, some of the following major course outcomes can be attained:
   After completion of the project, the students will be able to:

a) Implement the planned activity individually and/or as team.
b) Select, collect and use required information / knowledge to solve the identified problem.
c) Take appropriate decisions based on collected and analysed information.
d) Ensure quality in product.
e) Communicate effectively and confidently as a member and leader of team.
f) Prepare project report following proper guideline using appropriate tools (if any).

2. **Course details:**
   As the implementation of the major project progresses and which has to be submitted at the end of project work, one of the outputs of this course is a detailed Project Report that is continuously prepared by the student. Such major project work has to be executed throughout 5th and 6th semester and has to be completed at the end of 6th semester. At the end of 5th semester, each student has to present a 'Seminar' presentation on progressand has to submit a 'Progress Report' on major project.

3. **Suggested contents of the project report:**
   a) Title page (Polytechnic name along with name of team members and guide teacher).
   b) Certificate (in the format given in this document as annexure A).
   c) Acknowledgement
   d) Abstract (not more than 200/ 150 words)
   e) Content (Objective of the project, Methodology/Planning of Execution, Procedure Followed, Results, Conclusions, Appendix if any, and References)
   f) Abbreviations (if any)

4. **Suggested fields of Major Projects :**
   The list of major projects which may be selected and executed by the students towards attainment of the required competency:
   a) Fabrication based project.
   b) Design and fabrication based project.
   c) Experiment based project.
   d) Survey based projects.
   e) Maintenance based projects.
   f) Industrial engineering based project.
   g) Innovative/Creative projects.
   h) Project (related to mechanical engineering) may be selected other than the area specified above.

5. **Suggested Scheme for Internal Assessment: [Total Marks: 60]**

Involvement	Total Marks
Continuous assessment of performance, contribution and in time submission of progress of major project.	30
Seminar Presentation and Viva Voce on to the progress of major projects at the end of the semester.	20
Class attendance	10
Total Internal Assessment:	**60**
Pass criterion for Internal Assessment = 24 Marks [Minimum]	

6. **Suggested Scheme for End Semester Examination: [Total Marks: 40]**

Involvement	Total Marks
Evaluation of progress report on the day of End Semester Exam.	20
Viva Voce on to the progress and future plans of completion of major project on the day of End Semester Exam.	20
Total External Assessment:	**40**
Pass criterion for Internal Assessment = 16 Marks [Minimum]	

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Name of the Course: Diploma in Mechanical Engineering	
Category: Internship	**Semester: Fifth**
Code No.: SI301	**Full Marks : 100**
Course Title: Internship - II	**Examination Scheme:** **Internal Assessment:100 marks** [Submission of report after Industrial visit – 60 marks (in scheduled time) Seminar on Internship – 40 marks]
Duration:	
Total practical class/week (after 4th Semester) : Nil	
Credit:1	
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in internal assessment.	

Suggested Internship Project Work in 5thSemester

After the **4thSemester,** for **Internship-II**, students are required to be involved to undergo internship with industry / NGOS / Government Organizations / Micro / Small / Medium Enterprises to make themselves ready for the industry. All stakeholders including Training & Placement Cell and concerned teachers will take necessary initiatives to coordinate the internship program for the students. Online internship options may be explored.

After completion of Internship II, the student should prepare a comprehensive report to indicate what he/she has observed and learnt during internship period. The student may contact Industrial Supervisor / Faculty Mentor/TPO for assigning topics and problems and should prepare the final report on the assigned topics. The Industrial Supervisor / Internship Faculty Mentor, TPO and HOD would sign the training report.

The Internship report will be evaluated based on the following criteria (as applicable):

Sl.No.	**Criteria for evaluation of Internship Report** [60 marks]
1.	Originality
2.	Adequacy and purposeful write-up
3.	Organization, format, drawings, sketches, style, language
4.	Practical applications and relationships with basic theory
5.	Concepts taught in the course outcome
6.	Practical applications, relationships with basic theory and concepts taught in the course.
7.	Attendance record, daily diary, quality of the Internship Report

Seminars must be arranged for the students based on his/her training report, before an internal committee constituted by the concerned department of the institute. The evaluation will be based on the following criteria:

Sl.No.	**Criteria for evaluation of Internship Seminar** [40marks]
1.	Quality of content presented
2.	Proper planning for presentation

3.	Effectiveness of presentation
4.	Depth of knowledge and skills
5.	Viva voce
Total Marks:100	
Pass criterion for Internship-II = 40 Marks [Minimum]	

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