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)

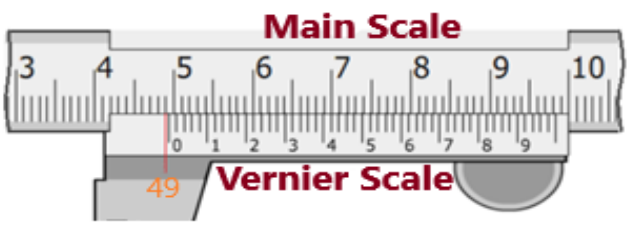
i) Compile a exhaustive chart of measuring instruments and gauges that are commonly used in production for inspection purpose. Chart must contain name of instrument/gauge, specification (range, least count etc), maker and use.

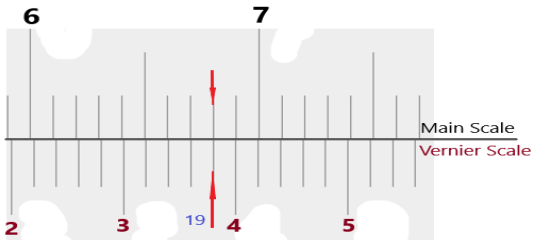
ii) Calculate the limits, tolerances, and allowances on a 25 mm shaft and hole pair designated as H7/g6 to get a precision fit. The fundamental tolerance is to be calculated by the following equation: $= 0.45\sqrt[3]{D} + 0.001D$. The following data are given – a) Upper deviation of shaft = $-2.5D^{0.34}$,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

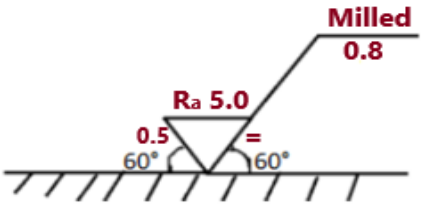
So, main scale reading = ... divisions = (..... x .....) = ...mm

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

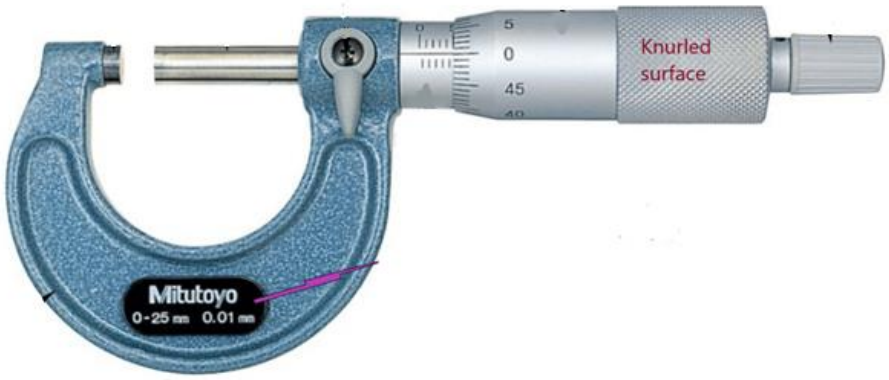
Therefore, total reading = [..... + ...] = ... mm

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

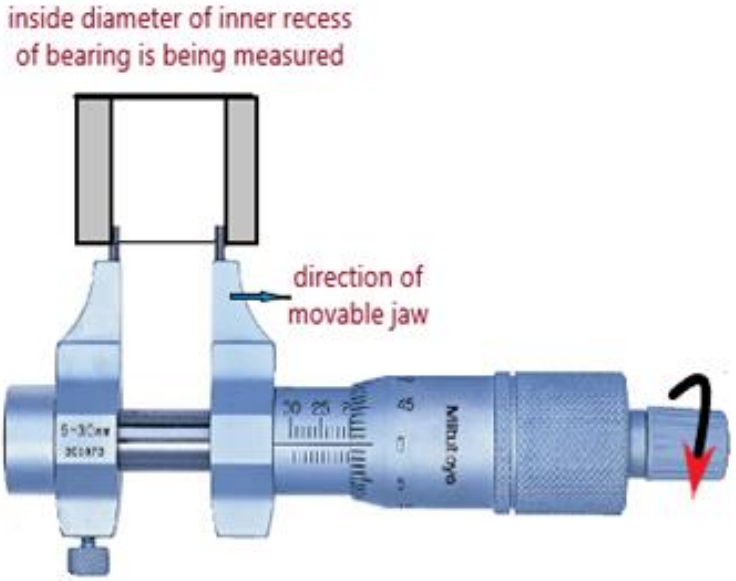
vii) What does the following figure indicate regarding statements and symbols used for surface texture?



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

<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. : MEPC210</td><td colspan="3">Practical : 100 Marks</td></tr>
<tr><td>Course Title : Computer Aided Machine Drawing Practice</td><td colspan="3">Sessional Examination Scheme:</td></tr>
<tr><td rowspan="8">Duration : 17 weeks (3 hours per week)</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>Submission of drawing sheets (in scheduled time)</td><td>30</td><td rowspan="3">60 marks</td></tr>
<tr><td>Class performance & attendance</td><td>20</td></tr>
<tr><td>Viva voce (after submission of drawing sheets)</td><td>10</td></tr>
<tr><td>Total practical class/week: 3</td><td colspan="2">Total marks</td><td>100</td></tr>
<tr><td>Credit: 1.5</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):

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**

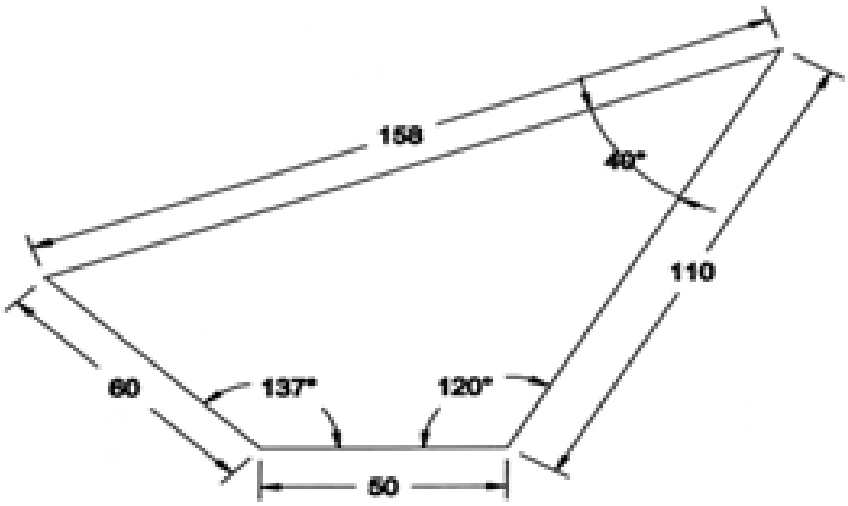
problems are to be drawn. (Refer Annexure- 3)	drawn figures.			
Sheet No. -4 At least one problem of full / half sectional assembled views is to be drawn. (Refer Annexure- 4)	4a. Draw full/half sectional front view and top view / side view of an assembled machine drawing. 4b. Apply various features of '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**	

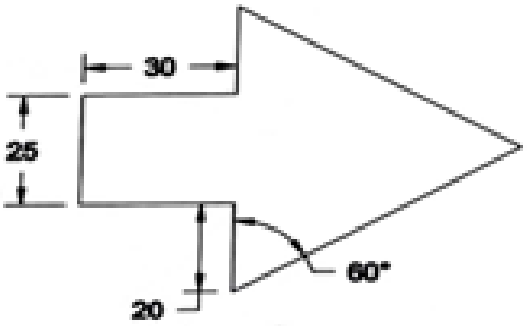
4**. Rubrics for the internal assessment of drawing sheets** [40 marks]:

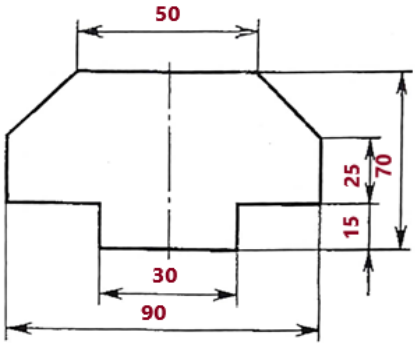
Sl No.	Performance Indicators	Weightage in %
1	For interpretation of problems given by subject teacher	20
2	For proper layout of drawing sheets (maintaining correct types of lines and their thickness)	50
3	For proper dimensioning, symbols of the drawn views	10
4	For neatness & cleanliness of drawing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

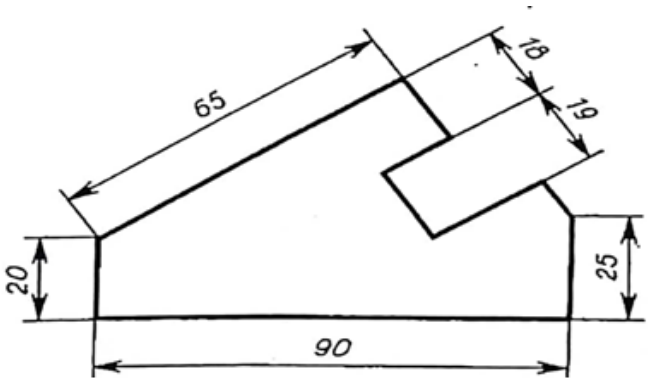
Annexure-1:

(Application of line)



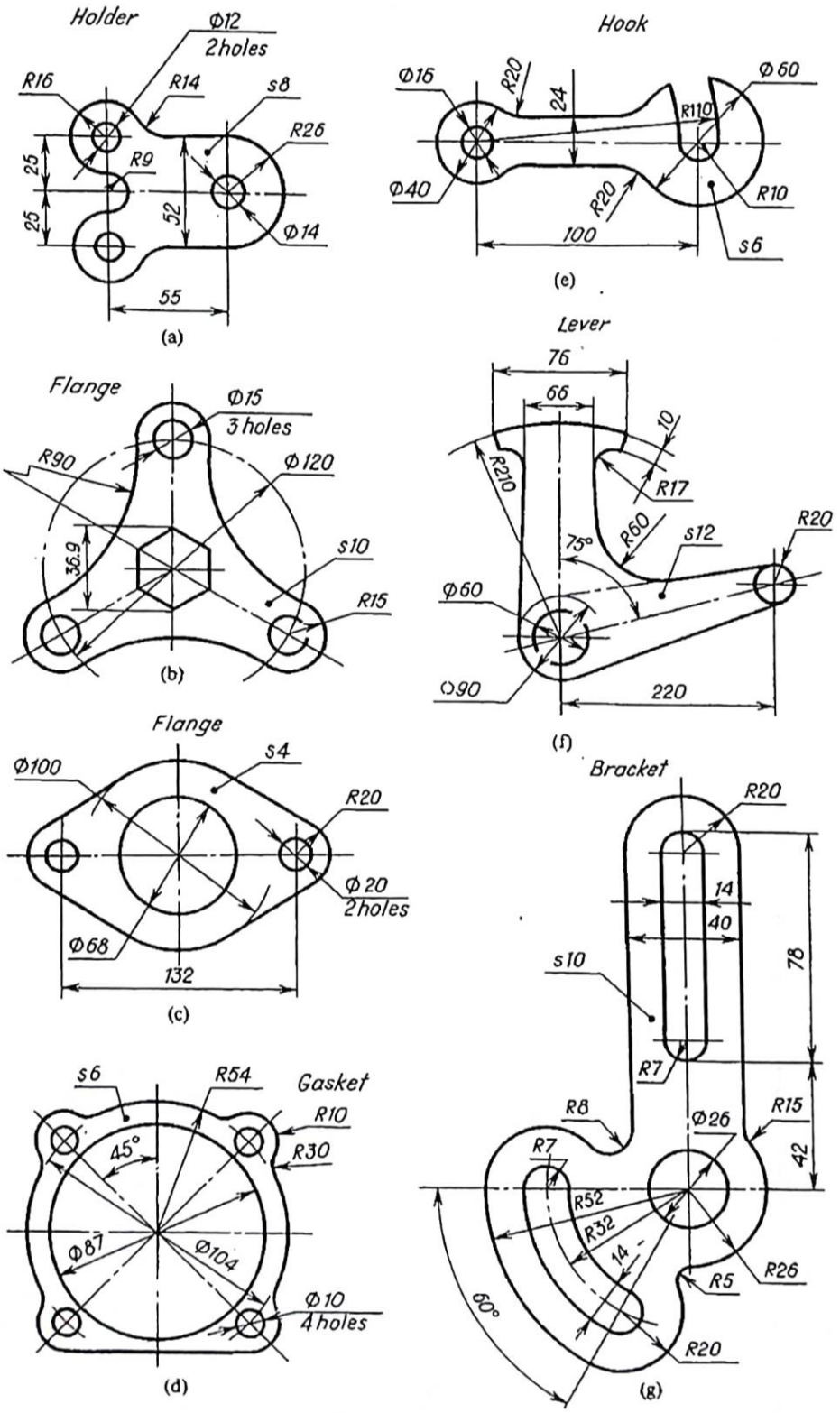






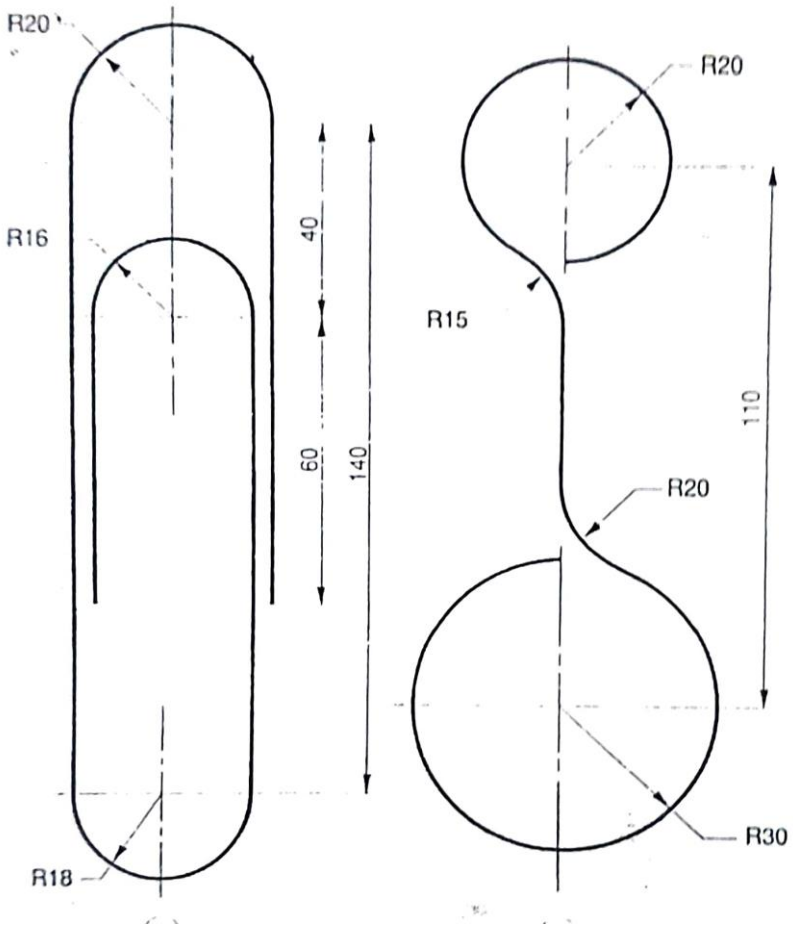
Annexure – 2

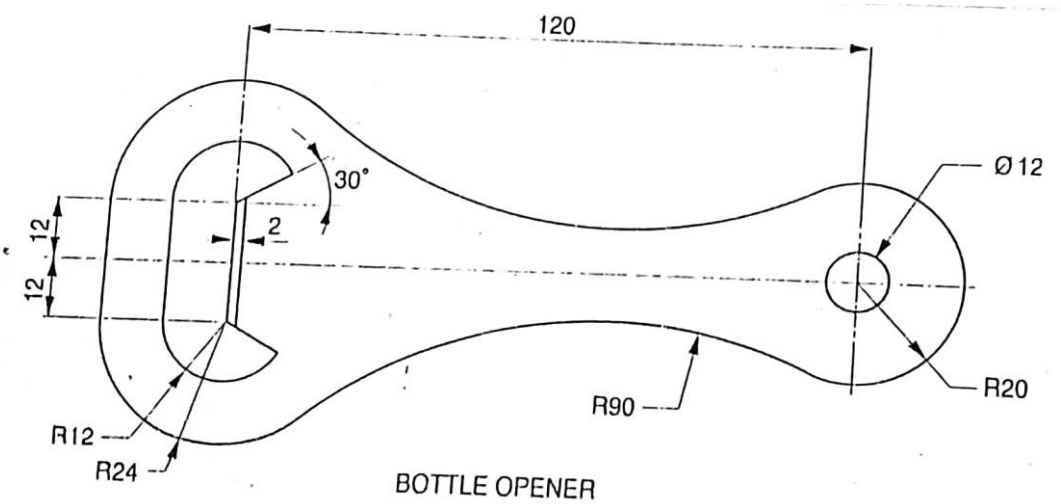
(Application of Circle)



Annexure – 3

(Application of Curves)

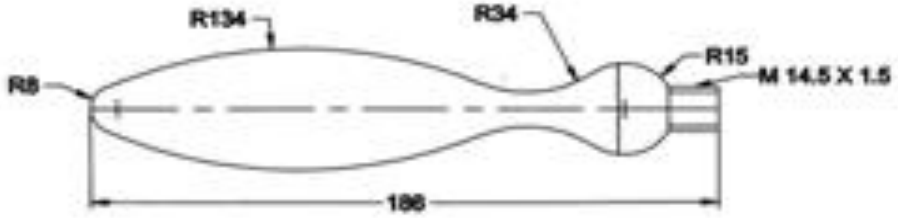


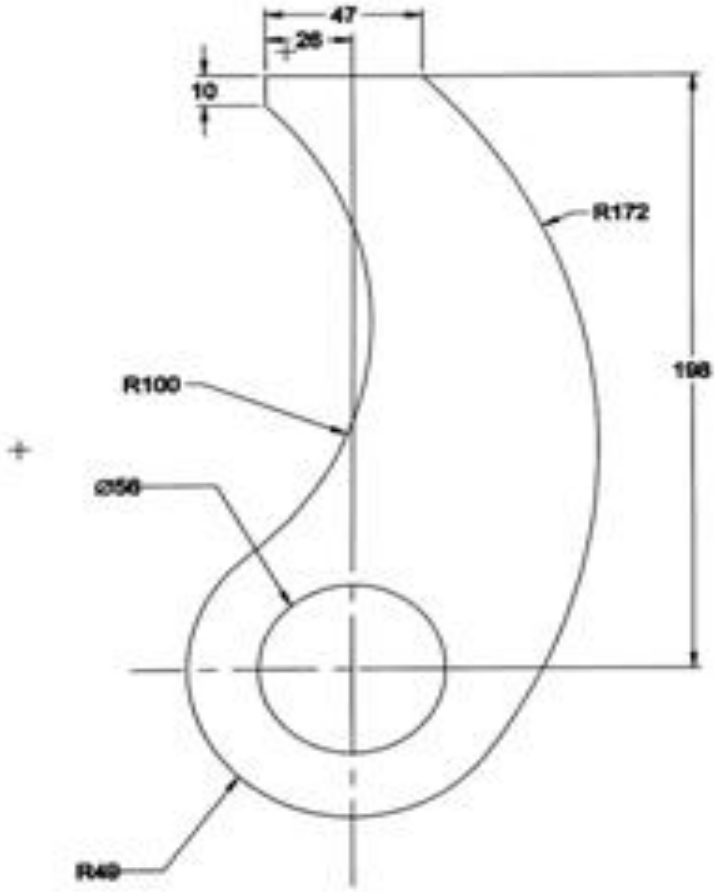


BOTTLE OPENER

Annexure – 3

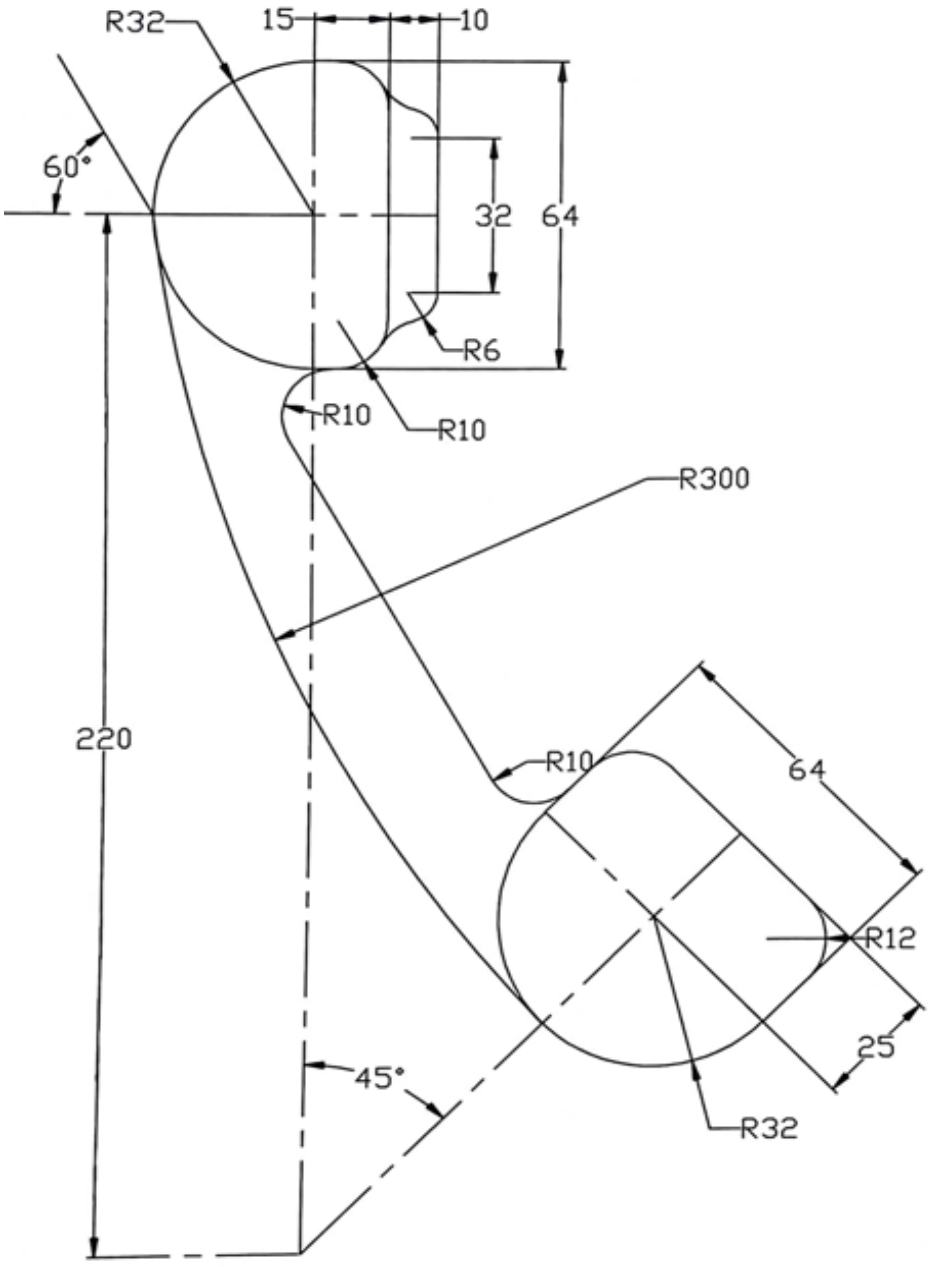
(Application of Curves)





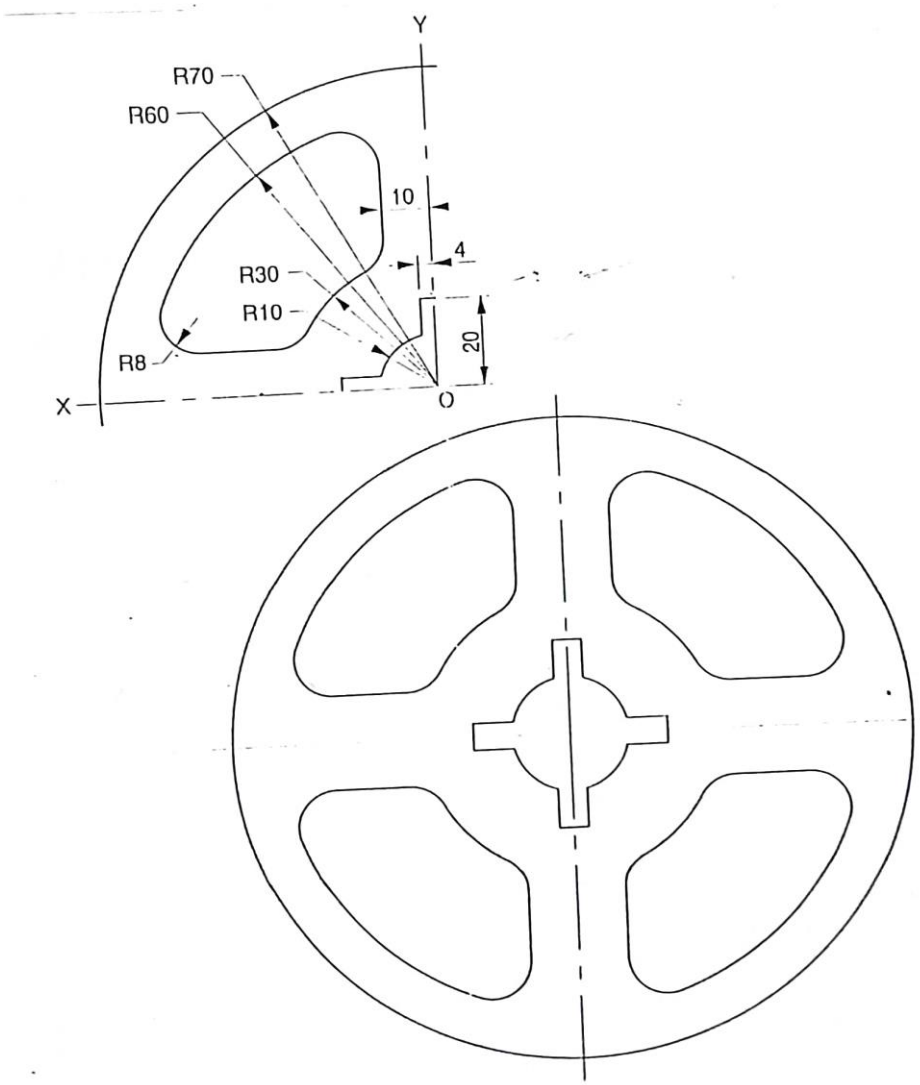
Annexure – 3

(Application of Curves)



Annexure – 3

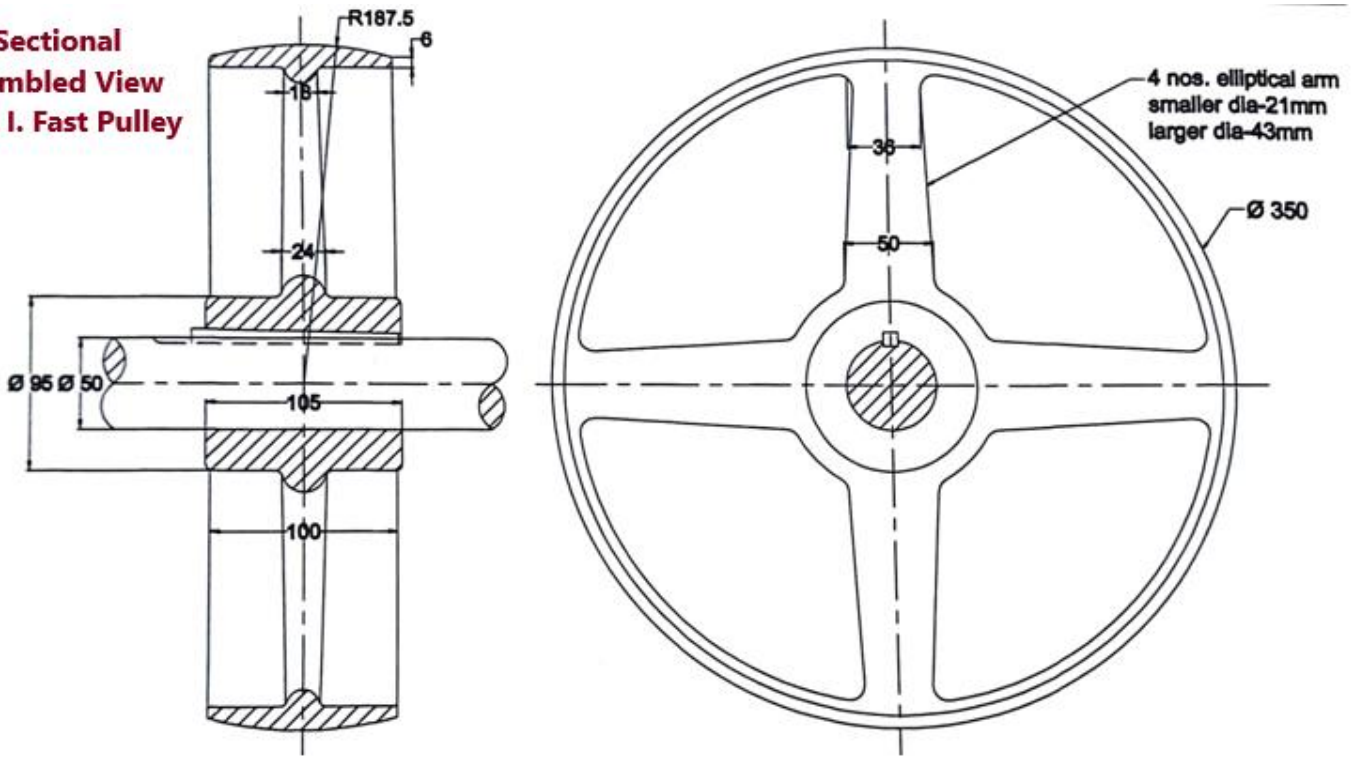
(Application of Curves)



Annexure – 4

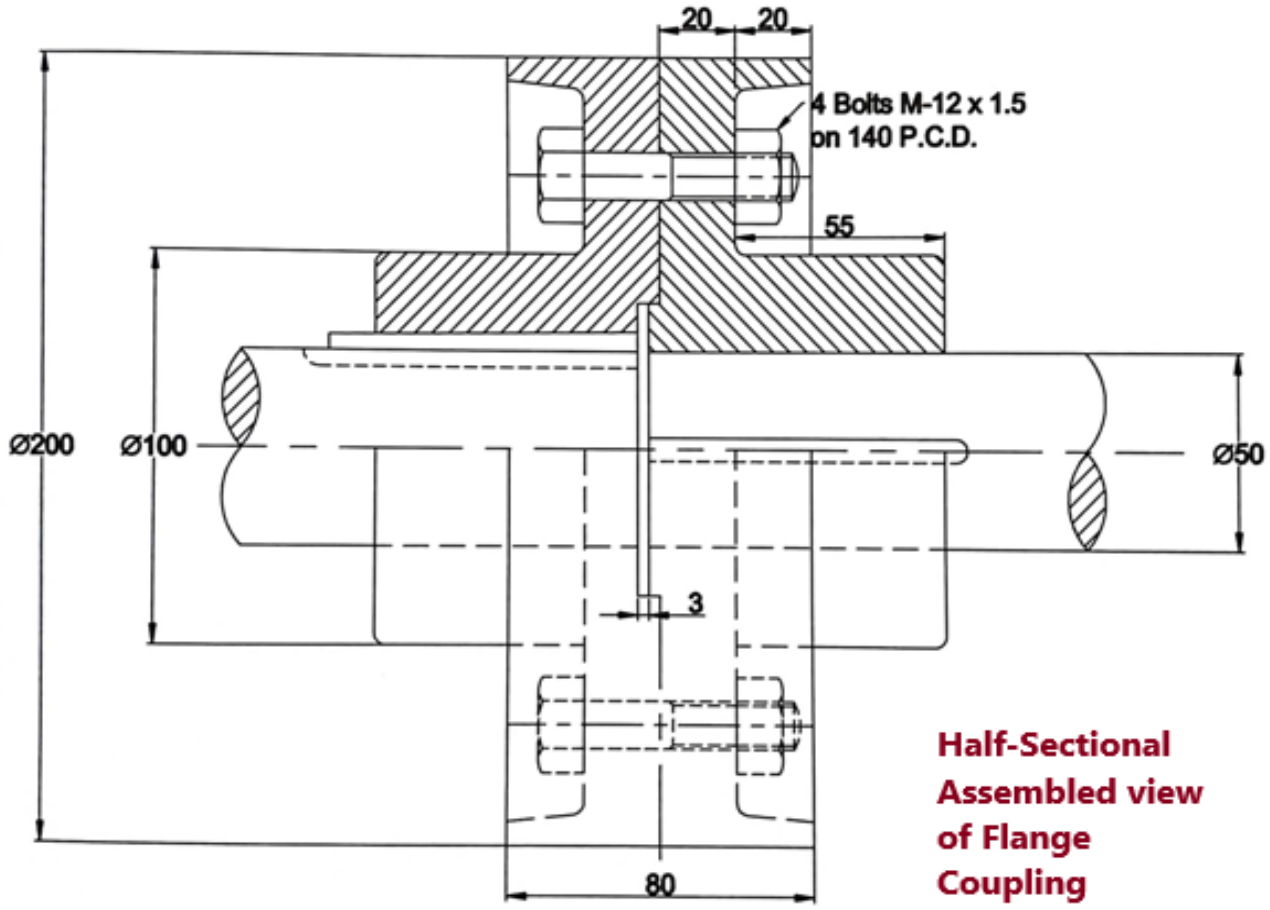
(Assembled View of C. I. Pulley)

Full Sectional Assembled View of C. I. Fast Pulley



Annexure – 5

(Assembled view of Flange Coupling)

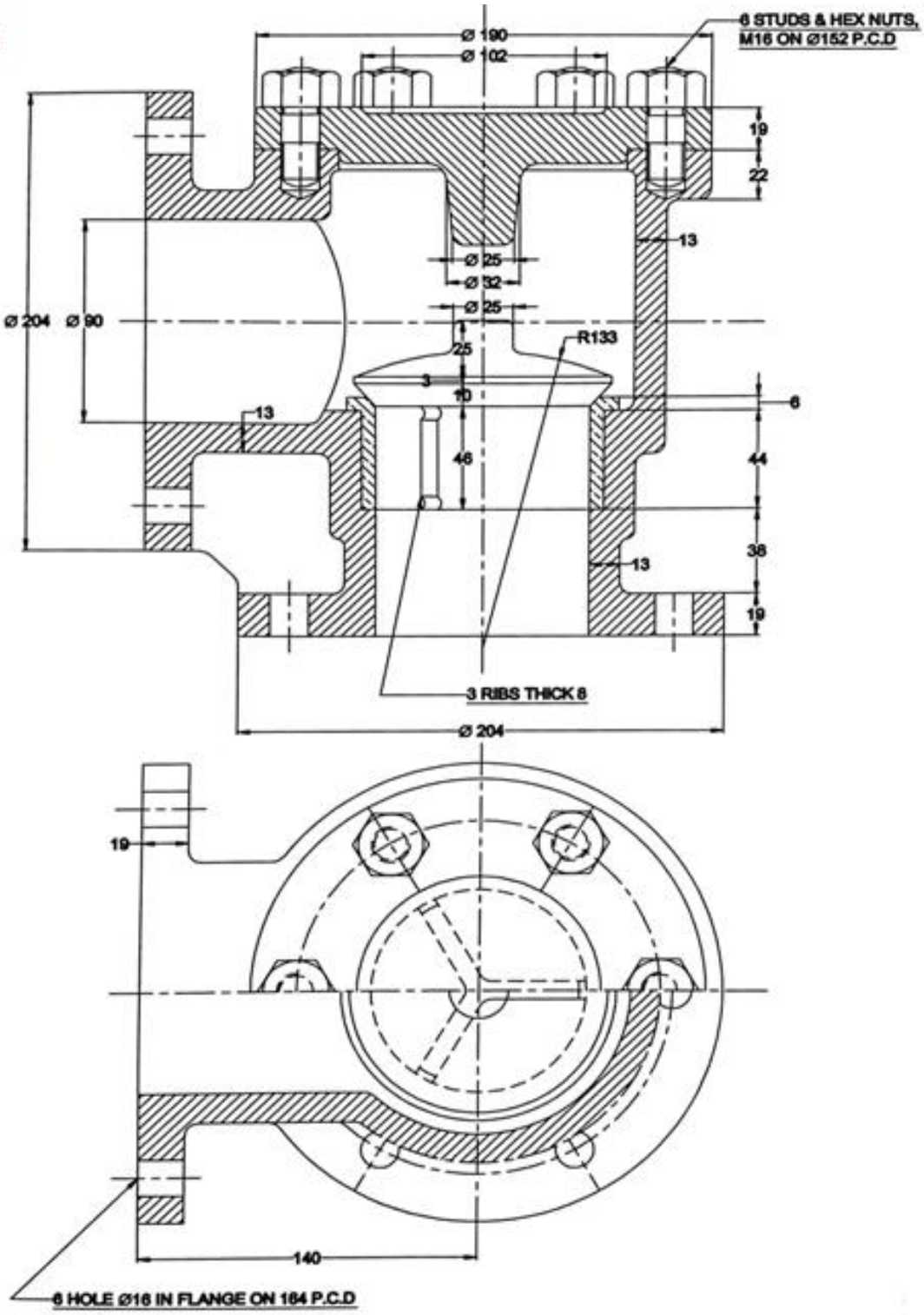


Half-Sectional Assembled view of Flange Coupling

Annexure -6

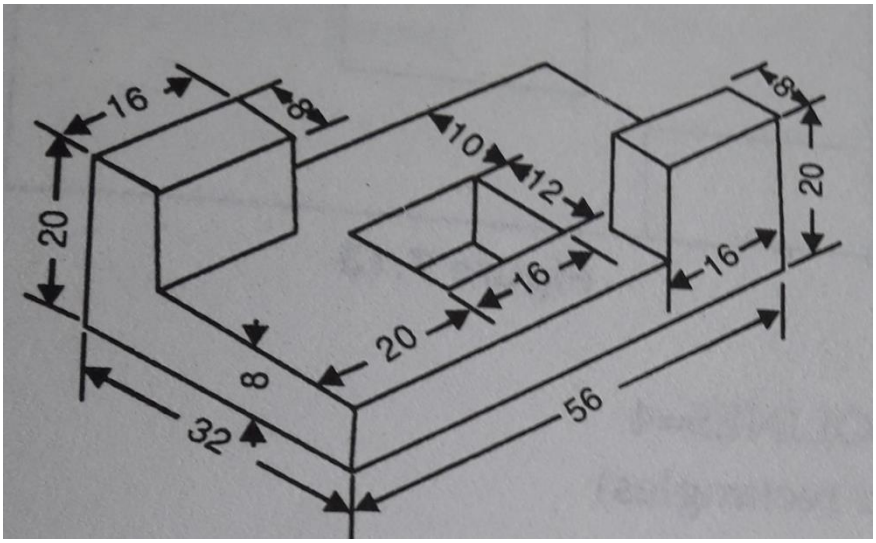
(Assembly to Detailed Sectional Drawing)

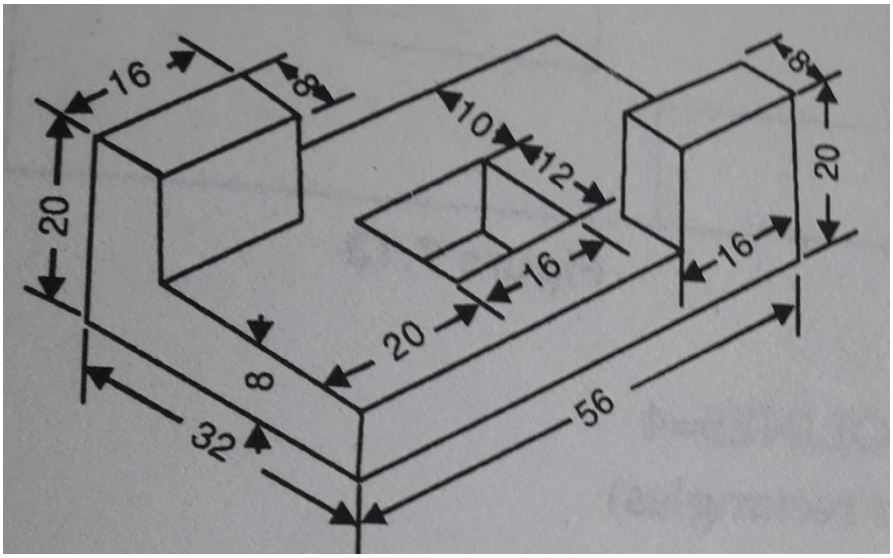
Assembly of Non-Return Valve :

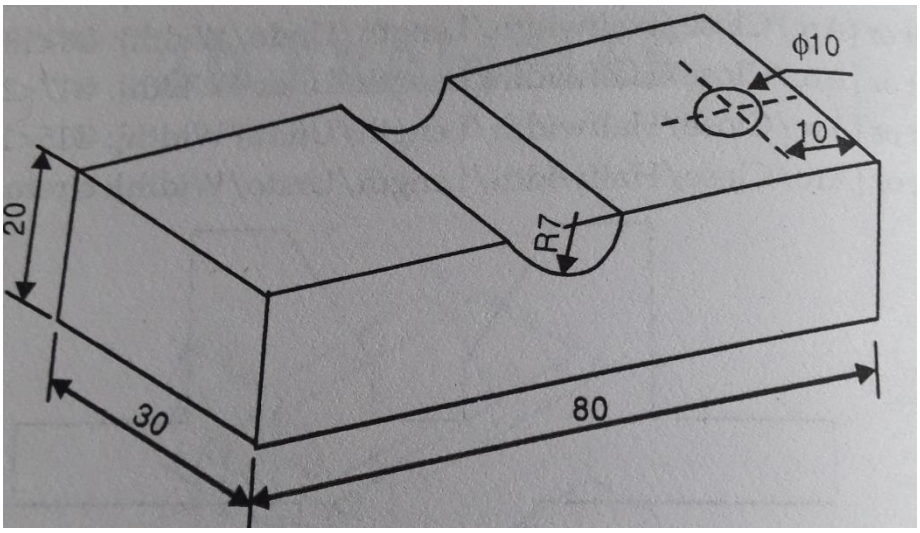


Annexure – 7

(3 D Modeling)



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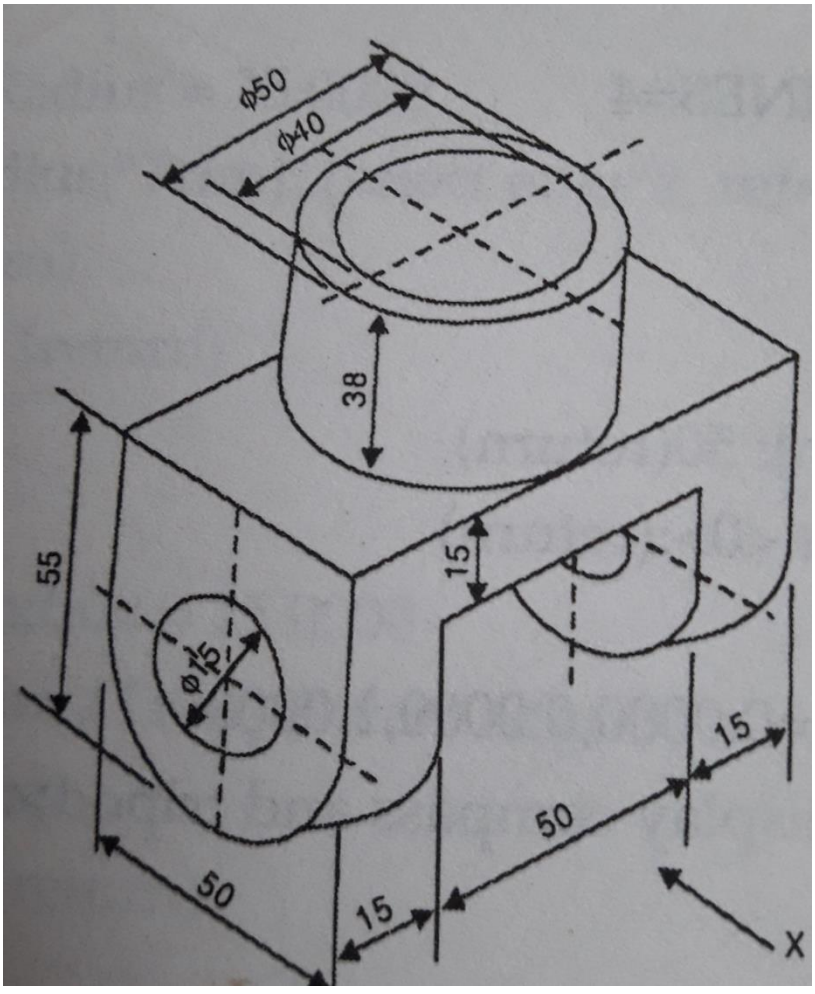
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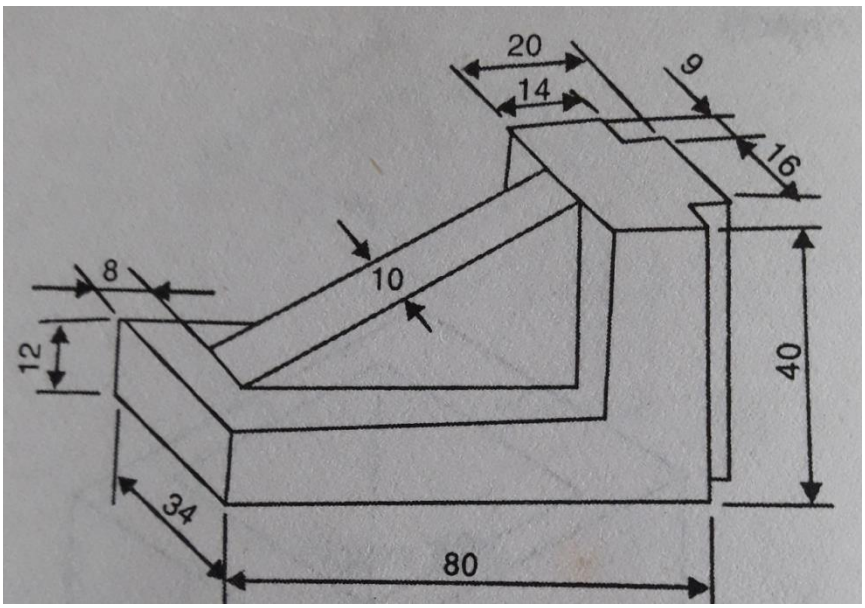
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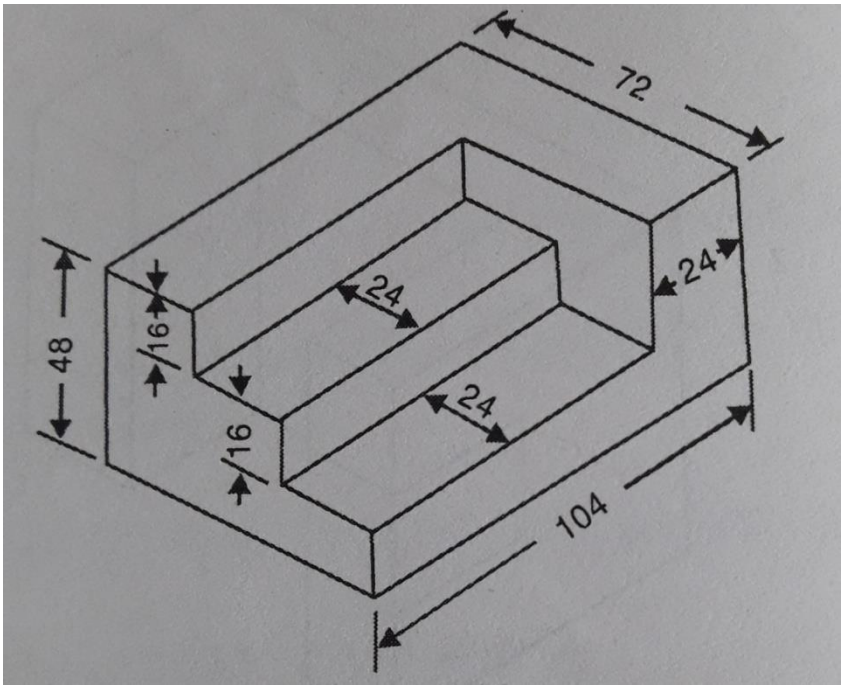
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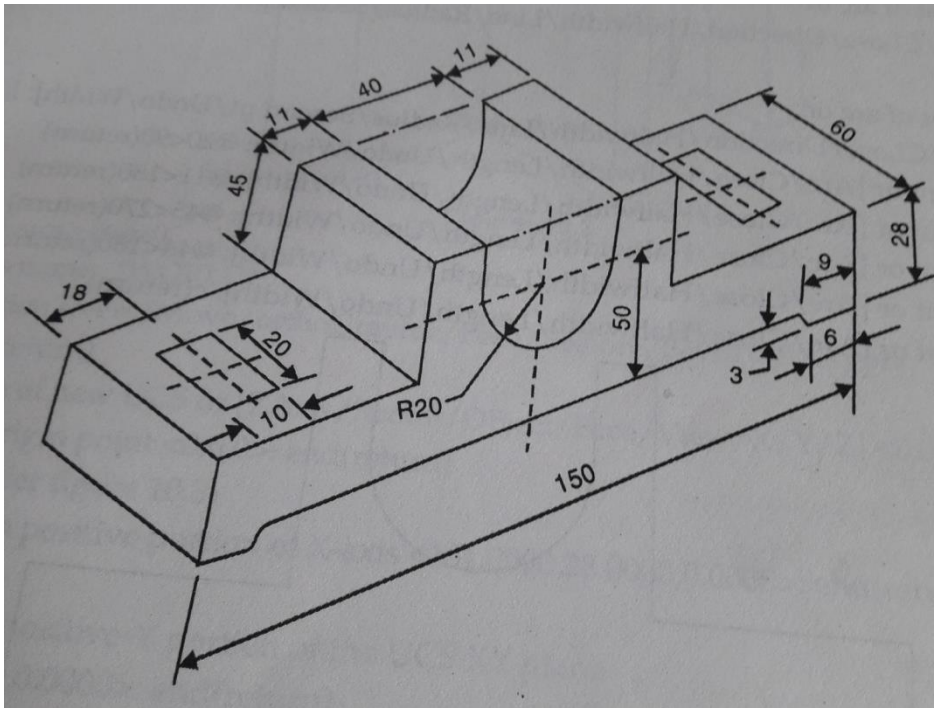
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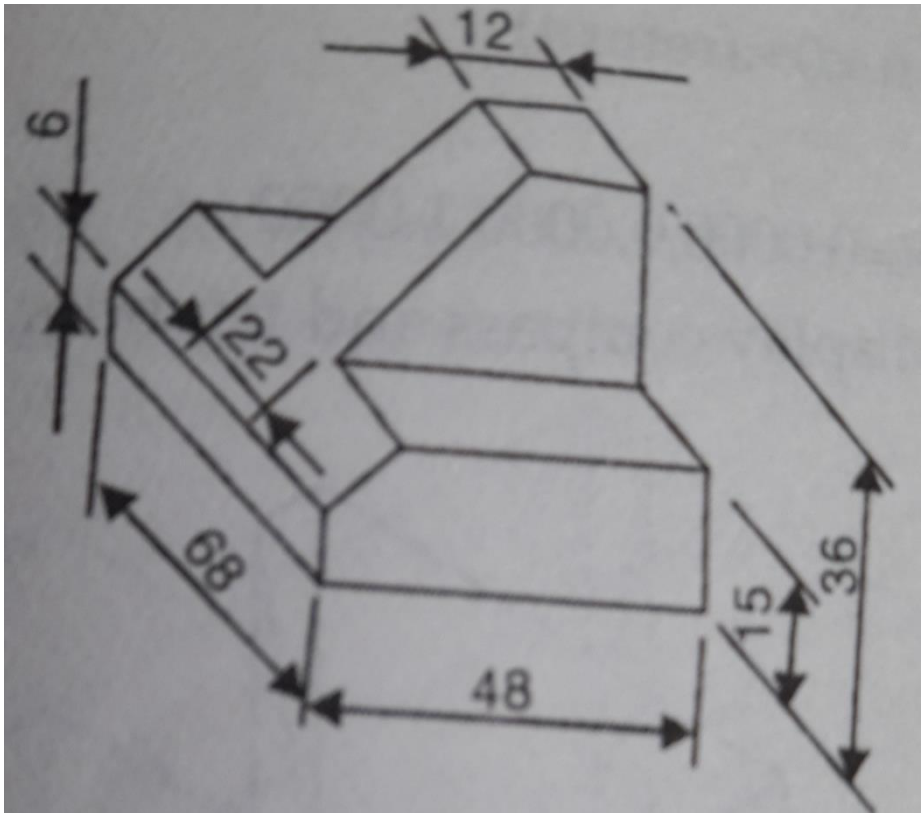
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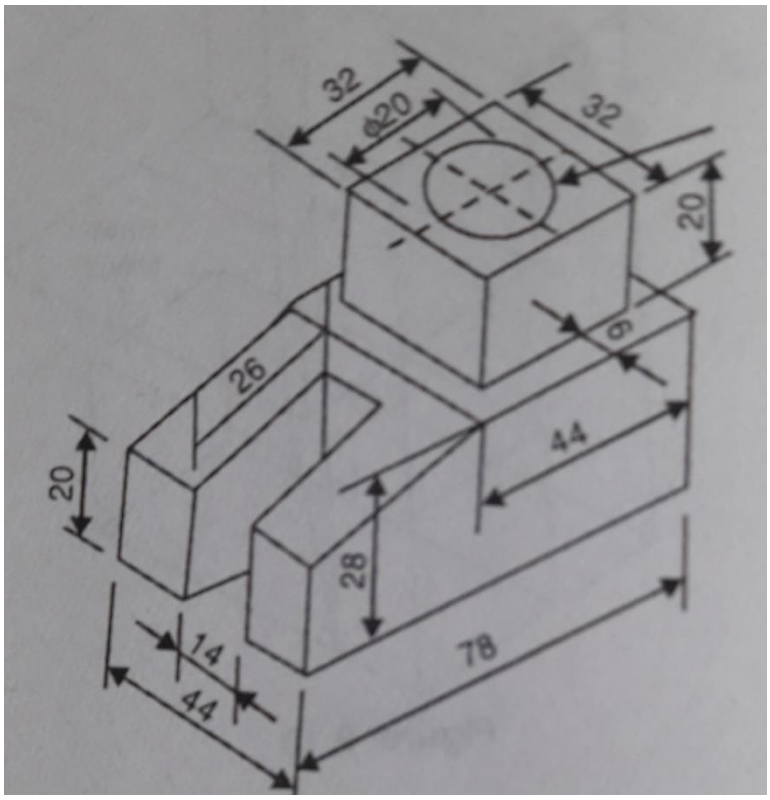
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WEST BENGAL STATE COUNCIL OF TECHNICAL & VOCATIONAL EDUCATION AND SKILL DEVELOPMENT
[A Statutory Body under West Bengal Act XXVI of 2013]
(Formerly West Bengal State Council of Technical Education)
"Karigori Bhavan", 4th Floor, Plot No. B/7, Action 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="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="4">Total lecture class/week : 2</td><td>Continuous assessment of class performance and in time submission of assignment</td><td>30</td><td rowspan="3">60 marks</td></tr>
<tr><td>Viva voce</td><td>20</td></tr>
<tr><td rowspan="2">Credit : 1</td><td>Class attendance</td><td>10</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. 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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<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. : MEPC214</td><td colspan="3">Practical : 100 Marks</td></tr>
<tr><td>Course Title : Engineering Metrology & Mechanical Measurement 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>Continuous assessment of class performance and in time submission of assignment</td><td>30</td><td rowspan="3">60 marks</td></tr>
<tr><td>Viva voce</td><td>20</td></tr>
<tr><td>Total lecture class/week : 2
Credit : 1</td><td>Class attendance</td><td>10</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. 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.

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

Syllabus
of

Diploma in Mechanical Engineering (Production) [MEP]

Part-II (4th Semester)

Revised 2022

CURRICULAM STRUCTURE MECHANICAL ENGG.(PRODUCTION)

4TH SEM ME(P)

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 MACHINES	3	0	3	3	100	40	60
2	Program Elective	ME(P)PE202	PROGRAM ELECTIVE	2	0	2	2	100	40	60
3	Program core	ME(P)PC204	INDUSTRIAL PRODUCTION TECHNOLOGY-II	3	0	3	3	100	40	60
4	Program core	ME(P)PC206	HEAT POWER ENGG.-II	3	0	3	3	100	40	60
5	Program core	MEPC208	ENGINEERING METROLOGY	3	0	3	3	100	40	60
6	Program core	MEPC210	COMPUTER AIDED MACHINE DRAWING PRACTICE	0	3	3	1.5	100	60	40
7	Program core	ME(P)PC212	INDUSTRIAL PRODUCTION TECHNOLOGY -II LAB	0	2	2	1	100	60	40
8	Program core	MEPC214	ENGINEERING METROLOGY AND MECHANICAL MEASUREMENT LAB	0	2	2	1	100	60	40
9	Program Core	ME(P)PE216	HEAT POWER ENGG.-II LAB	0	2	2	1	100	60	40
10	MINOR PROJECT	PR202	MINOR PROJECT	0	3	3	1.5	100	60	40
			TOTAL CREDITSAND MARKS	**14**	**12**	**26**	**20**	**1000**	**500**	**500**

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: **ME(P)PE202/1)**	**2**
2.Tool Engineering (Sub code: **ME(P)PE202/2)**	

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Name of the Course: Diploma in Mechanical Engineering(Production)			
Category: Programme Core	**Semester : Fourth**		
Code No. : MEPC202	**Theory : 100** Marks		
Course Title : Theory of Machine **(Same with Mechanical Engg.)**	**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	**12**

	of gearing. (Simple problems on gear train).	
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(Production)			
Category: Programme Elective	**Semester : Fourth**		
Code no. : ME(P)PE202/1	**Theory : 100** Marks		
Course Title : Refrigeration & Air Conditioning (Same with Mechanical Engg.)	**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. 3.6 Flow diagram and working principle of Water cooler. 3.7 Flow diagram and working principle of Cold storage.	**08**
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(Production)			
Category: Programme Elective	**Semester : Fourth**		
Code no.: ME(P)PE202/2	**Theory : 100** Marks		
Course Title: Tool Engineering **(Same with Mechanical Engg.)**	**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.	**08**
Unit: 2 Jigs and	**2.1** Concept, meaning, difference and benefits of jig and fixtures. **2.2** Concept and meaning of locating and clamping.	**08**

Fixtures	**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.	
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 (Production)	
Category: Programme Core	**Semester: Fourth**
Code no.: ME(P)PC204	**Theory: 100** Marks
Course Title: Industrial Production Technology-II	**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 hour/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.	

Course Learning Objectives:

- To understand basic production processes and technologies of relevance to the manufacturing industry and related sectors, particularly in the production, process and development areas.
- To select, operate and control the appropriate processes for specific applications and production processes, surface finishing processes and plastic processes.

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:

CO1 Use the basic machine tools like lathe, shaping and milling.
CO2 Understand and select the gear cutting processes.
CO3 Demonstrate understanding of metal cutting principles and mechanism
CO4 Understand the abrasive process
CO5 Understand the non-conventional machining processes

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-I: Theory of Metal Cutting	**1.1** Principle of metal cutting process. **1.2** Idea of generatrix and directrix. **1.3** Machining requirements. **1.4** Definition and function of machine tools. **1.5** Cutting parameters. **1.6** Cutting tool materials. **1.7** Classification of machine tools.	**03**
UNIT-II: Lathe Machines	**2.1** Classification of lathe. **2.2** Centre lathe – working Principle. **2.3** Specification and function of various parts.	**10**

	2.4 Different lathe operations-turning-facing-Knurling-boring-parting and grooving-drilling. **2.5** Taper and taper turning methods **2.6** Thread cutting in lathe-lathe setting-change gear ratio. **2.7** Capstan and turret lathe-basic parts-comparison. **2.8** Machining time calculation in Turning, facing.	
UNIT-III: Reciprocating Machines	**Shaper:** **3.1** Types of shapers-specifications. **3.2** Principles of operations. **3.3** Quick -return mechanism. **3.4** Machining time calculation in shaping horizontal surface(Simple numerical) **Planer:** **3.5** Types of planers-description of double housing planer. **3.6** Specifications of planer. **3.7** Principles of operation. **3.8** Comparison between shaper and planer. **Slotter:** **3.9** Types of slotters-specifications. **3.10** Principles of operation.	**08**
UNIT-IV: Milling Machines	**4.1** Types-column and knee type-plain-universal milling machine-vertical milling machine. **4.2** Specification of milling machines. **4.3** Principles of operation. **4.4** Methods of milling-up milling-down milling. **4.5** Milling operations. **4.6** Classification of milling cutter. **4.7** Cutting parameters & machining time calculations for plain milling operations. (simple numerical) **Gear Generating Processes:** **4.8** Basic geometry of spur gear. **4.9** Gear machining methods-gear shaping-Dividing head and indexing-Gear hobbing-Principle of operation only. **4.10** Gear finishing processes-Shaving-Grinding and Lapping.	**10**
UNIT-V: Drilling, Boring & Reaming	**5.1** Comparison between drilling, boring and reaming. **5.2** Construction, uses of different types of drilling machine. **5.3** Counter boring, counter sinking, spot facing and tapping.	**04**
UNIT-VI: Abrasive Process and Broaching	**Abrasive Process:** **6.1** Grinding and its classification. **6.2** Principles of operations. **6.3** Grinding wheels-Composition and nomenclature of grinding wheel-glazing and loading-Dressing and Truing of wheels. **6.4** Superfinishing processes- Honing & Lapping. **Broaching:** **6.5** Types of broaching machine-horizontal, vertical and continuous broaching. **6.6** Principles of operation-types of broaches classification.	**05**
UNIT-VII: Non-Conventional Machining Processes	**7.1** Need and characteristics of non-conventional machining processes. **7.2** Construction and working and of Ultrasonic machining-chemical machining-electrochemical machining-electrical discharge machining-plasma arc machining-LASER machining.	**05**

Sub Total: Total Lecture Classes	**45**
No. of classes required for conducting Internal Assessment examination	**06**

Grand Total:	51

3. Suggested Home Assignments/ Student Activities: 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 report on different machining operations on Lathe.
b) Prepare a diagram showing the different parts of Capstan and Turret Lathe 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 Non-conventional machining processes.

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 suggested list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty member also.

a) Prepare a machining product of different mechanical engineering drawing models.
b) Prepare various types of machine tools (with suitable material components) for display and demonstration purposes.
c) Prepare different types of cutting tools for display and demonstration purpose.
d) Prepare various types of milling cutter with suitable material.
e) Prepare model or suitable chart of the drive mechanism generally being used in Lathe.
f) Prepare model of gear nomenclature for display and demonstration purposes.
g) Prepare model of any non-conventional machining process for display and demonstration purposes.
h) Prepare working model of the taper turning attachment generally being used in Lathe.

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)

Multiple Choice Questions						**Subjective Questions**					
Group	**Unit No.**	**To be Set**	**To be Answered**	**Marks per Question**	**Total Marks**	**Group**	**Unit No.**	**To be Set**	**To be Answered**	**Marks per Question**	**Total Marks**
A	1 & 2	**06**	**20**	**01**	**[20 x 1] = 20**	A	1 & 2	**03**	Total 5 questions are to be answered taking at-	**08**	**[5 x 8] = 40**
B	3 & 4	**08**				B	3 & 4	**04**			

C	5 & 6	**06**				C	5 & 6	**03**	least 1 from each group.		
Pass Criterion for End Semester Examination = 24 Marks [Minimum]											

6 Rubrics for the Assessment of Student's 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

Questions to be set as per Bloom's Taxonomy				
Internal Assessment	**Distribution of Theory Marks:**			
	Level 1	**Level 2**	**Level 3**	**Total**

7 Suggested Learning Resources:

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 Processes	Kalpakjian & Schemid	Pearson Education, New Delhi
4	Manufacturing Technology – Volume I & II	P. N. Rao	Tata McGraw-Hill, New Delhi,
5	Manufacturing Science	Amitabh Ghosh, Mallik	East-West Press Pvt. Ltd. New Delhi.
6	Materials and Processes in Manufacturing	DeGarmo	Wiley
7	Machining & Machine Tool	A.B. Chattopadhyay	Wiley
8	Welding & Welding Technology	Richard L Little	Tata McGraw-Hill, New Delhi,
9	Workshop Technology - Volume I , II & III	W.A.J. Chapman	Viva Books (p) Ltd.

8 Suggested Learning Websites:

a) ELS web-portal of WBSCTE
b) https://nptel.ac.in
c) https://swayam.gov.in
d) https://play.google.com/store/apps/details?id=com.mhrd.ndl
e) https://www.vlab.co.in

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

	(Remember)	(Understand)	(Apply & above)	
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:

f) ELS web-portal of WBSCTE
g) https://nptel.ac.in
h) https://www.nitttrchd.ac.in
i) https://swayam.gov.in
j) https://play.google.com/store/apps/details?id=com.mhrd.ndl
k) https://www.youtube.com/watch?v=j6rGuSFGCbE&list=PLkyVnO47pDX80flvlTAs2rEVckV853Z1R&index=2 : Surface Grinding
l) https://www.youtube.com/watch?v=WOqOv8O54R8&list=PLkyVnO47pDX80flvlTAs2rEVckV853Z1R&index=3 : Shaper
m) https://www.youtube.com/watch?v=aeOaAZRwpfY : Milling M/C
n) https://www.youtube.com/watch?v=SvlWaeq94dA&list=RDCMUCQUIiUbuOa09-FTwoZrgO_w&index=3 : Milling Cutter
o) https://www.youtube.com/watch?v=a-GkDjXGJI0 : Indexing
p) https://www.youtube.com/watch?v=rRW-mNLIPxA&list=RDCMUCQUIiUbuOa09-FTwoZrgO_w&index=14 : Types of Gear
q) https://www.youtube.com/watch?v=Uc6b1g8SHV0 : Spur Gear cutting using Milling M/C
r) https://www.youtube.com/watch?v=XLEzaT4hNYk : Gear Hobbing
s) https://www.youtube.com/watch?v=OjyH6qIMgLI : Gear Shaping
t) https://www.youtube.com/watch?v=_Yy3jZu4PXE : Gear finishing
u) 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 (Production)	
Category: Programme Core	**Semester: Fourth**
Code no.: ME(P)PC	**Theory: 100** Marks

Course Title: Heat Power Engineering - II	**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) 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.

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 I: POWER CYCLES	**Gas Power Cycles:** 1.1.Carnot Gas Power Cycle and Carnot Vapour Power Cycle with representation of the same on P-V & T-S diagrams. 1.2.Deduction of Thermal Efficiency of Carnot Power Cycle. Impracticability of Carnot Cycle in practical application. 1.3.Ericsson cycle. 1.4.Otto cycle and Diesel cycle- P-V & T-S diagrams- deduction of thermal efficiency-comparison-simple numerical on Otto and Diesel cycles. 1.5.Brayton cycle. **Vapour Power Cycles:** 1.6.Simple steam power cycle. 1.7.Rankine Cycle and representation of the cycle on P-V, T-S & H-S diagrams. (Simple numerical on Rankine Cycle). 1.8.Comparison between Carnot Cycle and Rankine Cycle. 1.9.Deduction of Thermal Efficiency of Rankine cycle, steam rate and heat rate. 1.10. Mean temperature of heat addition. 1.11. Basic Principle, representation on P-V, T-S & H-S diagrams, labelled schematic flow diagram and utility of the following cycles: (No numerical) • Reheat Cycle. • Regenerative Cycle. • Reheat-Regenerative Cycle.	**11**
UNIT II: REFRIGERATION CYCLES	**2.1** Definition of Refrigeration, Ton of Refrigeration (Unit of Refrigeration) and Coefficient of Performance (COP) of Refrigerator & Heat Pump. **2.2** Reversed heat engine cycle. **Air Refrigeration:** **2.3** Basic Principle, representation on P-V & T-S diagrams, labelled schematic flow diagram of Bell Coleman Cycle (Reversed Joule Cycle) (Simple numerical). **Vapour Compression Refrigeration:** **2.4** Basic Principle, representation on P-V, T-S & H-S diagrams, labelled schematic flow diagram and function of components of ideal Vapour Compression Refrigeration Cycle. (Simple	**08**

	numerical).	
UNIT III: STEAM CONDENSER	**3.1** Working Principle and Purpose of using Steam Condenser in Power Plant. **3.2** Steam condenser parts. **3.3** Classification of Steam Condensers. **3.4** Comparison between Surface Condenser and Jet Condenser. **3.5** Sources of Air Leakage in Steam Condenser. Effect of Air Leakage. **3.6** Working Principle and Purpose of using Cooling Tower.	**07**
UNIT IV: AIR COMPRESSER	**4.1** Uses of Compressed Air. **4.2** Working Principle and Classification of Air Compressors. **4.3** Definition of Compression Ratio, Compressor Capacity and Swept volume. **Reciprocating Air Compressor** **4.4** Construction and Working Principle of Single Stage and Two Stage Air Compressor. **4.5** Volumetric Efficiency, Isothermal Efficiency & Mechanical Efficiency. (Simple numerical on single stage compressor). **4.6** Advantages of Multi Staging over single stage. **Rotary Air Compressor** **4.7** Construction and Working Principle of Screw, Lobe, Vane and Centrifugal, Axial Flow Compressors. (No numerical). **4.8** Comparison of Reciprocating Compressor and Rotary Compressor. **4.9** Application Areas of Reciprocating Compressor and Rotary Compressor.	**08**
UNIT V: BASIC 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 Gray Bodies. **5.8.**Classification and working principle of Heat exchanger-based on flow arrangement (parallel flow, counter flow & cross flow). 5.9.Basic concept of logarithmic mean temperature difference (LMTD).	**08**
UNIT VI: NOZZLE & DIFFUSER	**6.1** Working principle of steam nozzle and diffuser. **6.2** Types of nozzles. **6.3** Application areas of steam nozzle and diffuser. **6.4** Continuity equation, sonic velocity and concept of Mach number. **6.5** Steady flow energy equation for nozzle and diffuser.	**03**
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

7 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 (07)	10	10 x 01 = **10**
A2	3 & 4 &5	05 (08)		
~~**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	06 (07)	10	10 x 01 = **10**
B2	3 & 4 & 5	05 (08)		
~~**B3**~~	~~5 & 6~~	~~04~~		
	Total:	**15**	**10**	**10**
C: Short Answer Type Questions (Carrying 1 mark each)				
Group	**Unit**	**To be Set**	**To be Answered**	**Total Marks**
C1	1& 2	06 (07)	10	10 x 01 = **10**
C2	3 & 4 & 5	05 (08)		
~~**C3**~~	~~5 & 6~~	~~04~~		
	Total:	**15**	**10**	**10**
			Sub-Total [A+B+C]:	**30**
D: Subjective 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	03 (06)		
~~**D3**~~	~~5 & 6~~	~~03~~		
	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**	03 **(05)**		
~~**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	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.
6	Engineering Thermodynamics	P K Nag	TATA McGraw-Hill

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Name of the Course: Diploma in Mechanical Engineering(Production)			
Category: Programme Core	**Semester : Fourth**		
Code no. : MEPC208	**Theory : 100** Marks		
Course Title : Engineering Metrology **(Same with Mechanical Engg.)**	**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-II: **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-III: **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-IV: **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-V: **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-VI: **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-VII: **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**

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

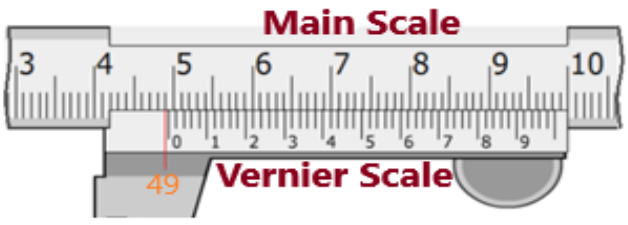
i) Compile a exhaustive chart of measuring instruments and gauges that are commonly used in production for inspection purpose. Chart must contain name of instrument/gauge, specification (range, least count etc), maker and use.

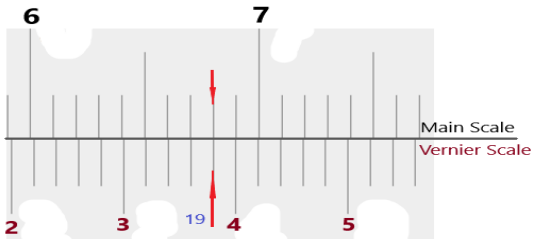
ii) Calculate the limits, tolerances, and allowances on a 25 mm shaft and hole pair designated as H7/g6 to get a precision fit. The fundamental tolerance is to be calculated by the following equation: $= 0.45\sqrt[3]{D} + 0.001D$. The following data are given – a) Upper deviation of shaft = $-2.5D^{0.34}$,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

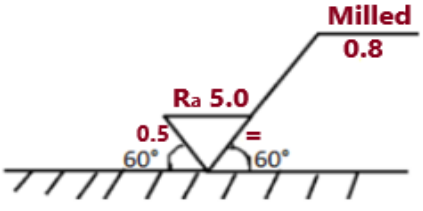
So, main scale reading = ... divisions = (..... x .....) = ... mm

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

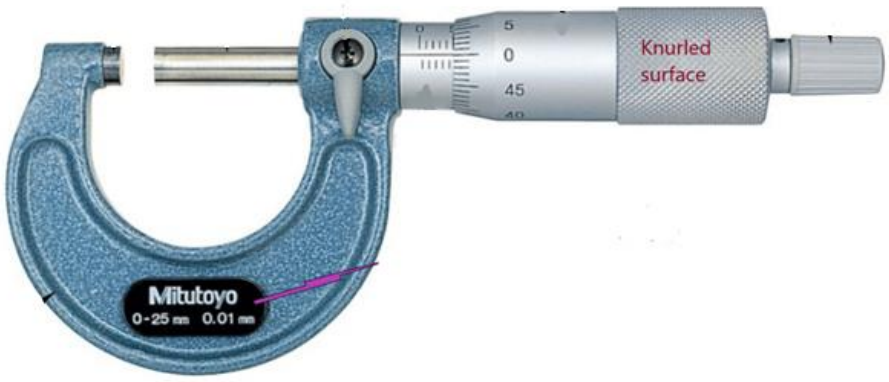
Therefore, total reading = [..... + ...] = ... mm

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

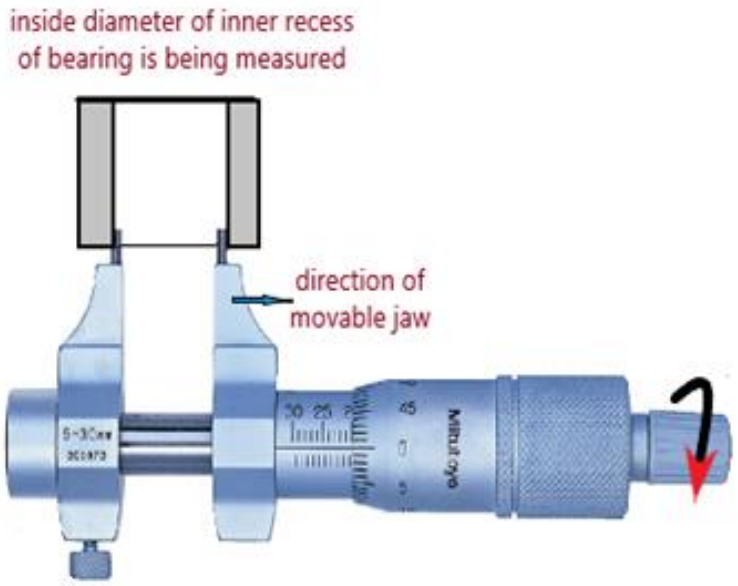
vii) What does the following figure indicate regarding statements and symbols used for surface texture?



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**

4. 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

5. 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

<table>
<tr><td colspan="4">Name of the Course: Diploma in Mechanical Engineering</td></tr>
<tr><td rowspan="2">Course Title : Computer Aided Machine Drawing Practice

(Same with Mechanical Engg.)</td><td colspan="3" rowspan="2">Semester : Fourth</td></tr>
<tr></tr>
<tr><td>Category: Programme Core</td><td colspan="3">Full Marks: 100</td></tr>
<tr><td>Code no. : MEPC210</td><td colspan="3">Sessional Examination Scheme:</td></tr>
<tr><td rowspan="5">Duration : 17 weeks</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="2">Total Practical class/week : 3</td><td>Submission of drawing sheets (in scheduled time)</td><td>40</td><td rowspan="2">60 marks</td></tr>
<tr><td>Class performance & attendance</td><td>10</td></tr>
</table>

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, cotters, riveted, bolted and welded joints.

CO3: Draw the three dimensional views of different elements related to mechanical engineering including keys, couplings, cotters, riveted, bolted and welded joints.

2. Theory Components:

Unit	Unit Outcomes	Topics	Teaching Hours
01		**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		**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		**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 , 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.	**05**

		HATCHING: Basics of HATCHING – Boundary Hatch Options: Quick tab, Advance tab – Hatching around Text, Traces, Attributes, Shapes and Solids – Editing Hatch Boundary.	
04		**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		**Printing of Drawings**	**01**
06		**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**

2. Suggested assignments for continuous assessment:

From the following suggested assignments at least six sheets are to be attempted on A-4 size 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 (Refer Annexure-1)	1a.		**02**	**5**
Sheet No. -2 (Refer Annexure-2)	2a.		**0**	**5**
Sheet No. -3 (Refer Annexure-3)	3a.		**08**	**5**

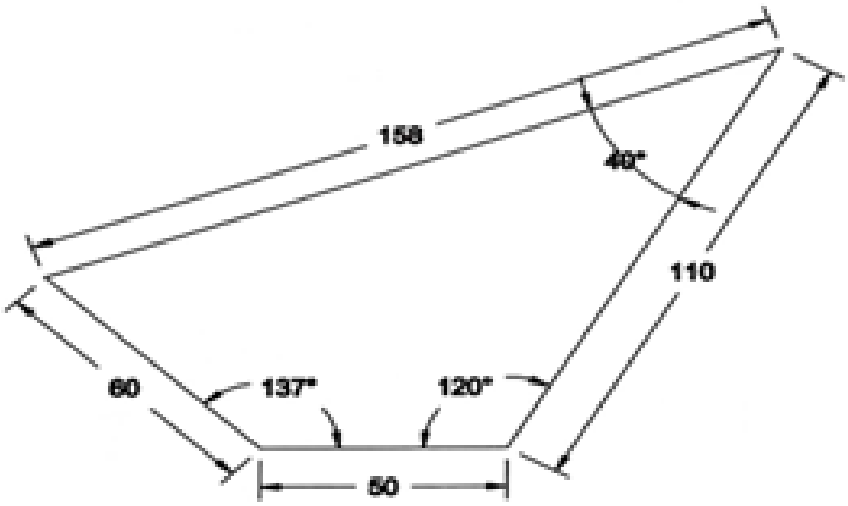
Sheet No. -4 (Refer Annexure-4)	4a. Draw sectional front view, top view and side view		**10**	**5**
Sheet No. -5 (Refer Annexure-5)	5a. Draw assembly drawing (sectional front view and side view) from the given detailed drawings of components.		**12**	**5**
Sheet No. -6 (Refer Annexure-6)	6a. Identify various components in the given assembly drawing and the sequence of dismantling it. 6b. Describe the procedure for dismantling the given assembly drawing. 6c. Draw part drawing (sectional front view and side view) from the given assembly drawing.		**14**	**5**
Sub Total: **Practical classes**			**30 Hours**	**30**
Preparation for ESE			**06 Hours**	
Grand total :			**36 Hours**	

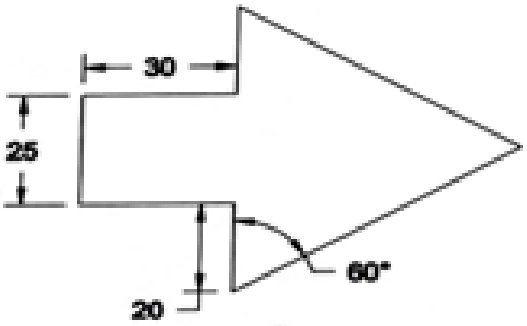
3**. Rubrics for the internal assessment of drawing sheets [40 marks]:**

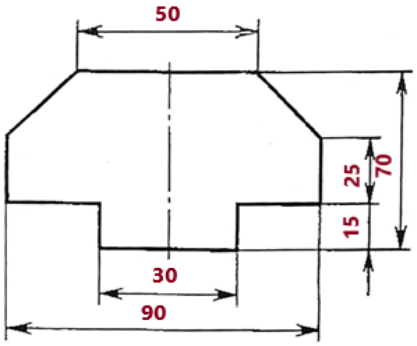
Sl No.	Performance Indicators	Weightage in %
1	For interpretation of problems given by subject teacher	20
2	For proper layout of drawing sheets (maintaining correct types of lines and their thickness)	50
3	For proper dimensioning, symbols of the drawn views	10
4	For neatness & cleanliness of drawing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

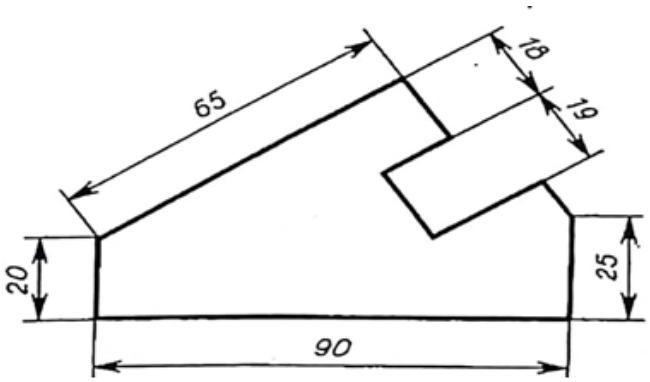
Annexure-1:

(Application of line)



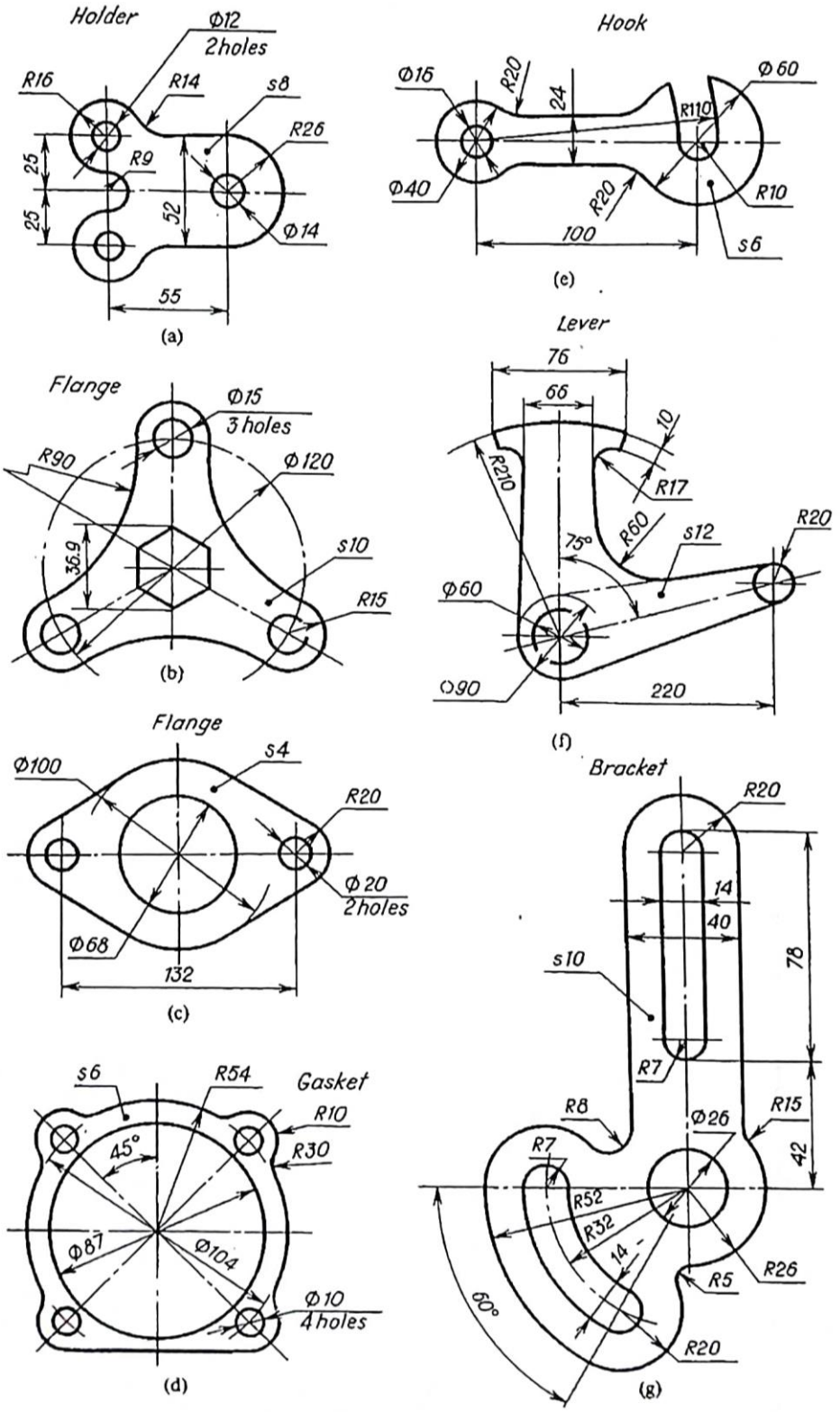






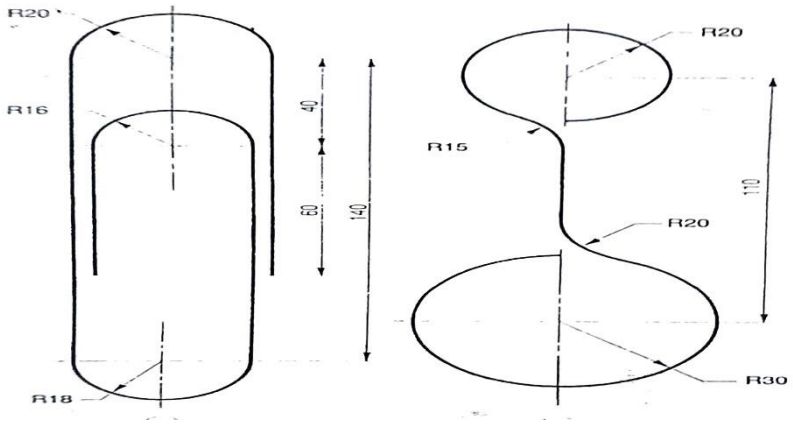
Annexure – 2

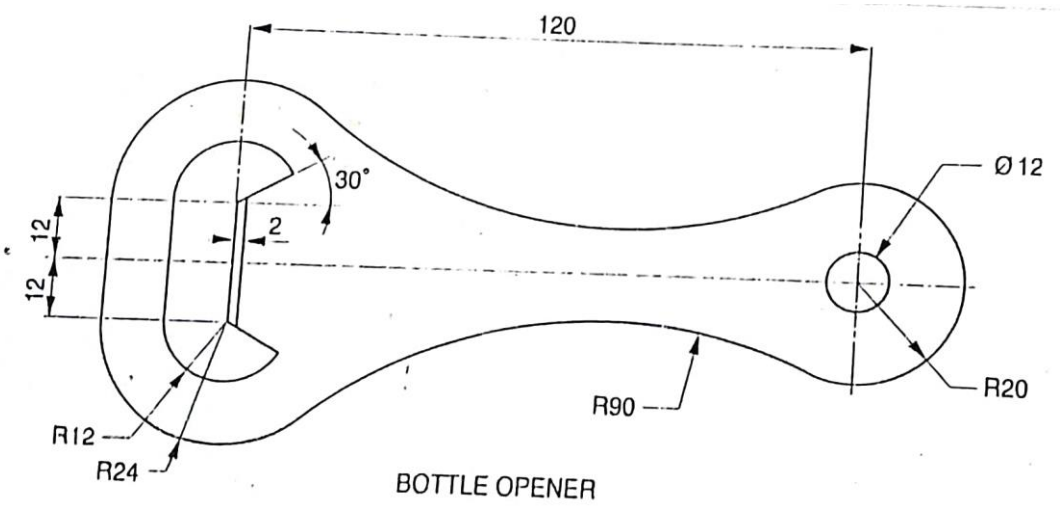
(Application of Circle)


Holder
Ø12
2 holes
R16
R14
s8
R26
R9
25
25
52
Ø14
55
(a)
Hook
Ø16
R20
24
Ø60
R110
Ø40
R20
R10
100
s6
(e)
Flange
Ø15
3 holes
R90
Ø120
s10
36.9
R15
(b)
Lever
76
66
10
R210
R17
R60
75°
s12
R20
Ø60
Ø90
220
(f)
Flange
Ø100
s4
R20
Ø20
2 holes
Ø68
132
(c)
Bracket
R20
14
40
78
s10
R7
R8
Ø26
R15
42
R7
R52
R32
14
R26
R5
60°
R20
(g)
s6
R54
Gasket
R10
45°
R30
Ø87
Ø104
Ø10
4 holes
(d)

Annexure – 3

(Application of Curves)

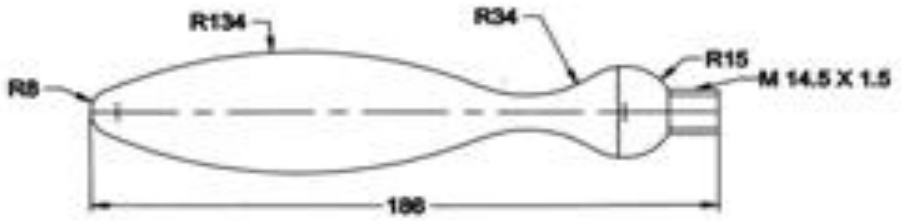




BOTTLE OPENER

Annexure – 3

(Application of Curves)



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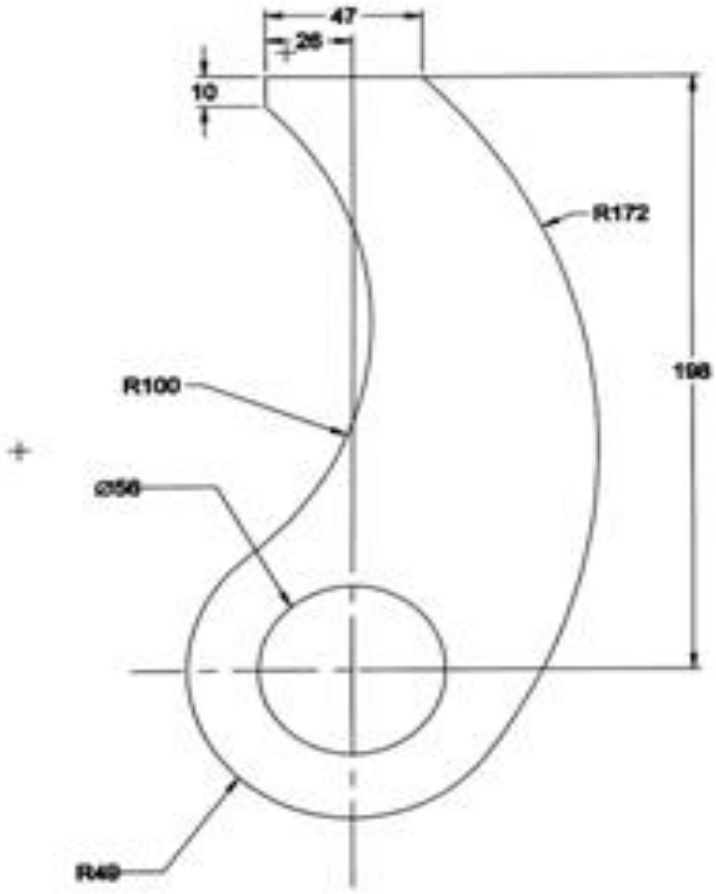
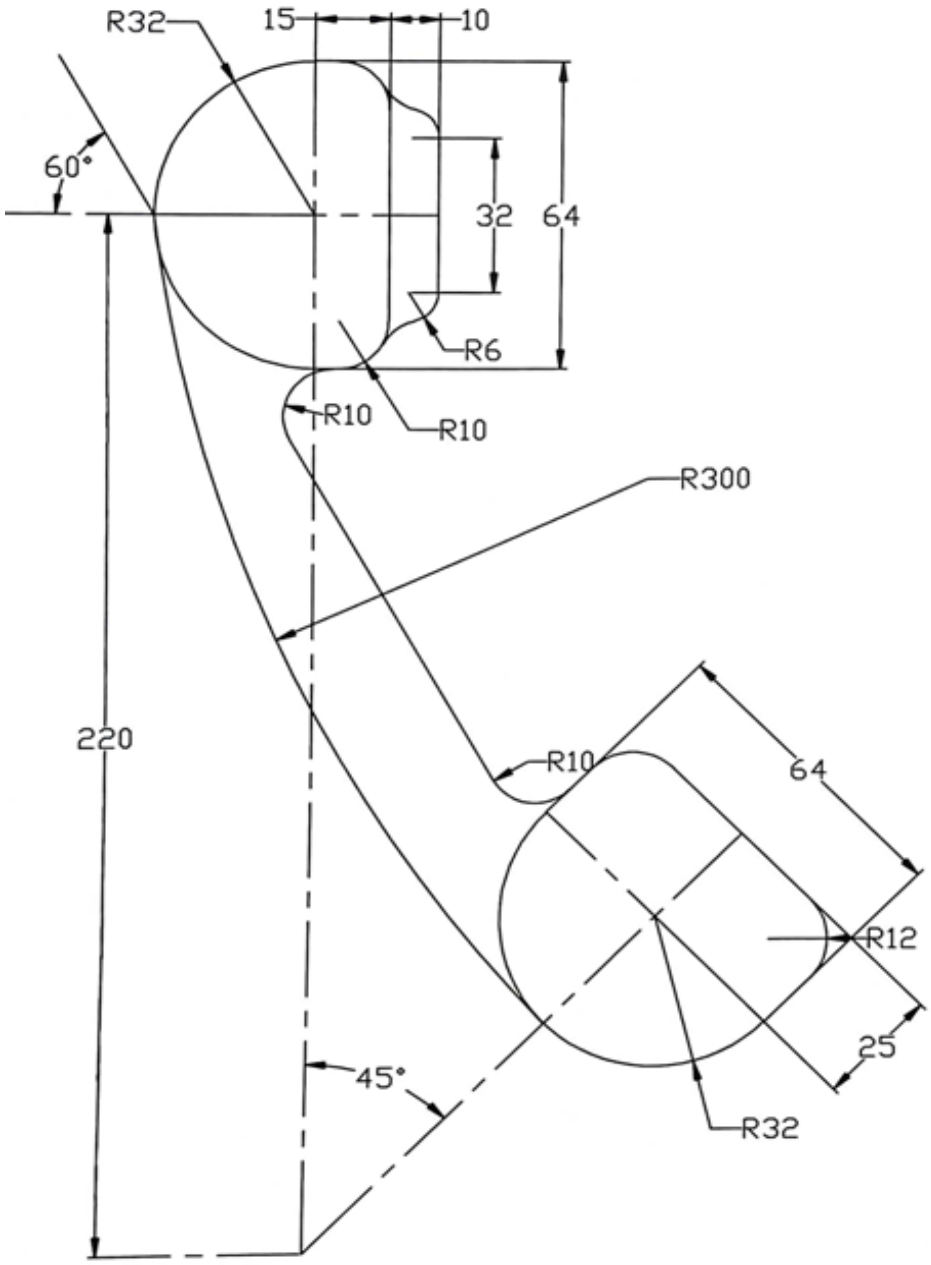


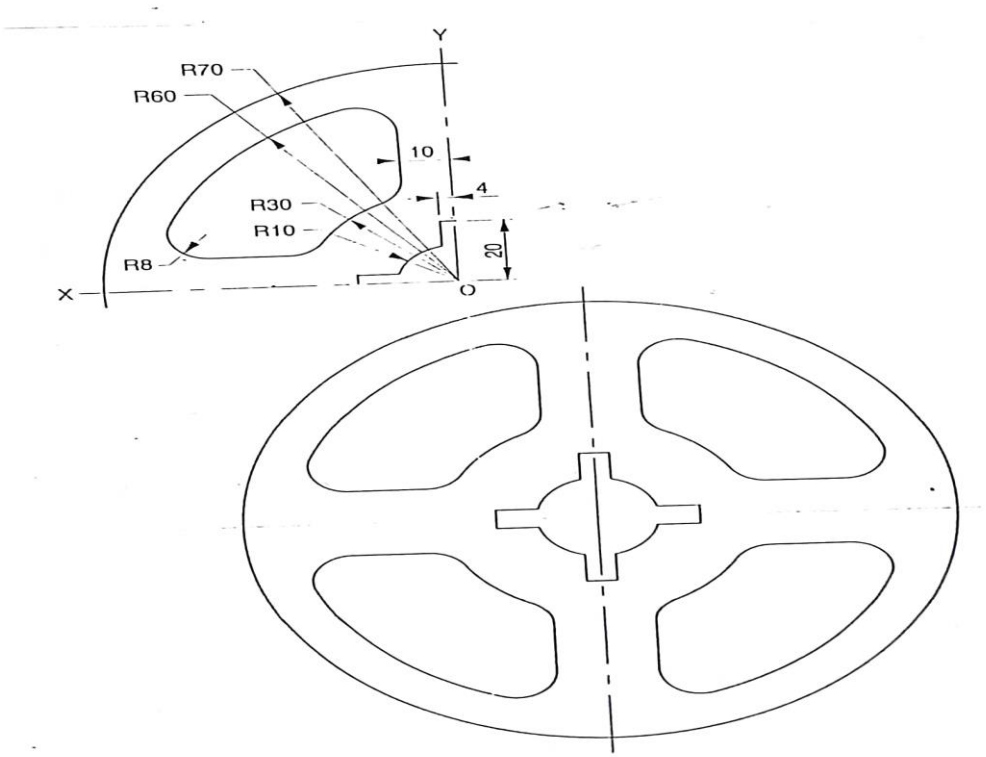
Annexure – 3

(Application of Curves)



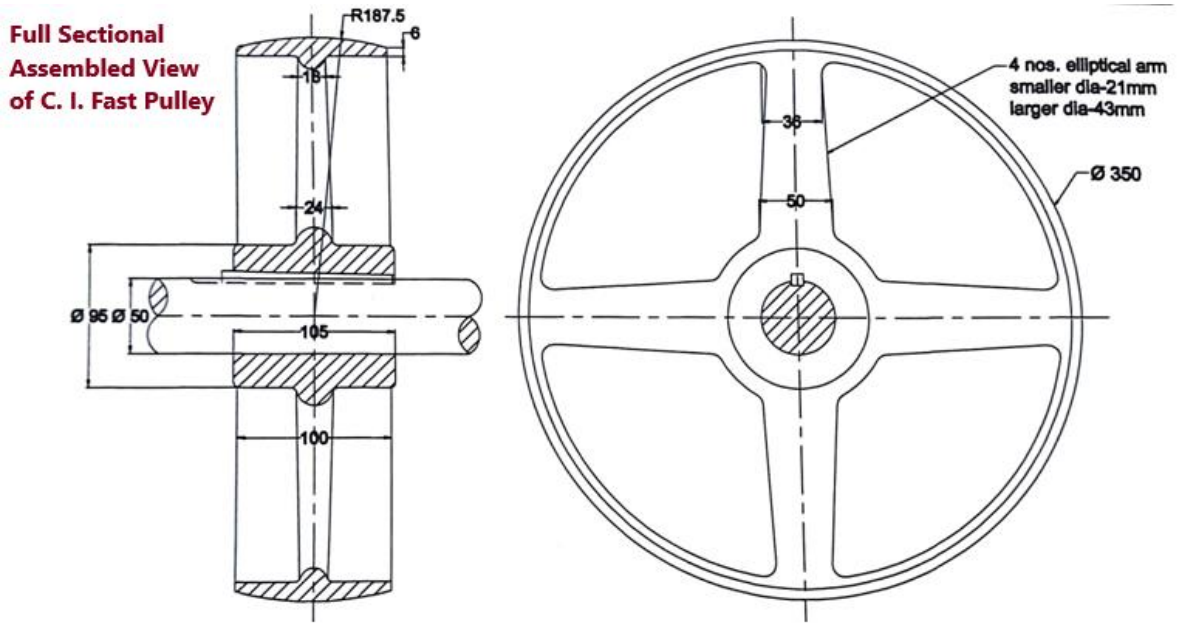
Annexure – 3

(Application of Curves)



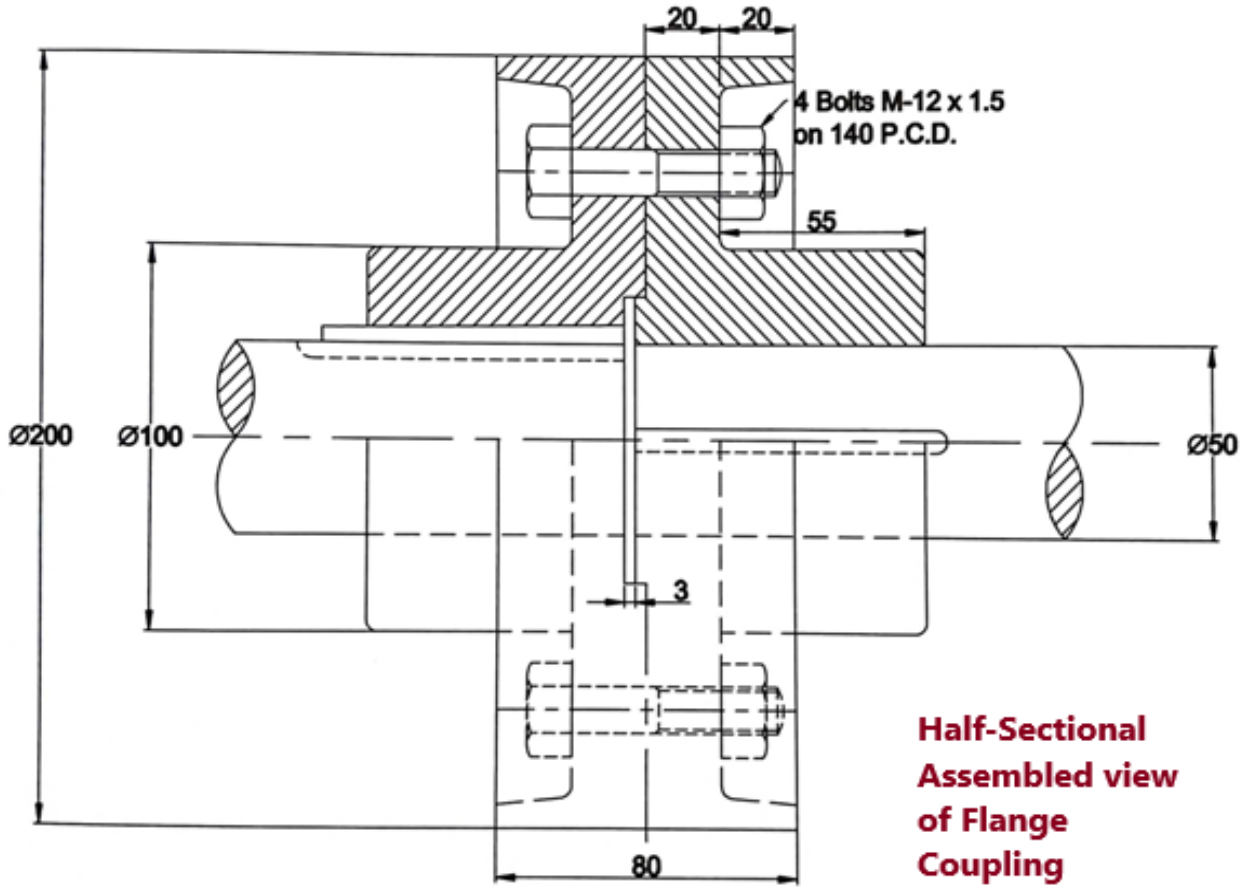
Annexure – 4

(Assembled View of C. I. Pulley)



Annexure – 5

(Assembled view of Flange Coupling)

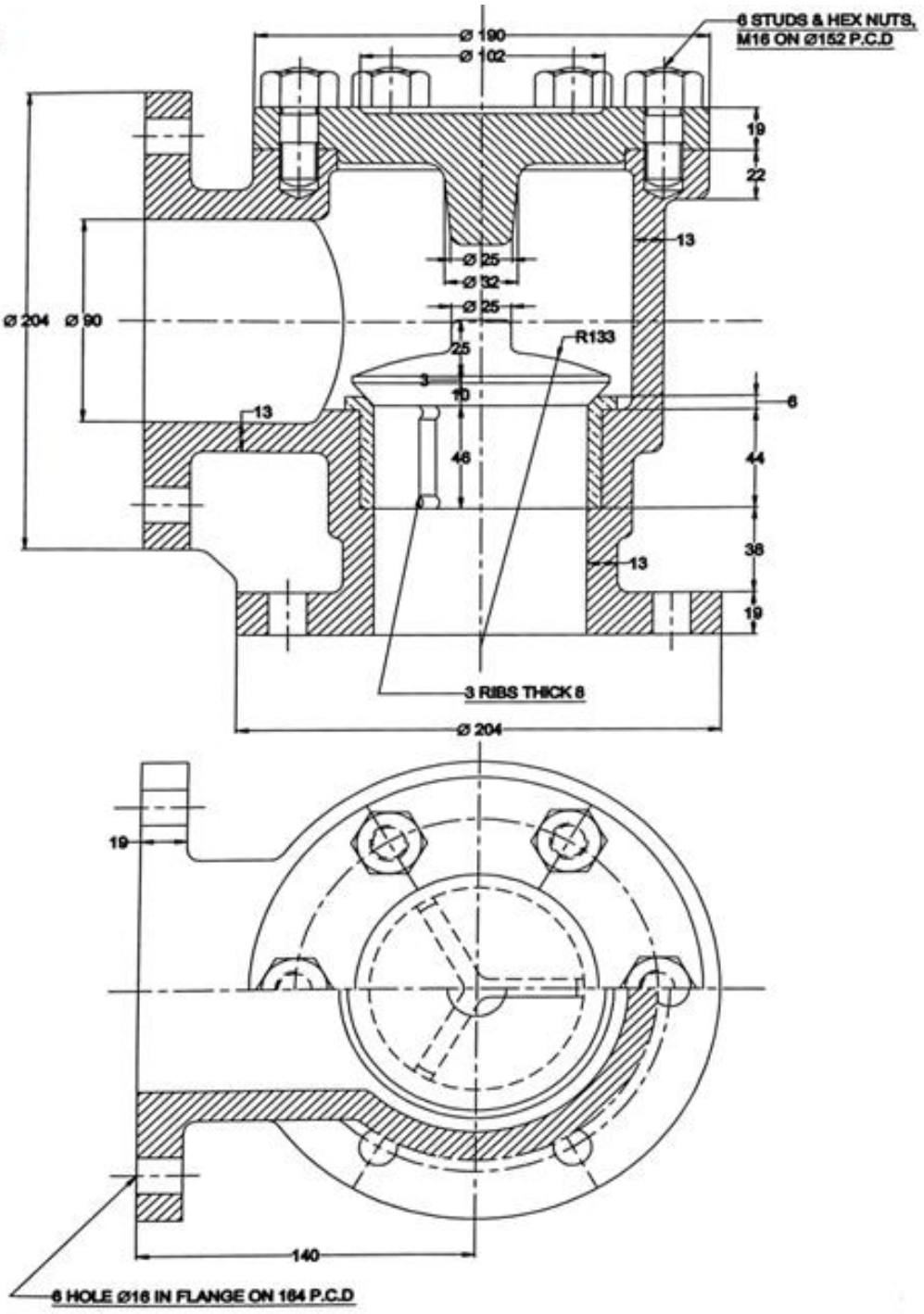


Half-Sectional Assembled view of Flange Coupling

Annexure -6

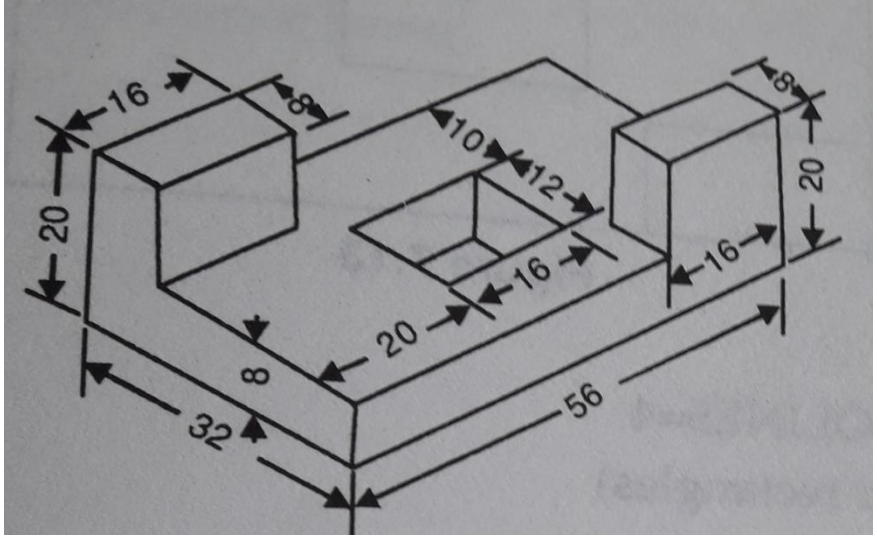
(Assembly to Detailed Sectional Drawing)

Assembly of Non-Return Valve :



Annexure – 7

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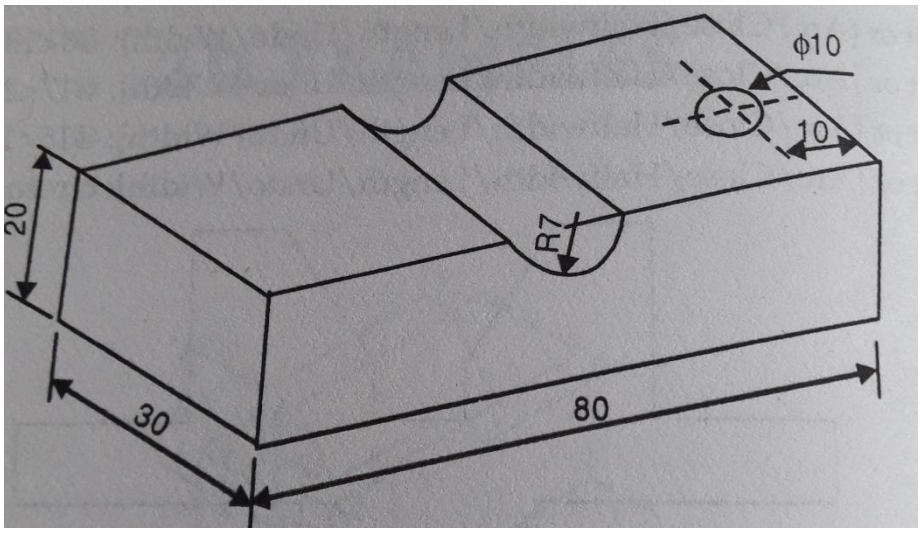
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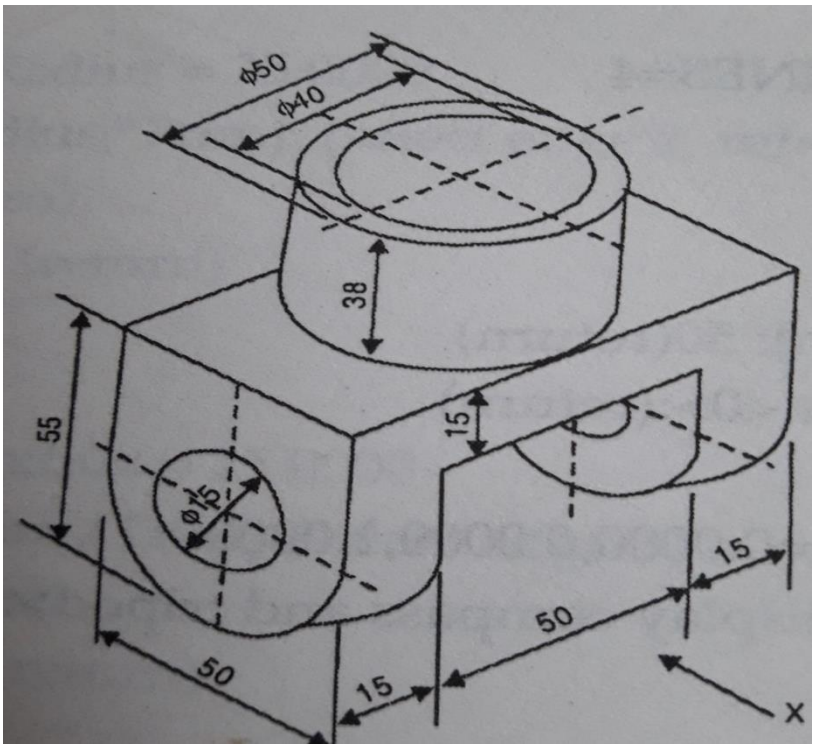
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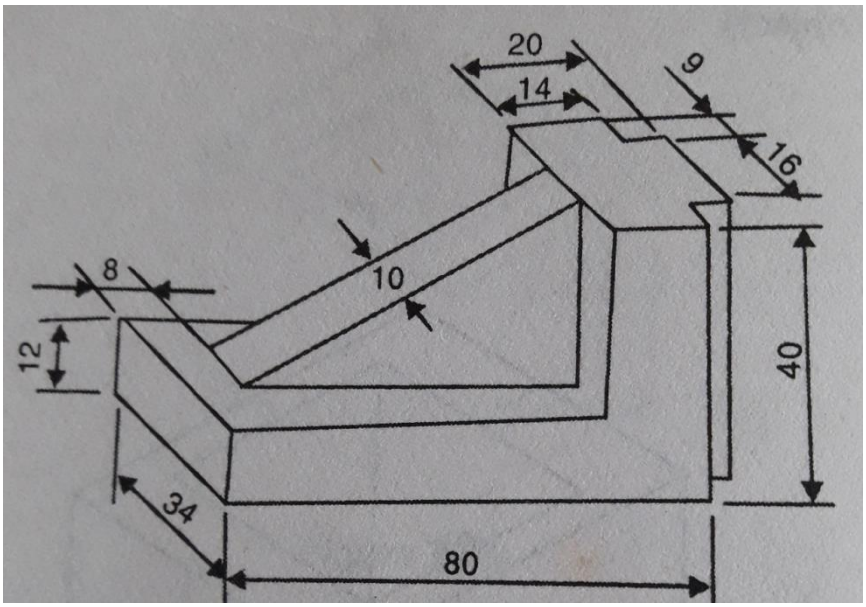
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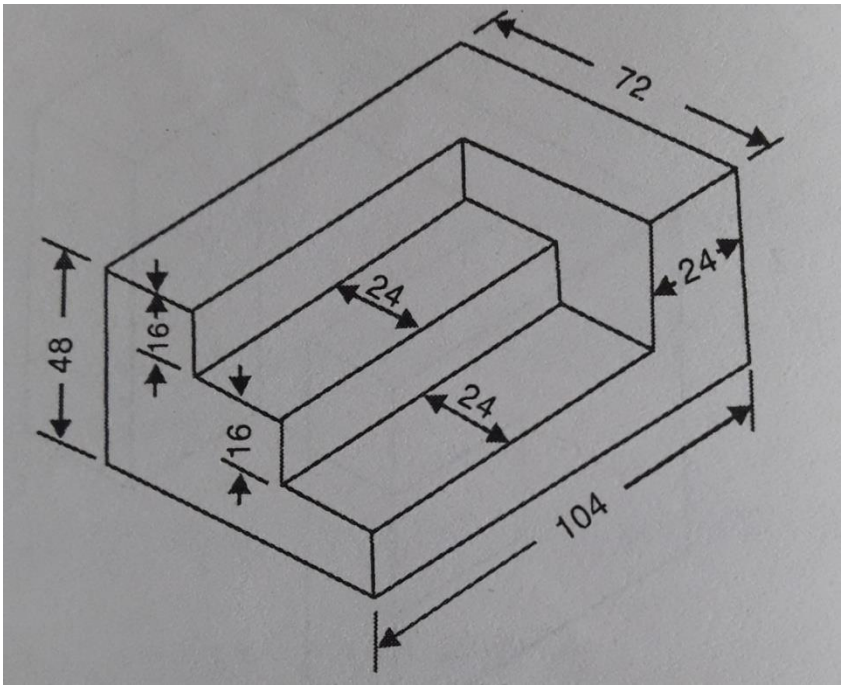
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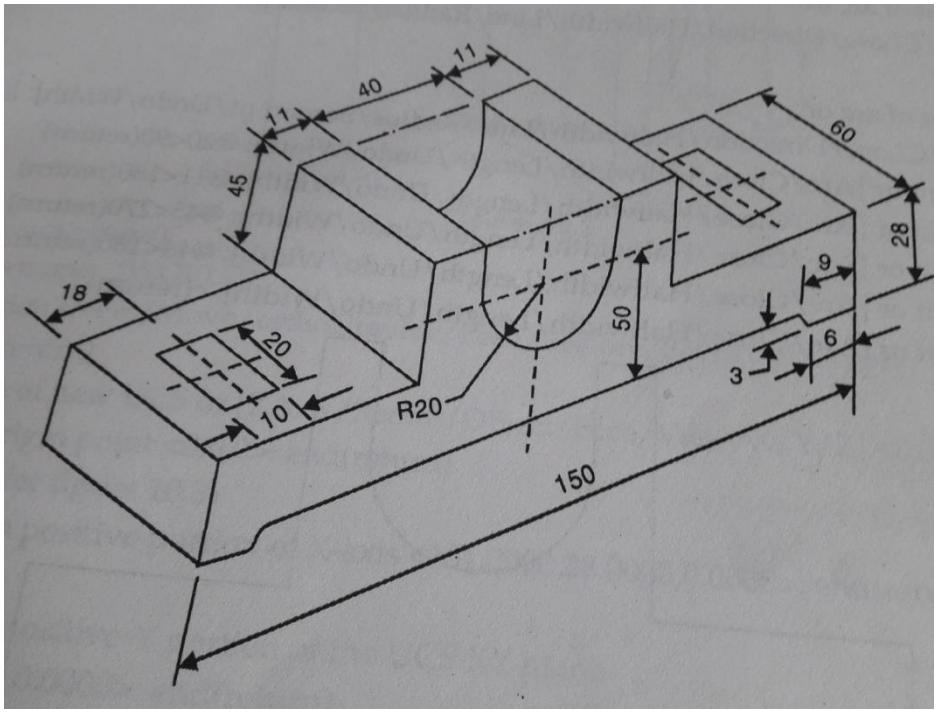
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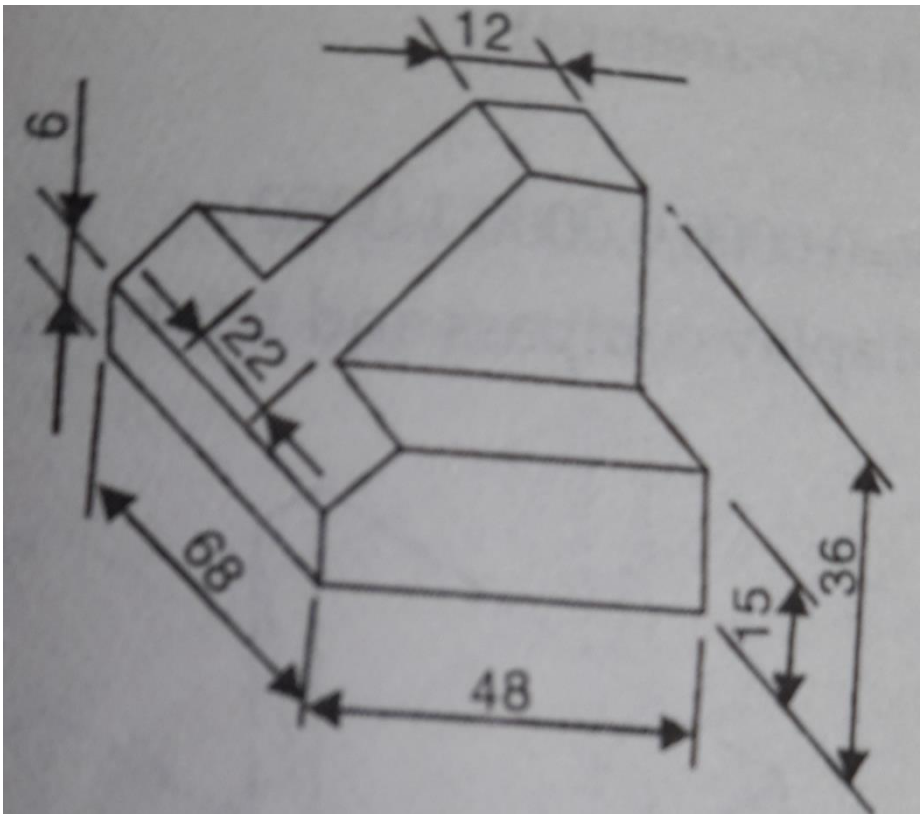
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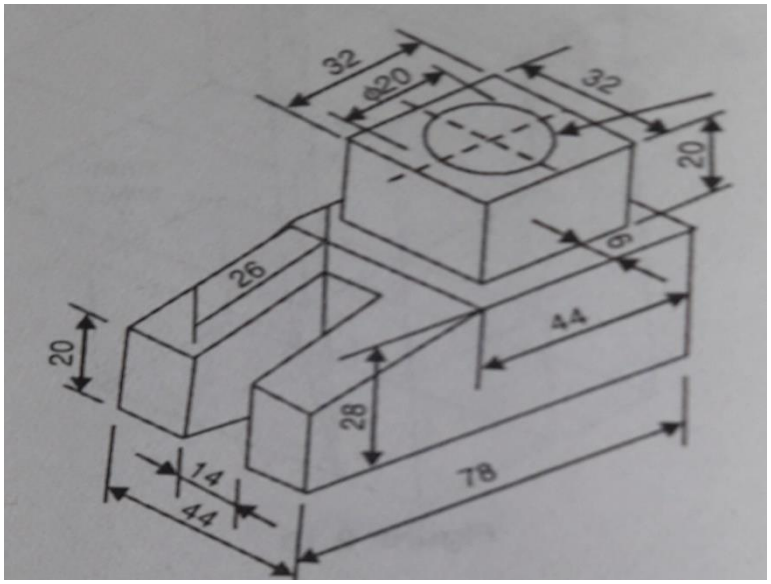
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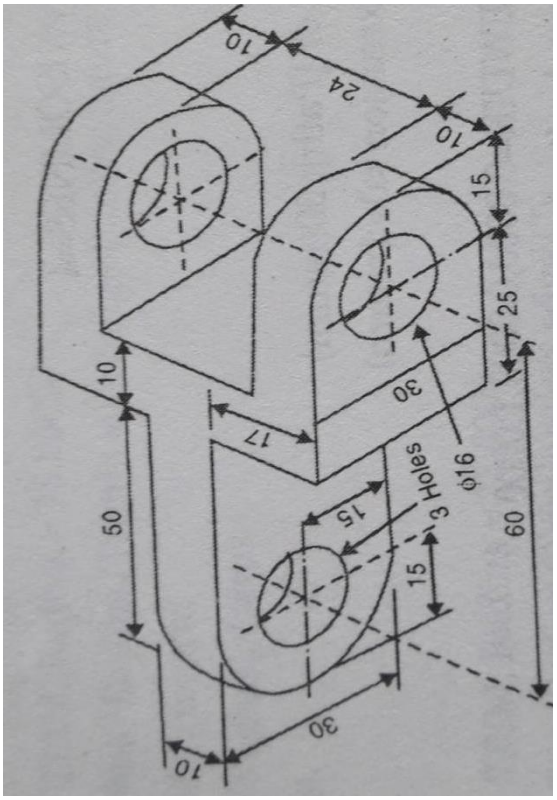
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WEST BENGAL STATE COUNCIL OF TECHNICAL & VOCATIONAL EDUCATION AND SKILL DEVELOPMENT
[A Statutory Body under West Bengal Act XXVI of 2013]
(Formerly West Bengal State Council of Technical Education)
"Karigori Bhavan", 4th Floor, Plot No. B/7, Action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

Name of the Course: Diploma in Mechanical Engineering(Production)	
Category: Programme Core	**Semester: Fourth**
Code no.: ME(P)PC212	**Total Marks: 100**
Course Title: Industrial Production Technology-II Lab	**Examination Scheme:** **(i) Internal Assessment: 60 Marks** [Continuous assessment of class performance and in time submission of Assignments : 30 Marks Viva Voce : 20 Marks Class Attendance: 10 Marks]
Duration : 17 weeks (4 hours per week)	
Total practical class/week: 4	
Credit: 2	**(ii) External Assessment: 40 Marks** (End Semester Examination) [Assignment on the day of viva voce :20 marks Viva voce (before Board of Examiners): 20 marks]
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.	
Pre requisite: 1. Knowledge of -I [**C**ode No – ME(P)PC 207]	

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 associated with the above mentioned competency:
   - Operate various machines like Lathe, Shaper etc.
   - Prepare jobs as per given dimensions involving various operations on Lathe, drilling, milling etc.
   - Identify various parts of Lathe, drilling, milling etc.
   - Perform surface finishing operations on grinding machine.
   - Knowledge of different parts of EDM machine.

2. **Practical Outcomes (PrOs):**
   The practical experiences associated with this subject are to be taught and implemented, so that the student demonstrates the following industry oriented course outcomes associated with the above mentioned competency:
   Skills to be developed:
   Intellectual Skills:
   1. Identify the constructional features & working of various Machine Tools.
   2. Understand the different parts of various Machine Tools.
   3. Understand plain turning, taper turning, thread cutting etc.
   4. Identify various tool holding & work holding devices.
   5. Identify different grinding machines.
   6. Understand the working principles of EDM.

   Motor Skills:
   1. Perform various operations on Lathe Machines.
   2. Produce jobs on drilling and Milling machines
   3. Perform operations on Shaping machine.
   4. Operate Grinding machines.
   5. Knowledge of different parts of EDM machine.

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

The practical's in this section are PrOs (i.e. subcomponents of COs) to be developed, implemented and assessed for the students towards attainment of the competency.

Sl. No.	Practical Outcomes (PrOs)	Hours (Min^{m}.)
01	Lathe Operations:- Facing, Turning, step turning, Chamfering, Groove cutting, Thread cutting, Taper Turning, Knurling, Drilling. To make jobs involving all the operations.	04
02	Shaping Operations:- Study of shaping machine & Identify different basic parts, drives, clapper 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 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.	04
03	Drilling Exercises:- Preparation of jobs with two or three different sizes holes for different materials. Preparation of jobs with different holes by maintaining minimum distance between them.	04
04*	Practice on Milling Machine:- Milling square hexagon from round bars with indexing and without indexing, Milling keyways of different types, Milling splines and T-slots, Generation of spur gear teeth on a round bar. Practice on making a spur gear of given module by using milling machine and dividing head.	02
05	Grinding Machines:- Grinding flat surface on a surface grinder using magnetic chuck and clamping devices, grinding external and internal surface, grinding cutting tools.	04*
06*	Non-conventional machining:- Identify different parts of EDM machine; constructional features of EDM.	04
07	Cutting Tools:- Identify different cutting tools used in different machine tools; Study of various cutting angles given on single point cutting tools, Twist drill, Milling cutter.	04
08*	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.	04

Note:

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

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

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

Sl. No.	Performance Indicators	Weightage in %
01	Preparation of job drawing, selection of material, tool and estimation of cutting parameters.	20
02	Set up of machine, tool and job.	15
03	Actual machine operation.	20

04	Inspection of job using measuring instruments.	15
05	Answer to questions on operations.	10
06	Submission of job and workshop report in time.	10
07	Safety precautions and good housekeeping	10
	Total:	**100**

The above PrOs also compromise of the following social Skills / attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory / field based experiences:

- Follow the safety practices.
- Practice good housekeeping.
- Demonstrate working as a leader / team member.
- Maintain tools and equipments in good working condition.
- Handle the machine and tools with care.

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.(Minimum 60% attendance is required for eligibility in Semester Exam)	10
Total Internal Assessment:	**60**
Pass criterion for Internal Assessment = 24 Marks [Minimum]	

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 Internal Assessment:	**40**
Pass criterion for Internal Assessment = 16 Marks [Minimum]	

References:

Sl. No.	**Title of Book**	**Author**	**Publication**
1	Elements of workshop Technology – Volume II	S. K. Hajra Chowdhury, Bose, Roy	Media Promoters and Publishers limited, Mumbai,
2	A Course in Workshop Technology – Volume- II	B.S.Raghuwanshi	Dhanpat Rai Publications, New Delhi,
3	Manufacturing Technology - Volume 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.

Suggested Learning Websites:

https://nptel.ac.in
www.basicmechanicalengineering.com/lathe-machine-operations-basic-turning-
www.thelibraryofmanufacturing.com/forming-basics.html
www.themetalcasting.com/casting-process.html

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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 : Fourth</td></tr>
<tr><td>Code no. : MEPC214</td><td colspan="3">Practical : 100 Marks</td></tr>
<tr><td>Course Title : Engineering Metrology & Mechanical Measurement Lab

(Same with Mechanical Engg.)</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 lecture class/week : 2</td><td>Continuous assessment of class performance and in time submission of assignment</td><td>30</td><td rowspan="3">60 marks</td></tr>
<tr><td>Viva voce</td><td>20</td></tr>
<tr><td rowspan="2">Credit : 1</td><td>Class attendance</td><td>10</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. 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 for Continuous Assessment: (**Any seven practical**)**

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.

3. **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**

4. 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

<table>
<tr><td colspan="4">Name of the Course: Diploma in Mechanical Engineering(Production)</td></tr>
<tr><td>Category: Programme Core</td><td colspan="3">Semester : Fourth</td></tr>
<tr><td>Code no. : ME(P)PC216</td><td colspan="3">Practical : 100 Marks</td></tr>
<tr><td>Course Title : Heat Power Engg-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
(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>Continuous assessment of class performance and in time submission of assignment</td><td>30</td><td rowspan="3">60 marks</td></tr>
<tr><td>Viva voce</td><td>20</td></tr>
<tr><td>Total lecture class/week : 2</td><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 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 labelled 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(Production)	
Category: Minor Project	**Semester : Fourth**
Code no.: PR202	**Practical : 100** Marks
Course Title: Minor Project **(Same with Mechanical Engg.)**	**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:

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 Speed vs. 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. Similar minor projects could be added by the concerned faculty member 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]	

1. 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.