

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



Syllabus
of

Diploma in Mechanical Engineering [ME]

Part-II (3rd Semester)

Revised 2022

**CURRICULUM STRUCTURE FOR PART-II (SEMESTER 3) OF THE
FULL-TIME DIPLOMA COURSES IN MECHANICAL ENGINEERING**

WEST BENGAL STATE COUNCIL OF TECHNICAL EDUCATION										
TEACHING AND EXAMINATION SCHEME FOR DIPLOMA IN ENGINEERING COURSES										
COURSE NAME: FULL TIME DIPLOMA IN MECHANICAL ENGINEERING										
DURATION OF COURSE: 6 SEMESTERS										
BRANCH: MECHANICAL ENGINEERING										
SL No	Category	Code No	Course Title	L	P	Total Class per week	Credit	Full marks	Internal Marks	ESE Marks
1	Program core	MEPC201	Mechanical Engineering Drawing	2	-	2	2	100	40	60
2	Program core	MEPC203	Mechanical Engineering Materials	3	-	3	3	100	40	60
3	Program core	MEPC205	Strength of Materials	3	-	3	3	100	40	60
4	Program core	MEPC207	Manufacturing Processes-I	3	-	3	3	100	40	60
5	Program core	MEPC209	Thermal Engineering -I	3	-	3	3	100	40	60
6	Program core	MEPC211	Mechanical Engineering Drawing Practice	-	4	4	2	100	60	40
7	Program core	MEPC213	Materials Testing Lab	-	2	2	1	100	60	40
8	Program core	MEPC215	Thermal Engineering -I Lab	-	2	2	1	100	60	40
9	Program core	MEPC217	Manufacturing Processes -I Practice	-	4	4	2	100	60	40
10	Internship	SI201	Internship I	-	-	0	1	100	60	40
Total:				14	12	26	21	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										



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 : Third
Code No. : MEPC201	Theory : 100 Marks
Course Title : Mechanical Engineering Drawing	Examination Scheme: i) External Assessment: 60 Marks (End Semester Examination) ii) Internal Assessment: 40 Marks [Class test : 20 Marks Home assignments : 10 Marks Class attendance : 10 Marks]
Duration : 17 weeks (Total hours per week = 2)	
Total lecture class/week: 2	
Credit : 2	
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.	

1. Course Outcomes: After completion of this course the students will be able to

- i) Comprehend the methods of development of lateral surfaces of different truncated and frustum objects, such as tray, funnel, hopper, bend pipe, transition pieces, etc.
- ii) Realise the curves of intersection of commonly used two interpenetrating solids.
- iii) Interpret machining symbols and surface texture on production drawings.
- iv) Interpret various drawing symbols, codes and conventions as per IS: SP-46.
- v) Realise the sectional views of various casting / machining components.
- vi) Interpret assembly drawing and detailed drawings of various objects such as machine tool parts, power transmission elements, bearings, valves etc.

2. Theory Components:

Unit	Topics& Sub-topics	Teaching Hours
Unit: 1 Development of Surfaces	1.1 Developments of lateral surfaces of the regular oblique solids for the following cases: Truncated oblique prism, truncated oblique cylinder, truncated / frustum oblique pyramid and truncated / frustum oblique cone. 1.2 Applications of development of surfaces such as hopper, funnel, tray, transition piece (square to circular).	06
Unit: 2 Intersection of Surfaces of Two Interpenetrating Solids	2.1 Curves of intersection of the two interpenetrating regular solids for the following cases: Square prism with square prism, Cylinder with cylinder when the axes of them are at 90 ⁰ and bisecting. Cylinder with cone when the cone is resting vertically on HP and the axis of cylinder is parallel to both HP and VP and axes of them are intersecting at 90 ⁰ .	05

<p>Unit: 3 Standard Convention for Engineering Drawing using SP 46 : 2003</p>	<p>3.1 Conventional representation of the following materials: Cast Iron, Mild Steel, Aluminium, Brass Bronze, Glass, Concrete, Wood & Rubber.</p> <p>3.2 Conventional long and short break in pipe, rod and shaft.</p> <p>3.3 Conventional representation of common features like slotted head, knurling, serrated shaft, splined shaft, ratchet & pinion, holes on circular pitch, internal & external thread, square on shafts, repeated parts.</p> <p>3.4 Conventional representation of standard parts like gears, springs, ball & roller bearings.</p> <p>3.5 Counter sunk and counter- bored holes.</p> <p>3.6 Pipe joints and valves.</p> <p>3.7 Tapers.</p> <p>3.8 General welding symbols, sectional representation and symbols used in engineering practices.</p>	<p>03</p>
<p>Unit: 4 Limits, Tolerances, Fits and Surface Roughness</p>	<p>4.1 Limits, Fits and Tolerances:</p> <p>a) Introduction to ISO system of Tolerance.</p> <p>b) Selection and representation of dimensional tolerance- number and grade method. Definitions concerning tolerance and limit system, Unilateral and bilateral tolerance, Hole basis and shaft basis system, Clearance fit, Interference fit, Transition fit, Selection of fit for various engineering applications.</p> <p>c) Calculation of limit sizes and identification of types of fit from the given sizes like $\Phi 50H7/c8$, $\Phi 50H6/k5$, $\Phi 50H7/s6$ etc.</p> <p>4.2 Geometrical Tolerances: Types, terminology for deviation, representation of geometrical tolerance on drawing.</p> <p>4.3 Machining Symbols and Surface Texture: Indication of machining symbol showing direction of lay, sampling length, machining allowances, manufacturing methods and roughness grades. Representation of surface roughness on drawing.</p>	<p>03</p>
<p>Unit: 5 Sectional Views</p>	<p>5.1 Isometric views to Orthographic views (front view, top view and side view) of the following objects:</p> <p>a) Machine components</p> <p>b) Castings like hanger and shaft support.</p> <p>5.2 Sectional views of the following casting objects:</p> <p>a) Bearing bracket</p> <p>b) Shaft bracket</p> <p>c) Sliding block.</p>	<p>03</p>
<p>Unit: 6 Assembly Drawings</p>	<p>6.1 Introduction, types of assembly drawing, accepted norms to be observed for assembly drawings, sequence for preparing assembly drawing. Bill of material.</p> <p>6.2 Assembly drawing from the following detailed drawings:</p> <p>a) Couplings: Rigid flange coupling & Universal coupling.</p> <p>b) Knuckle joint.</p>	<p>04</p>

	c)C.I. pulleys: Fast pulley and Stepped cone pulley. d) Bearing: Plummer block. e) Screw jack. f) Bench vice. g) Square tool post of Lathe machine.	
Unit: 7 Part Drawings (assembly to detailing)	7.1 Detailing of the following assemblies: a) Knuckle joint b) Castor wheel c) Socket and spigot type cotter joint. d) Foot step bearing e) Crane hook f) Drilling jig g) Tail stock of Lathe machine h) Non-return valve. 7.2 Construction of tooth profile of a spur gear – (i) by using approximate construction method, (ii) by using involute method.	04
Sub Total : Total Lecture Classes		28
No. of classes required for conducting Internal Assessment examination		06
Grand Total :		34

3. Suggested Home Assignment/Student Activities :(At least four assignments)

Other than practice work in classroom, students should conduct the following suggested activities in group or individual, which are suitable for this subject as per instruction of the subject teacher:

- (a) Students should maintain a separate A3 size sketch book which will be their part of practice work and has to submit that sketch book along with drawing sheets in scheduled time. Following additional Home Assignments are to be attempted on this sketch book (not to scale drawing following first angle method of projection) as instructed by the subject teacher for the attainment of the COs of MEPC201:

Unit No.	Topics for Home assignment	Marks
03	a. Conventional representation as per IS: SP-46 (1988) of the following: <ul style="list-style-type: none"> - Materials: Cast Iron, Mild Steel, Aluminium, Brass Bronze, Glass, Concrete, Wood & Rubber. - Conventional long and short break in pipe, rod and shaft. - Common features like slotted head, knurling, serrated shaft, splined shaft, ratchet & pinion, holes on circular pitch, internal & external thread, square on shafts, repeated parts. - Standard parts like gears, springs, ball & roller bearings. - Counter sunk and counter bored holes. - Pipe joints and valves. - Tapers. 	10

	- General welding symbols, sectional representation and symbols used in engineering practices.	
04	<p>a. Calculation of limit sizes and identification of types of fit from the given sizes like $\Phi 50H7/c8$, $\Phi 50H6/k5$, $\Phi 50H7/s6$ etc.</p> <p>b. Representation of geometrical tolerance on drawing.</p> <p>c. Machining Symbols and Surface Texture: Indication of machining symbol showing direction of lay, sampling length, machining allowances, manufacturing methods and roughness grades. Representation of surface roughness on drawing.</p>	
05	<p>Assembly drawing (including bill of materials and conventional representation of tolerances and surface finish symbols) of the following detailed drawings of components:</p> <p>a) Universal coupling, b) Stepped cone pulley, c) Plummer block, d) Screw jack, e) Bench vice, f) Square tool post of Lathe machine.</p>	
06	<p>Part drawing including conventional representation of tolerances and surface finish symbols of the following assembly drawing:</p> <p>a) Castor wheel, b) Crane hook, c) Foot step bearing, d) Drilling jig, e) Tail stock of Lathe machine, f) Non-return valve,</p>	

- b) They should prepare paper-models of development of lateral surfaces of objects such as tray, funnel, hopper, transition piece etc., and paper-models of two interpenetrating solids showing curves of intersection.
- c) Only one micro-project is planned to be undertaken by each student assigned to him/her by the subject teacher at the beginning of the semester. The micro-project could be industry application based, workshop-based or field-based. It should be individually undertaken to build up the skill and confidence in every student so that she/he contributes to the projects of the industry. A suggestive list of micro-projects is given here for the attainment of the COs:
- (i) Visit Institute's workshop (Fitting shop or Machine shop) and prepare assembly drawing and detailed drawings of lathe tool post / lathe tail-stock / shaper tool head / Drilling machine vice etc (as per availability) using proper measuring instruments.
- ii) Visit nearby sheet metal workshop (if possible) and prepare a report related to type of components, dimensions, material, field of applications, operations performed etc.
- iii) Other than practice work, at least one visit for students to nearby industries/workshops is to be arranged for understanding various production drawings. Students should collect production drawings (if possible) and try to interpret the object from the given views in collected drawing.
- iv) Any other micro-projects suggested by the subject-teacher on similar field.

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	05	10	10 x 01 = 10
A2	3 & 4	04		
A3	5, 6 & 7	06		
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	05	10	10 x 01 = 10
B2	3 & 4	04		
B3	5, 6 & 7	06		
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	05	10	10 x 01 = 10
C2	3 & 4	04		
C3	5, 6 & 7	06		
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 & 5	04	06	06 x 02 = 12
D2	3 & 4	03		
D3	6 & 7	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 & 5	04	03	06 x 03 = 18
E2	3 & 4	02		
E3	6 & 7	03		
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 [20 marks]:

Sl No.	Performance Indicators
1.	Imitation of Solved Drawing,
2.	Accomplishing assigned problem,
3.	Performing the drawing task masterfully/expertly using drafting instruments.

4.	Performing the task following standards and ethics,
5.	Submitting assignment sketch book / micro-project related activity on time,

7. Suggested Learning Resources:

Sl. No.	Title of Book	Author	Publication
1	Machine Drawing	N. D. Bhatt V. M. Panchal	Charotar Publishing house Pvt. Ltd. Anand, Gujrat, ISBN: 9789380358635
2	A text book of Machine Drawing	P. S. Gill	S. K. Kataria & Sons, New Delhi, ISBN: 9789350144169
3	A text book of Machine Drawing	R. K. Dhawan	S. Chand & Company New Delhi
4	Production Drawing	K. L. Narayana, P. Kannaiah, K. Venkata Reddy	New Age International Publication, New Delhi, ISBN: 9788122435016
5	Machine Drawing	Basudev Bhattacharya	Oxford University Press ISBN: 0-19-807077-2
6	Engineering Drawing Practice for Schools & Colleges- SP 46 : 1988	Bureau of Indian Standard	Bureau of Indian Standard New Delhi -110002 First Revision July 2003 ISBN: 81-7061-019-2

8. Suggested software / learning website link

i) <https://law.resource.org/pub/in/bis/S01/is.sp.46.2003.pdf>

Complete the Orthographic views from the following isometric views: Annexure 1

1) Annexure 1: https://drive.google.com/file/d/136tkLk_vxBLGivF0LvZK631eae3L0wQm/view?usp=sharing

Surface Development: Annexure 2

2) Annexure 2: <https://drive.google.com/file/d/1Z6XD90eWApikxQTyRbTi7fEAAY6iOa-E/view?usp=sharing>

Isometric view to Orthographic view: Annexure 3

3) Annexure 3: <https://drive.google.com/file/d/1FT6wc7wXMNTfN5BjmQHJIHJtd1vRzXLL/view?usp=sharing>

Intersection of Solids: Annexure 4

4) Annexure 4: https://drive.google.com/file/d/1zpNoLbQ0e9GD1N_K0PalXeFZLqu5o2dr/view?usp=sharing

Introduction to sectional view (as per SP: 46-1988): Annexure 5

5) Annexure 5: https://drive.google.com/file/d/1T2p-veL2dG_KPhABlrQlhOqdQ2gM-0vX/view?usp=sharing

Assembly Drawing from Detailing: Annexure 6

6) Annexure 6: https://drive.google.com/file/d/1TSS_zyAyywdwhShCd20CmEU13z7y0YvF/view?usp=sharing

Part Drawing from Assembly: Annexure 7

7) Annexure 7: <https://drive.google.com/file/d/13oc3fZgklShtSpByluzRJGhUmZQqTgRg/view?usp=sharing>



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Name of the Course: Diploma in Mechanical Engineering	
Category: Programme Core	Semester : Third
Code no. : MEPC203	Theory : 100 Marks
Course Title : Mechanical Engineering Materials	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):

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

- a. Explain about crystal structures.
- b. Identify properties of materials.
- c. Classify the ferrous metals and describe their properties and applications.
- d. Describe the non-ferrous metals, cutting tool materials, and composites along with their properties and applications.
- e. Explain various heat treatment processes & their applications on various engineering components for improving their mechanical properties.
- f. Describe plastic moulding process and its applications.
- g. Understand non-destructive testing methods & its applications.

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 and Sub-topics	Teaching Hours
Unit-1: Basics of Engineering Materials	1.1 Introduction, classification of engineering materials. 1.2. Crystal structures: Unit cell and space lattice. Crystal system- The seven basic crystal systems. Crystal structure for metallic elements- BCC, FCC and HCP. Coordination number for simple cubic, BCC and FCC. Atomic radius- definition, atomic radius for simple cubic, BCC and FCC. Atomic packing factor (APF) for simple cubic, BCC, FCC and HCP. Simple problems on finding number of atoms and atomic packing factor for a unit cell. 1.3 Mechanical properties of materials - elasticity, plasticity, ductility, malleability, toughness, hardness, harden ability, brittleness, fatigue, and creep. 1.4. Introduction to corrosion, methods to prevent of corrosion.	06
Unit-II	2.1. Cooling curve and showing allotropic transformation of iron. Iron- Carbon equilibrium diagram and its explanation. Critical temperatures and its significance. Principal micro	09

Ferrous Metals and Alloys	<p>constituents of an iron carbon system up to 2.0% C content (austenite, ferrite, cementite, pearlite, eutectoid, hypo-eutectoid & hyper –eutectoid steel)</p> <p>2.2 Broad classification of ferrous metals (steel, cast iron, wrought iron) according to percentage of carbon. Process flow diagram for production of iron and steel.</p> <p>2.3 Steel: compositions, properties and applications of - i) Plain carbon steel: low (including dead steel & free cutting steel), medium and high carbon steel; effect of silicon, sulphur, phosphorus and manganese. ii) Alloy steel: low, medium and high alloy steel, purpose of alloying, effects of various alloying elements like chromium, nickel, manganese, tungsten, vanadium, cobalt, and molybdenum. iii) Tool steel: cold work tool steel, hot work tool steel, high speed steel (HSS) - composition and applications. iv) Stainless steel: types and applications.vi). Spring steel: composition and applications. vii) Designation of steels on the basis of chemical composition (IS -7598: 1974).</p> <p>2.4 Type of Steel used for following: shafts, axles, nuts, bolts, crank shafts, camshafts, house hold utensils, surgical instrument, anti-friction bearings and gears.</p> <p>2.5Cast Iron & Wrought Iron: Classification and application of cast iron as white grey, nodular, and malleable. Wrought iron - composition and its use.</p>	
Unit-III: Heat Treatment of Steel	<p>3.1 Introduction to heat treatment, TTT Diagram for eutectoid steel.</p> <p>3.2 Heat Treatment Process: Purpose, process and applications of - Annealing, Normalising, Hardening & Tempering.</p> <p>3.3 Austempering & Martempering: Purpose, process and application.</p> <p>3.4 Surface hardening: Purpose, process and application of - case hardening, flame hardening, and induction hardening.</p>	10
Unit-IV: Non-Ferrous Metals and Alloys	<p>4.1 Properties and application of copper and its alloys such as brass, muntz metal, gun metal and bronze.</p> <p>4.2 Properties and application of aluminium alloys such as Y-alloy, hinalium, and duralumin.</p> <p>4.3 Properties and application of nickel alloys such as inconel, monel metal, and nichrome.</p> <p>4.3 Properties and application of bearing metals such as white metal, babitt metal, and phosphor bronze.</p>	05
Unit-V: Non-Metallic and Advanced Materials	<p>5.1 Polymeric materials.</p> <p>5.2 Properties and applications of thermoplastics, thermosetting plastics and rubbers.</p> <p>5.3 Plastic Moulding process: compression moulding, transfer moulding, injection moulding, blow moulding, vacuum forming, extrusion, calendaring, rotational moulding.</p> <p>5.4 Application of ABS, acrylics, nylons and vinyl, polyesters, epoxies, melamine and bakelite.</p> <p>5.5 Application of rubbers: neoprene, butadiene, buna and silicon.</p> <p>5.6 Ceramics - properties and applications of glasses and refractories.</p> <p>5.7 Composite materials - properties and applications of laminated and fibre reinforced materials.</p> <p>5.8 Advanced engineering materials- Properties and applications of Nano materials and smart materials.</p>	10
Unit-VI: Non-Destructive Testing	<p>7.1 Importance of non-destructive testing, difference between destructive and non-destructive testing.</p> <p>7.2 Non-destructive testing methods – Radiography (X-Ray & Gamma Ray), Ultrasonic crack detection, Dye penetration test, Magnaflux test – comparison & applications.</p>	05

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)

List of assignments are to be performed by the students in subject of **Mechanical Engineering Materials [any two]**:

1. Prepare a chart showing the diagrams and detailed calculations of coordination number, atomic radius and atomic packing factor for BCC, FCC and HCP Crystal Structures for demonstration purpose.
2. Prepare a chart showing the composition and applications of the following materials for demonstration purpose: a) Babitt Metal, b) Phosphor Bronze, c) Brass, d) Bronze, e) Gun Metal, f) Bell Metal, g) Duralumin, h) German silver, i) Monel Metal, j) Inconel, k) Nichrome **[any five]**.
3. Prepare a chart showing the Iron-Carbon Equilibrium Diagrams (drawn in proper scale) and explain its critical temperatures, micro constituencies up to 2% carbon content in tabulated form for demonstration purpose.
4. Prepare a chart showing the selection of material with their composition and proper justifications for the following components: a) Shaft and spindle, b) Rail track, c) Wires, d) Boiler plate, e) Connecting rod, f) Die block, g) Cutting tool, h) Hand chisel i) Hammer, j) Drill bit **[any five]**.
5. Prepare a chart showing the microstructure, composition and properties of the following steels for demonstration purpose: a) Ferrite, b) Pearlite, c) Cementite, d) Bainite, e) Sorbite, f) Martensite.
6. Prepare a chart showing the process flow diagram with proper explanations for production of steel from iron ore for demonstration purpose.
7. Prepare a flow chart showing the sequential processes of suggested heat treatment with explanation and proper justifications for enhancing the performances of the following components: a) Gear used in power transmission in lathe, b) Anvil of smithy shop, c) Crank shaft used in 4 stroke engines, d) Cast Iron pulley, f) Rail wheels **[any one]**.
8. Prepare a chart showing sequential process flow diagrams with explanation and specific applications of any two types of non-destructive testing methods generally being used in Industry for material testing.
9. With suitable diagram explain and specify its applications of the following plastic forming processes: a) Compression moulding, b) Transfer moulding, c) Injection moulding, d) Blow moulding, e) Vacuum forming, f) Extrusion **[any two]**.
10. Prepare a chart by organizing the following engineering materials such as Cast iron, Mild steel, Wrought iron, Copper, Aluminium according to their mechanical properties such as Strength, Malleability, Ductility, Hardness and Machinability.

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	05	10	10 x 01 = 10
A2	3 & 6	05		
A3	4 & 5	05		
Total:		15	10	10
B: Fill-in the BlankType Questions(Carrying 1 mark each)				
Group	Unit	To be Set	To be Answered	Total Marks
B1	1& 2	05	10	10 x 01 = 10
B2	3 & 6	05		
B3	4 & 5	05		
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	05	10	10 x 01 = 10
C2	3 & 6	05		
C3	4 & 5	05		
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	03	06	06 x 02 = 12
D2	3 & 6	04		
D3	4 & 5	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	03	03	06 x 03 = 18
E2	3 & 6	03		
E3	4 & 5	03		
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 Materials Science and Metallurgy	O.P.Khanna	Dhanpat Rai and Sons, New Delhi.
2	Materials Science for Polytechnic	R.K.Rajput	S. K. Kataria & Sons, New Delhi, ISBN: 9789350144169

3	Engineering Materials	B.K.Agrawal	McGraw Hill Education, New Delhi.
4	Material Science	R.S. Khurmi,	S. Chand & Co. Ltd., New Delhi, 2005.
5	Material Science & Engineering	Raghavan	PHI



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Name of the Course: Diploma in Mechanical Engineering	
Category: Programme Core	Semester : Third
Code no. : MEPC205	Theory : 100 Marks
Course Title : Strength of Materials	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 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:

- Demonstrate different types of stress induced on components under the action of different types of loading condition.
- Interpret the variation of MOI for different cross-sections of mechanical components.
- Determine stresses, deformations in the simple load carrying members subjected to an axial, transverse, radial, twisting or thermal loading,
- Draw shear force and bending moment diagrams for beams with different support conditions and different load conditions,
- Analyze both solid and hollow shaft subjected to torsion,
- Solve the problems of column for different end conditions using different methods like Euler’s Formula & Rankine-Gordon formula,

2. Theory Components:

Unit	Topics& Sub-topics	Teaching Hours
Unit-01: Simple Stresses and Strains	1.1 Definition of SOM & concept of rigid body, deformable body & equilibrium of forces. 1.2 Types of loads (normal and tangential), types of stresses - normal stress (tensile stress and compressive stress) & shear stress, strain -concept, types- longitudinal and lateral strain, and Poisson’s ratio. 1.3 Hooke’s law, Young’s modulus, longitudinal stress and strain values of uniform and stepped bar under the influence of normal force; stress and strain values of uniform bar due to self-weight only. 1.4. Behaviour of ductile and brittle materials subjected to axial tension, stress-strain or load-deformation curve for ductile (MS) and brittle material (CI) - discussion on salient point, limit of proportionality, yielding, permanent set, yield stress and ultimate stress, factor of safety (simple problems on normal stresses and longitudinal strain. No discussion on composite section). 1.5 Direct shear stress (single/double shear) and shear strain, modulus of rigidity, (simple problems on direct shear in riveted joint, punching press). 1.6 Lateral strain, Poisson’s ratio, volumetric strain, bulk modulus, relation among elastic constants without deduction.	12

	<p>1.7 Thin cylindrical shell - hoop stress, longitudinal stress and relation between them (simple problems).</p> <p>1.8 Temperature stress and strain in case of bodies having uniform cross-section with and without yielding (simple problems but no discussion on composite section).</p>	
<p>Unit-02: Moment of Inertia</p>	<p>2.1 Definition of area and mass moment of inertia.</p> <p>2.2 Parallel axis theorem, Perpendicular axis theorem, Polar moment inertia, Radius of gyration.</p> <p>2.3 MOI about axes passing through the centroid (for solid having square, rectangular, circular, semi-circular, triangular sections and for hollow having square, rectangular, circular sections only)</p> <p>2.4 MOI of angle section, channel section, Tee section, and I-section about centroidal axis and any other axis parallel to centroidal axis. Polar moment of inertia of circular sections (solid and hollow).</p> <p>2.5 Simple problems.</p>	06
<p>Unit-03: Shear Force & Bending Moment of Beam</p>	<p>3.1 Types of beams, types of loads (point load, uniformly distributed load, UVL, VL), and types of supports.</p> <p>3.2 Meaning of SF, BM of beam, and relation between them, sign convention of SF & BM.</p> <p>3.3 Shear force and bending moment diagram (for simply supported beam and cantilever subjected to point loads/uniformly distributed load/their combination).</p> <p>3.4 Location of point of maximum bending moment for simply supported beam.</p> <p>3.5 Concept of overhanging beam and point of contra flexure.</p> <p>3.6. Problems on cantilever and simply supported beam.</p>	08
<p>Unit-04: Bending stresses in Beams</p>	<p>4.1. Theory of pure bending, assumption in theory of bending, flexural formula, neutral axis.</p> <p>4.2 Moment of resistance, section modulus and neutral axis.</p> <p>4.3 Simple problems on bending stress in beams having rectangular, circular, and I-section (symmetrical section about both axes).</p>	04
<p>Unit-05: Deflection of Beams</p>	<p>5.1 Concepts of deflection, maximum deflection and slope in a beam.</p> <p>5.2 Maximum deflection and slope of simply supported beam subjected to point load at mid span and / or uniformly distributed load on entire span (no deduction).</p> <p>5.3 Maximum deflection and slope of cantilever beam subjected to point load at free end and / or uniformly distributed load on entire span(no deduction)</p> <p>5.4 Simple problems on maximum deflection and maximum slope of simply supported beam and cantilever subjected to above mentioned loading.</p>	03
<p>Unit-06: Columns & Struts</p>	<p>6.1 Introduction, difference between strut and column, types of column.</p> <p>6.2 Concept of slenderness ratio, equivalent length of column for different end conditions.</p> <p>6.3 Euler's formula, assumptions, formula for critical/buckling loads of columns for different end conditions (no deduction), safe load, limitations of Euler's formula.</p> <p>6.4 Rankin's formula, calculation of critical / buckling load.</p> <p>6.5 Simple problems.</p>	04
<p>Unit-07: Torsion of circular shafts</p>	<p>7.1 Concept of pure torsion, field of applications (shaft, flange couplings, shear bolts), torsional rigidity, angle of twist, polar modulus, torsional equation for solid and hollow circular shafts, assumptions made for deriving the pure torsion equation.</p> <p>7.2 Torsional resistance for solid and hollow circular shafts, comparison between them, power transmitted by shaft.</p> <p>7.3 Simple problems on pure torsion.</p>	05
<p>Unit-08 Springs:</p>	<p>8.1 Function, types, materials used, practical applications.</p> <p>8.2 Coiled spring terminology - spring stiffness, solid length, spring index, and mean radius of coil.</p> <p>8.3 Angle of twist in the spring wire, deformation, and energy stored in the closely coiled helical spring subjected to an axial load. [No Derivation; Only Formula use]</p> <p>8.4 Equivalent stiffness of coiled springs in series & parallel.</p> <p>8.5 Simple problems on closed-coil helical spring subjected to an axial load.</p>	03
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: Students are to solve at least four assignments from the set of assignment attached in separate sheet (Annexure 1).

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 & 3	07	10	10 x 01 = 10
A2	2, 4, 5 & 6	05		
A3	7 & 8	03		
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 & 3	07	10	10 x 01 = 10
B2	2, 4, 5 & 6	05		
B3	7 & 8	03		
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 & 3	07	10	10 x 01 = 10
C2	2, 4, 5 & 6	05		
C3	7 & 8	03		
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 & 3	03	06	06 x 02 = 12
D2	2, 4, 5 & 6	05		
D3	7 & 8	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 & 3	03	03	06 x 03 = 18
E2	2, 4, 5 & 6	04		
E3	7 & 8	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 the Assignment work / Micro Project Work
4	Viva voce

7. Suggested Learning Resources:

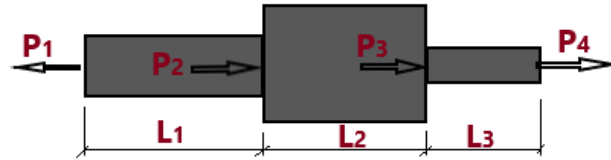
Sl. No.	Title of Book	Author	Publication
1	Strength of Materials	R.S. Khurmi	S.Chand
2	Strength of Materials	R. Subramanian	Oxford
3	Strength of Materials	S.S. Rattan	McGraw Hill Education
4	Strength of Materials	R.K Rajput	S. Chand
5	Strength of Materials	S. Ramamurtham	Dhanpat Rai Publishing.

(Annexure 1)

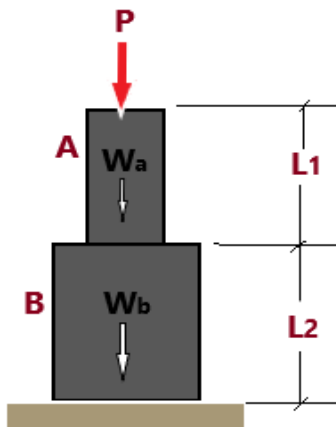
Samples of SOM Assignment

(any two from first four and any two from next six)

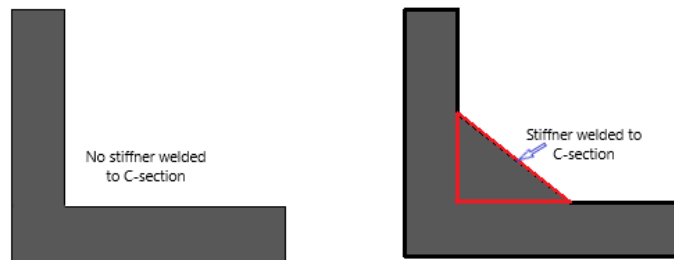
1. To find the induced stress and its nature, and deformation in each part and the resultant deformation of whole body. Given – E and cross sectional area of each part.



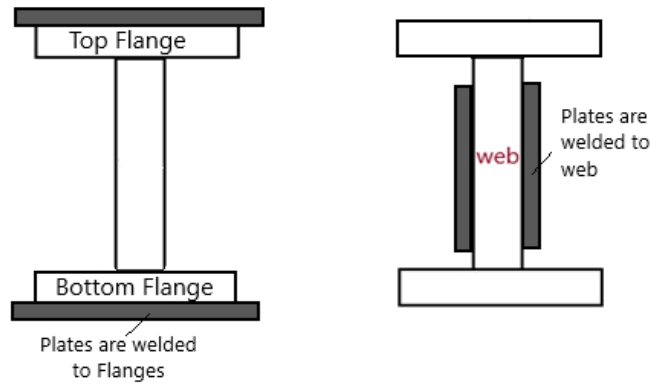
2. To find the decrease in length of the body made up of different materials A and B, under the action of axial compressive load. Given E_A , E_B , cross sectional area of each section, considering the self weight of W_A , W_B and axial load P .



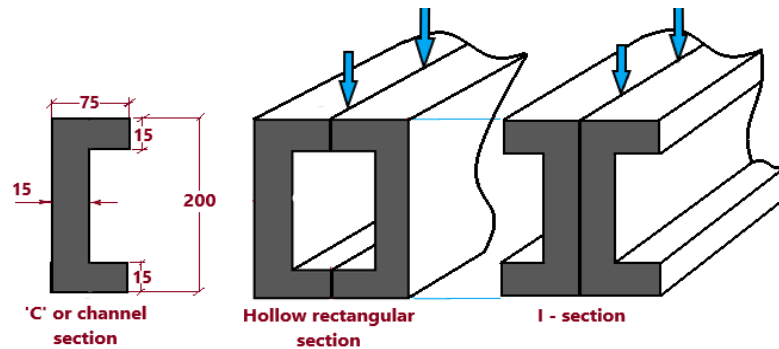
3. To justify the joining of stiffener to the C-section as shown below and determine the increase of moment of resistance of C-section with stiffener in comparison to without stiffener. Given, various dimensions associated with sketches, bending stress.



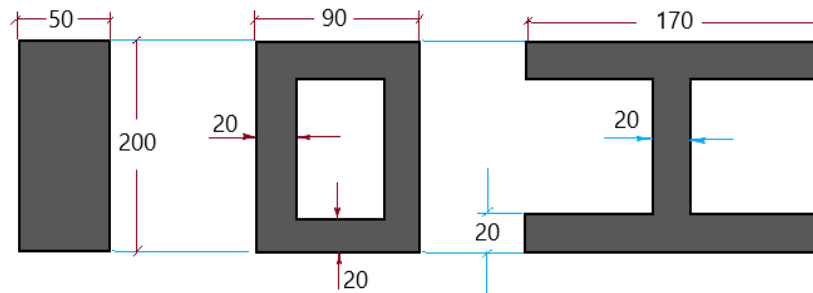
OR, To choose the best option from two given alternatives in which two identical plates are welded to the (i) flanges of symmetrical I-section, and (ii) web of symmetrical I-section as shown. Given, various dimensions associated with sketches and bending stress.



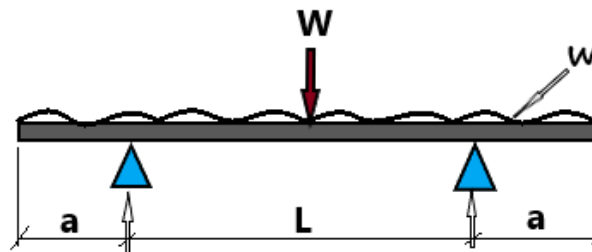
4. Compare the bending strength of the two beams having different cross section (one is of hollow rectangular cross section and other is of I-section). I-section is formed by welding of back to back webs of two 'C' sections whereas hollow rectangular section is formed by welding of face to face top & bottom flange of two 'C' sections as shown.



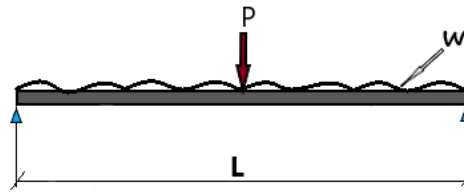
OR, Compare the bending strength of three sections of the same cross sectional area and depth if one of them has a solid rectangular section (50 mm wide and 200 mm deep), the second one is of hollow rectangular section (external dimensions of 90 mm wide and 200 mm deep with 20 mm wall thickness), and the last one is an I-section of equal flanges (170 mm wide web and flange thickness equal to 20 mm).



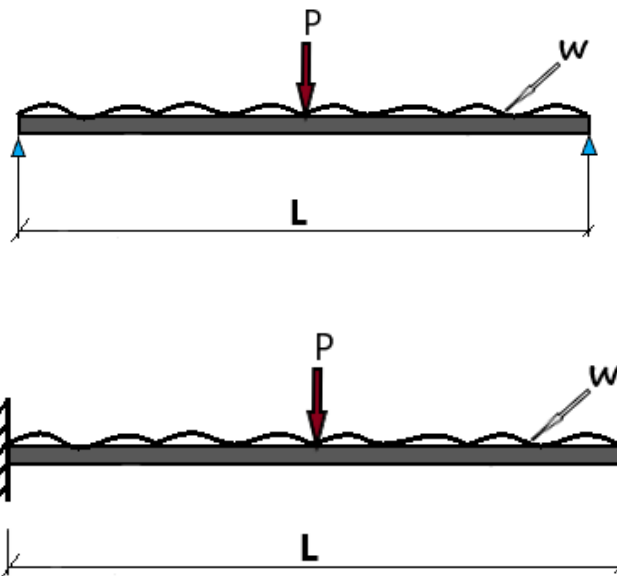
5. To determine the position of two supports of an equally overhanging beam for the least maximum BM, draw SF and BM diagram of such loaded beam. To find the point of contra flexure, if any.



6. To determine the economical cross-section of a simply supported beam subjected to combined loading from the given two options - square cross section and circular cross section. Given, allowable bending stress, length of beam, magnitude of point load and intensity of u.d.l.

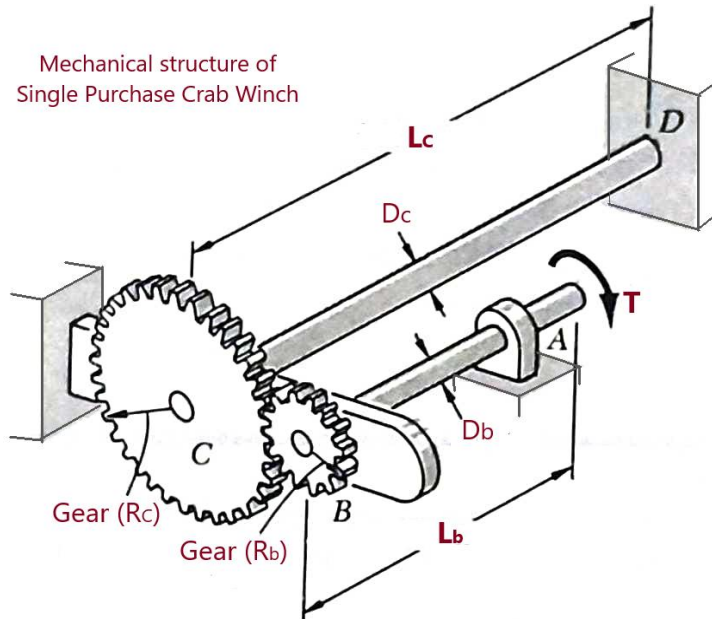


7. To draw the elastic curve and determine maximum deflection and maximum slope of cantilever and simply supported beam subjected to combined loading. Given, E , length of beam and moment of inertia of the cross section of beam.



8. To compare the crippling loads given by the Rankin's formula and Euler's formula for a column. Given, cross section of column and its MOI about centroidal axes (I_{GX} , I_{GY}), allowable crushing stress f_c , modulus of elasticity E , value of α , length and end condition of column.

9. To design the hollow shaft and determine the % saving in material for the replacement a solid shaft by a hollow shaft of same material. Given, maximum allowable shear stress is same for both the shafts, diameter of solid shaft, and ratio of the outer and inner diameter of hollow shaft.
10. Mechanical structure of a single purchase crab winch is shown in figure where two solid steel shafts AB & CD of same material are connected by two gears. Determine the largest torque 'T' that can be applied to the end A of shaft AB and the corresponding angle of twist for each shaft. Given, modulus of rigidity and allowable torsional shear stress of the shaft material, L_c & L_b , D_c & D_b , R_c & R_b .



11. A solid circular shaft is transmitting 100 kW at 180 rpm. The shaft is not to twist more than 1° in a length of 3 meters. The allowable torsional shear stress of the shaft material is 60 N/mm^2 . Assume modulus of rigidity of the shaft material is 80 kN/mm^2 . Determine the suitable shaft diameter for this purpose.

12. Two close-coiled helical springs wound from same wire having same length but with different core radii and are placed one into the other between two rigid plates at their two extreme ends. This mechanical structure is being subjected to compressive load. Determine the maximum shear stress induced in each coil spring. Given, diameter of wire, compressive load applied between the two rigid plates and core radii of the two springs.



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 : Third
Code no. : MEPC207	Theory : 100 Marks
Course Title : Manufacturing Processes-I	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.	

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:

- Understand the fundamental concept of manufacturing and identify different manufacturing processes to be performed for the given job.
- Prepare products using different metal forming processes.
- Plan, estimate and produce jobs by using Lathe.
- Prepare products using different casting processes.
- Assess and apply different metal joining processes to produce jobs.

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 Fundamentals of Manufacturing Processes	1.1 Concept of Manufacturing Processes and Classification: Metal forming processes, Metal machining processes, Metal joining processes and Metal finishing processes.	02
Unit: 2 Metal Forming Processes	Forging: 2.1.1 Concept of Hot Working & Cold Working. 2.1.2 Advantages and Disadvantages of Cold and Hot Working Processes. 2.1.3 Principle of forging processes. 2.1.4 Forging temperature and grain flow in forged parts. 2.1.5 Classifications of forging processes. 2.1.6 Types of dies: Open Die, Impression Die (Single Impression and Multi-implosion) and Closed die Forging. 2.1.7 Types of forging presses and hammers. 2.1.8 Forging defects.	04

	<p>Rolling and Extrusion:</p> <p>2.2.1 Basic principles of rolling and extrusion. 2.2.2 Hot and cold rolling. 2.2.3 Types of rolling mills: 2 Hi, 3 Hi & 4 Hi mills. 2.2.4 Rolling defects. 2.2.5 Hot and cold extrusion. 2.2.6 Methods of extrusion: Direct, Indirect, Backward & impact Extrusion, 2.2.7 Advantages, disadvantages & applications of rolling & extrusion.</p>	05
	<p>Press Working:</p> <p>2.3.1 Basic principles of press work on sheet metals. 2.3.2 Different components and their functions of standard die set with a punch. 2.3.3 Types of presses. 2.3.4 Press working operations: Cutting, bending, drawing, punching, banking, notching, lancing, piercing, coining and embossing.</p>	05
<p>Unit: 3 Fundamentals of Machining Processes</p>	<p>Machining:</p> <p>3.1 Basic concept of machining, cutting speed, feed and depth of cut. 3.2 Chip formation mechanism and types of chips. 3.3 Orthogonal cutting and oblique cutting. 3.4 Desirable properties of cutting tool materials and examples. 3.5 Cutting tool nomenclature & tool signature of single point cutting tool. 3.6 Tool life, factors effecting the tool life and different ways of measuring tool life. 3.7 Desirable properties, purpose and examples of cutting fluids.</p>	04
<p>Unit: 4 Lathe</p>	<p>Lathe:</p> <p>4.1 Basic components and their functions of centre Lathe. 4.2 Classification of Lathe. 4.3 Specification of Centre Lathe. 4.4 Comparison among Centre Lathe, Capstan Lathe and Turret Lathe. 4.5 Lathe accessories: Chucks, mandrels, rests, face plates, centres and angle plates. 4.6 Taper turning on Lathe: Different ways of representing taper on a job, different methods of taper turning and simple problems on taper turning. 4.7 Thread cutting on Lathe: Procedure, change gears calculation for thread cutting operation and related simple problems. 4.8 Other Lathe operations: Centering, facing, Turning, parting off, undercutting, grooving, Knurling, drilling and boring. 4.9 Cutting parameters & machining time calculation.</p>	10
<p>Unit: 5 Casting Processes</p>	<p>Casting:</p> <p>5.1 Types of patterns, pattern materials, and pattern allowances. 5.2 Moulding materials, types of moulding sands, properties of sand, moulding methods, cores and core prints. Elements of gating system. Bench and floor moulding methods. 5.3 Furnaces, construction and working of cupola furnace and electric arc furnace. 5.4 Special casting processes: Die casting, centrifugal casting, investment casting and shell moulding. 5.5 Casting defects and its remedies.</p>	07
<p>Unit: 6 Joining Processes</p>	<p>Welding, Brazing and Soldering:</p> <p>6.1 Classification of welding. 6.2 Gas welding (Process, Equipment and Applications). 6.3 Types of gas welding flame. 6.4 Arc Welding (Process, Equipment and Applications). 6.5 TIG and MIG welding (Process, Equipments and Application).</p>	08

6.6	Submerged arc welding (Process and Application).	
6.7	Shielded metal arc welding (Process and Application).	
6.8	Thermit welding (Process and Application).	
6.9	Resistance welding (Process and Application): Spot welding, Seam welding and Projection welding.	
6.10	Welding defects.	
6.11	Brazing and soldering (Process, Fillers and Applications).	
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:

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:

3.1 It may be submission of home assignment (at least three) 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 or present seminar on specific topic which is suitable for the given subject as per instruction of subject teacher as explained in 3.2 and 3.3.

3.2 Students may conduct one of the following activities in group and prepare reports for their (student's) activity, also collect / record physical evidences for their (student's) portfolio which will be useful for their placement interviews.

- a. Visit a / an Industry / Workshop where processes like metal forming (forging / rolling / extrusion / press work) or machining (Lathe operations) or casting or welding are carried out. Collect information on types of machines in operation, their specifications; observe various activities performed and characteristic of output products.
- b. Collect information of recent advancement in manufacturing processes like metal forming or machining or casting (Machines / Tools / Equipment) and also collect their specification, manufacturer's name & application in industry.
- c. Collect information on present status and recent advancement in welding. Also collect information on process specific machines, accessories required and their applications in industry.

3.3 Students may undertake one micro projects for their (student's) activity. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based, or field-based. The micro-project may be executed by the individual or by a group of students but the number of students in the group should not exceed five students. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it at the time of submission (ie. end of semester). The total duration of the micro-project should not be less than 16(sixteen) student engagement hours during the course.

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

- a. Prepare a cast product of different mechanical engineering drawing models with wax material.
- b. Prepare various types of welding joints (with metal components) for display and demonstration purposes.
- c. Prepare different types of keys (with metal components) for display and demonstration purpose.
- d. Prepare various types of patterns / core / core box etc. with suitable material.
- e. Prepare model or suitable chart of the drive mechanism generally being used in Lathe.
- f. Prepare working model of direct extrusion process for display and demonstration purposes.
- g. Prepare hammer forging working model 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)

A: Multiple Choice Type Questions(Carrying 1 mark each)				
Group	Unit	To be Set	To be Answered	Total Marks
A1	1& 2	04	10	10 x 01 = 10
A2	3 & 4	06		
A3	5 & 6	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	04	10	10 x 01 = 10
B2	3 & 4	06		
B3	5 & 6	05		
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	04	10	10 x 01 = 10
C2	3 & 4	06		
C3	5 & 6	05		
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	02	06	06 x 02 = 12
D2	3 & 4	04		
D3	5 & 6	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	02	03	06 x 03 = 18
E2	3 & 4	04		
E3	5 & 6	03		
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
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>



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 : Third
Code no. : MEPC209	Theory : 100 marks
Course Title : Thermal Engineering - I	Examination Scheme: a) External Assessment:60 marks (End Semester Examination) i) Internal Assessment:40 marks [Class test: 20 marks Quizzes, assignment, viva voce: 10 marks Class attendance: 10 marks]
Duration : 17 weeks (Total hours per week = 3)	
Total Theoretical class/week : 3	
Credit : 3	
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both continuous assessment and end semester assessment separately.	

1. Course Outcomes (COs):

- i. Understand fundamental concepts of thermodynamic systems and different laws of thermodynamic.
- ii. Understand various properties of perfect gas.
- iii. Apply 1st law of thermodynamics on open system and on closed system containing ideal gas executing thermodynamic processes.
- iv. Understand the formation and properties of steam.
- v. Solve simple numerical on properties of steam by using steam table / Mollier chart.
- vi. Determine dryness fraction of steam
- vii. Understand the working of different types of boilers and necessity of boiler mountings & accessories.

2. Theory Components:

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

Unit	Topics & Sub-topics	Teaching Hours
UNIT 1: Fundamentals and Laws of Thermodynamics	1.1. Basic concept of thermodynamics. 1.2. Thermodynamic System, Boundary, Surrounding. Classification of thermodynamic system: open system, closed system and isolated system. 1.3. Thermodynamic properties of system (Intrinsic and Extrinsic properties) with units and its conversion like Pressure (Atmospheric, Gauge Pressure and Absolute pressure), volume, density and temperature. 1.4. State of a thermodynamic system, change of state, path, thermodynamic process.	12

	<p>1.5. Thermodynamic equilibrium of a system (mechanical, thermal and chemical equilibrium), thermodynamic cycle.</p> <p>1.6. Concept of N.T.P.</p> <p>1.7. Energy-definition and units of transient energy (heat & work) and stored energy (PE, KE & IE).</p> <p>1.8. Point function & path function.</p> <p>1.9. Displacement work & flow work.</p> <p>1.10 Concept& units of power, enthalpy.</p> <p>1.11 Concept & units of heat, specific heat, specific heat at constant pressure (C_p), specific heat at constant volume (C_v) and adiabatic index.</p> <p>1.12 Zeroth law of thermodynamics and concept of temperature.</p> <p>1.13 First law of thermodynamics: Principle of energy conservation, simple energy equation for non-flow process, steady flow energy equation and its application to various thermodynamic system like boiler, nozzle, turbine, compressor & condenser, Concept of perpetual motion machine of 1st kind, limitations of First law of thermodynamics.</p> <p>1.14 Second law of thermodynamics: Kelvin–Plank statement & Clausius statement, application of 2nd laws to various thermodynamic system like heat engine, heat pump and refrigerator, thermal efficiency, coefficient of performance, concept of perpetual motion machine of 2nd kind, concept and units of entropy.</p> <p>1.15. Simple numerical on 1st law of thermodynamics for steady flow process, atmospheric pressure, gauge pressure and absolute pressure.</p>	
<p>UNIT 2:</p> <p>Properties of Perfect Gas</p>	<p>2.1. Concept of ideal gas & real gas.</p> <p>2.2. Laws of perfect gases such as Charle’s law, Boyle’s law and Avogadro’s hypothesis, equation of state ($PV = m.R.T$), characteristic gas constant and universal gas constant.</p> <p>2.3. Relation among two specific heats (C_p& C_v) with characteristic gas constant (R).</p> <p>2.4. Ideal thermodynamic processes of gas: governing equation of processes like constant pressure process, constant volume process, constant temperature process, adiabatic process & polytropic process, representation of all the above processes on p-V and T-s plane, deduction of work transfer, heat transfer, change in internal energy, change in enthalpy and change in entropy for each process.</p> <p>2.5. Simple numerical on above-mentioned perfect gas processes.</p>	11
<p>UNIT 3:</p> <p>Properties of Steam</p>	<p>3.1 Explanation of steam generation process with the help of p-V, T-s & T-h diagrams.</p> <p>3.2. Basic terms and properties of steam such as saturation temperature, saturation pressure, saturated liquid, saturated steam (wet steam, dry saturated steam), superheated steam, critical point, triple point, dryness fraction, degree of superheat, degree of undercooling, enthalpy of steam, sensible heat, latent heat of vaporization, superheat, specific volume, entropy and internal energy of steam.</p>	10

	<p>3.3. Steam table & its use, enthalpy- entropy (h-s) diagram of steam (Mollier chart) and its use.</p> <p>3.4. Vapour processes such as constant pressure processes, constant volume processes, constant entropy, constant temperature processes & constant enthalpy process and representation of the processes on p-V, T-s & h-s diagram.</p> <p>3.5. Determination of dryness fraction of steam using (a) separating calorimeter, (b) throttling calorimeter, & (c) combined separating & throttling calorimeter.</p> <p>3.6. Comparison of gas & vapour.</p> <p>3.7. Simple numerical on steam properties only using steam table and Mollier diagram.</p>	
<p>UNIT 4: Boilers (Steam Generator)</p>	<p>4.1. Definition and classification of boilers.</p> <p>4.2. Fire tube & water tube boilers with example, working principle, difference and applications.</p> <p>4.3. Construction & working principle of Cochran boiler, Lancashire boiler, Babcock and Wilcox boiler and La-Mont boiler.</p> <p>4.4. Definition of boiler mountings and accessories, Functions of boiler mountings and important accessories.</p> <p>4.5. Basic concept of stoker fired fluidized bed and pulverized fuel boilers.</p> <p>4.6. Boiler performance and sources of heat loss.</p> <p>4.7. Boiler draught, classification and comparison of boiler draught and calculation of chimney height.</p> <p>4.8. Necessity of boiler feed water treatment.</p> <p>4.9. Concept of modern high pressure boiler.</p> <p>4.10. Simple numerical on boiler performance and chimney heights calculation.</p>	12
Sub Total : Total Lecture Classes		45
No. of classes required for conducting Internal Assessment examination		6
Grand Total :		51

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

1. Show all processes of ideal gas on single P-V plane. Also show the work transfer during various processes of ideal gas on different p-v plane.
2. Draw P-V, T-S & H-S plane of steam and display saturated liquid line, dry saturated vapour line, wet saturated steam zone, critical point, triple point, superheated zone & under cooled liquid zone.
3. Draw P-V, T-S & P-T plane of steam and show constant pressure, constant temperature, constant volume & constant entropy line.
4. Draw Mollier Diagram and show different vapor processes on this diagram.
5. Prepare a chart showing comparative study of different types of Boiler.
6. Prepare a Chart showing Feed Water Treatment Plant.
7. Prepare a chart showing working principle of at least two mountings,

8. Prepare a chart showing working principle of at least two accessories,
9. Prepare a schematic diagram showing mountings and accessories of a modern high boiler.
10. Prepare a chart showing Forced Draught, Induced Draught and Balanced Draught of a boiler plant.
11. Prepare a report on visit to steam power plant / Dairy industry / Sugar factory etc. with specification of boiler and list of mountings and accessories along with their functions.

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	08	10	10 x 01 = 10
A2	3 & 4	07		
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	08		
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	07	10	10 x 01 = 10
C2	3 & 4	08		
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	05	06	06 x 02 = 12
D2	3 & 4	05		
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	05		
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:(20 Marks)

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
1	A Course in Thermal Engineering.	R. S. Khurmi	S. Chand & Co.
2	Engineering Thermodynamics (Principles & Practices)	D.S.Kumar	S.K. Kataria& Sons
3	A text book of Thermal Engineering.	V.M. Domkundwar	Dhanpat Rai & Co.
4	A Course in Thermal Engineering.	P. L. Ballaney	Khanna Publishers



WEST BENGAL STATE COUNCIL OF TECHNICAL & VOCATIONAL EDUCATION AND SKILL DEVELOPMENT

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"Karigori Bhavan", 4th Floor, Plot No. B/7, Action Area-III, New Town, Rajarhat, Kolkata-700160

Name of the Course: Diploma in Mechanical Engineering			
Course Title : Mechanical Engineering Drawing Practice	Semester : Third		
Category: Programme Core	Full Marks: 100		
Code no. : MEPC211	Sessional Examination Scheme:		
Duration : 17 weeks(4 hours per week)	External Assessment (End Semester Sessional Examination)		
	Assignment on the day of viva voce :	20	40 marks
	Viva voce (before Board of Examiners) :	20	
	Internal Assessment		
Total Practical class/week : 4	Submission of drawing sheets (in scheduled time)	40	60 marks
	Class performance & attendance	10	
Credit: 2	Viva voce (after submission of drawing sheets)	10	
	Total marks		
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.			
Pre requisite:			
<ul style="list-style-type: none"> Knowledge of Mechanical Engineering Drawing [Code No. – MEPC 201] 			

1. Course Outcomes (COs):

The practical exposures related with this course are to be taught and implemented, so that the student will be able to demonstrate the following industry oriented COs.

- i) Draw the development of lateral surfaces of different truncated and frustum objects, such as tray, funnel, hopper, bend pipe, transition pieces, etc.
- ii) Draw the curves of intersection of commonly used two interpenetrating solids.
- iii) Exercise various drawing symbols, codes and conventions as per IS: SP-46.
- iv) Apply machining symbols and surface texture on production drawings.
- v) Draw the sectional views of various casting / machining components.
- vi) Draw assembly drawing and detailed drawings of various objects such as machine tool parts, machine components, power transmission elements, bearings, valves etc.

2. Suggested Assignments for Continuous Assessment:

Following assignments are to be attempted on A1 drawing sheets (to scale drawing by using requisite drawing instruments and following the First angle method of projection) for the attainment of COs of MEPC211:

Sheet No.	List of Practical	Unit No.	Approx. Hours required	Marks per sheet
Sheet No. -1 (containing at least five problems)	1a. Develop plain / single curved lateral surfaces of oblique solids like prisms and cylinders. 1b. Develop plain / single curved lateral surfaces of oblique solids like pyramids and cones.	01	08	5
Sheet No. -2 (containing at least five problems)	2a. Develop lateral surfaces of compound solids like funnel, tray, oil can, hopper, transition piece (square to circular).	01	08	5
Sheet No. -3 (containing at least 3 problems)	3a. Draw curves of intersection of two interpenetrating solids having plane surfaces (vertical square prism with horizontal square prism). 3b. Draw curves of intersection of two interpenetrating solids having single curved surface (vertical cylinder with horizontal cylinder). 3c. Draw curves of intersection of two interpenetrating solids having single curved surface (horizontal cylinder with vertical cone).	02	08	5
Sheet No. -4 (containing at least five problems)	4a. Draw different orthographic views from the given isometric view. 4b. Draw sectional front view, top view and side view from the given isometric view of machine component, castings etc. (using conventions of sections)	04	10	5
Sheet No. -5 (containing at least three problems) [Preferably shaft Coupling, C.I. Pulley and Knuckle joint]	5a. State the procedure for assembly from the given detailed drawing. 5b. Draw assembly drawing (sectional front view and side view) from the given detailed drawings of components including conventional representation of tolerances and surface finish symbols. 5c. Prepare Bill of materials. (See Annexure-5b: sample of industrial drawing).	05	12	10
Sheet No. -6 (containing at least three problems) [Preferably Knuckle joint, Socket & spigot type cotter joint and construction of tooth profile of a Spur Gear]	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. 6d. Construct the tooth profile of a spur gear from given module, pressure angle and number of teeth.	06	14	10

Sub Total: Practical Classes	60 hrs.	40 marks
Preparation for ESE	08 hrs.	
Grand total :	68 hrs.	

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

Sl No.	Performance Indicators
1	Interpretation of given problems
2	Drawing sheets using proper drafting instruments
3	Performing the task following standards and ethics,
4	Submitting of assigned drawing sheets in time
5	Viva voce

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

- Practice good housekeeping.
- Demonstrate working as a leader / team member.
- Care and Maintain drawing instruments in good working condition.
- Follow ethical practice.



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Name of the Course: Diploma in Mechanical Engineering	
Category: Programme Core	Semester : Third
Code No. : MEPC 213	Total Marks : 100
Course Title : Materials Testing Lab	Examination Scheme: (i) Internal Assessment:60 marks [Continuous assessment of class performance and in time submission of assignment : 30 marks Viva voce : 20 marks Class attendance : 10 marks] (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]
Duration : 17 weeks (2 hours per week)	
Total practical class /week : 2	
Credit : 1	
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.	
Pre requisite: <ul style="list-style-type: none"> • Knowledge of Strength of Materials [Code No. – MEPC 205] • Knowledge of Mechanical Engineering Materials [Code No – MEPC 203] 	

1. Course Outcomes:

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

CO1: Use different material testing machines

CO2: Measure values of stress at different loading condition for mild steel specimen subjected to axial tensile load and plot them on stress-strain / load-deformation diagram.

CO3: Measure the shear stress of given materials by using relevant material testing equipment

CO4: Measure the impact strength of given materials by using relevant material testing equipment

CO5: Measure the hardness of given materials by using relevant material testing equipment

CO6: Measure the torsional shear stress of given materials subjected to torque by using relevant material testing equipment

CO7: Detect the external surface cracks in the test specimen by using Visual inspection and ring test /Die penetration test / Magnetic particle test.

2. Suggested Assignments for Continuous Assessment: (Any Five)

Sl. No.	List of Practical	Approx. Teaching Hours
1.	Tensile test on mild steel/ aluminum on UTM.	06
2.	To determine shear strength of mild steel by Direct Shear Test on UTM.	06

3	To find out the resistance of a standard specimen of common engineering materials against impact load by Izod and Charpy test.	06
4.	To determine the hardness value of mild steel / aluminum by Brinell Hardness tester.	06
5.	To determine the hardness value of mild steel / aluminum specimen by Rockwell Hardness tester.	06
6.	Torsion test on mild steel/ Aluminum bar.	06
7.	To detect the exterior surface cracks in the specimen using (i) Visual inspection and ring test, (ii) Die penetration test, (iii) Magnetic particle test.	06
8.	Determination of modulus of rigidity, strain energy, shear stress and stiffness by load deflection method (Closed coil helical spring)	06
Sub Total: Practical Classes		30 hrs.
Preparation for ESE		04 hrs.
Grand total :		34 hrs.

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

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

Sl No.	Performance Indicators
1	Awareness about the significance of particular test
2	Understanding working principle of machine / set-up
3	Setting and operation of experimental set up
4	Observations and recording data
5	Interpretation of result and conclusion
6	Submission of report in time
7	Answer to sample questions

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

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

Reference Books:

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



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Name of the Course: Diploma in Mechanical Engineering	
Category: Programme Core	Semester : Third
Code No. : MEPC 215	Total Marks : 100
Course Title : Thermal Engineering-I Lab	Examination Scheme: (ii) Internal Assessment:60 marks [Continuous assessment of class performance and in time submission of assignment :30 marks Viva voce : 20 marks Class attendance : 10 marks] (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]
Duration : 17 weeks (2 hours per week)	
Total Practical Class /week : 2	
Credit: 1	
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.	
Pre requisite: <ul style="list-style-type: none"> Knowledge of Thermal Engineering-I [Code No. – MEPC 209] 	

1. Course Outcomes (COs)

The experimental works associated with this course will help the students to demonstrate the following industry oriented Cos.

- Apply laws of thermodynamics to thermodynamic systems
- Use measuring instruments/charts in different thermodynamic processes
- Manage the working of steam boilers in different industries.
- Manage the operation of boiler mounting and accessories.
- Use steam calorimeter.

2. Suggested Assignments for Continuous Assessment: (At least Five Practical)

Sl.No.	List of Practical	Approx. Teaching Hours
1.	Observation of the working principle of Burden tube pressure gauge	06
2.	Calculation of characteristics gas constant of air using some practical data	06
3	Measurement of Dryness Fraction of Steam by Dryness Fraction Measuring Instrument.	06
4.	Use of Mollier Chart by plotting different vapour processes on it.	06

5.	Study of Cochran Boiler (fire tube boiler)	06
6.	Study of Lancashire Boilers (fire tube boiler)	06
7.	Study of Babcock and Wilcox Boiler (water tube boiler)	06
8.	Study of La-Mont Boiler (water tube boiler)	06
9	Study the boiler mountings and accessories	06
10	Trace the path of flue gas and water steam circuit of boiler	06
Sub Total: Practical Classes		30 hrs.
Preparation for ESE		04 hrs.
Grand total :		34 hrs.

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

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

SI No.	Performance Indicators
1	Awareness about the significance of particular test
2	Understanding working principle of machine / experimental set up
3	Setting and operation of experimental set up
4	Observations and recording data
5	Interpretation of result and conclusion
6	Submission of report in time
7	Answer to sample questions

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

- Follow the safety practices,
- Practice good housekeeping,
- Practice energy conservation,
- Demonstrate working as a leader / team member,
- Maintain tools and equipment to keep them in working condition,
- follow ethical practice

Reference Books:

Title of the Book	Name of the Author(s)	Name of the Publishers
Thermal Power Plant- Pre-Operational Activities	Dipak K. Sarkar	ELSEVIER
Power Plant Engineering.	R.K. Rajput	Laksmi Prakashani
Engineering Thermodynamics (Principles & Practices)	D.S.Kumar	S.K. Kataria & Sons
A text book of Thermal Engineering.	R. S. Khurmi	S. Chand & Co.
A Course in Thermal Engineering.	P. L. Ballaney	Khanna Publishers



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Name of the Course: Diploma in Mechanical Engineering	
Category: Programme Core	Semester: Third
Code no.: MEPC217	Total Marks:100
Course Title: Manufacturing Processes-I Practice	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] (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]
Duration : 17 weeks (4 hours per week)	
Total practical class/week: 4	
Credit: 2	
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 Manufacturing Process-I[Code No – MEPC 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:

- Operate the Lathe and Welding machine
- Create a component by operating the Lathe/ Welding machine
- Set the tools, jobs and set different parameter to run a machine for produce a job most effectively and economically
- Perform the work-in process inspection using different measuring tools to produce a job
- Create a component by using Smithy / Forging tools

2. Suggested Assignments/Practical for Continuous Assessment:

Sl. No.	List of Practical	Unit No.(as mentioned in sub code:MEPC207)	Approx. Teaching Hours
01*	Study of lathe: Identifying its major components: available spindle speed changing devices, available tool feeding devices, feed reversal devices, change gears, job holding devices, tool holding devices, types of cutting tools used in various lathe operations, setting of job and cutting tools, operate lathe without removal of chips and observe job-tool relative movement.	4	12
02*	Study of different equipment of Electric Arc Welding set-up or gas welding set-up or electric resistance 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.	6	12

03	Study the geometry of a single point cutting tool and produce an assignment on tool nomenclature and tool signature of a single point cutting tool.	3	10
04	Practice on making a job involving Lathe operations like facing, plain turning, step turning, grooving, knurling and chamfering.	4	10
05	Practice on making a job involving taper turning by swivelling the compound rest on Lathe as per given drawing.	4	10
06	Practice on making a job involving thread cutting operation on Lathe as per given drawing.	4	10
07	Practice on making welding joint (lap-joint or butt-joint or tee-joint or corner-joint) as per given drawing by utilizing available facilities of welding shop.	6	10
08	Practice on making a solid wooden pattern /split pattern as per given drawing.	5	10
09	Practice on making a mould by using a solid or split pattern as per given drawing.	5	10
10	Study of different tools and machines generally used in Smithy or Forging Shop and practice on different basic smithy or forging operations such as Upsetting, Drawing down, Setting down, Necking, Cutting, Bending, Fullering, Swaging, Punching and Drifting etc.	2	10
11	Practice on making a job on utility items like chain links, door rings, hooks etc. as per given drawing by utilizing smithy or forging shop's facilities.	2	10
Sub Total: Practical Classes		64 hrs.	
Preparation for ESE		04 hrs.	
Grand total :		68 hrs.	

Note: A suggested list of practical is given in the above table. At least 06 nos. practical need to be performed out of which the practical marked as [*] are compulsory.

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]	

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

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

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

Sl. No.	Performance Indicators
01	Interpretation of component drawing, setting up of machine, cutting tool and job

02	Preparing slip for requisition of tools, equipment and measuring instruments (with proper specification) needed for producing the component
03	Operating machine to execute the production process and Inspecting the component during production process using measuring instruments
04	Submission of job and workshop report in time
05	Viva voce

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

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

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.

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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Name of the Course: Diploma in Mechanical Engineering	
Category: Programme Core	Semester: Third
Code no.: SI201	Total Marks:100
Course Title: Internship 1	Examination Scheme: (i)Internal Assessment:100 Marks Internship Report - 60 Internship Seminar - 40 marks
Duration :	
Total practical class/week: After 2 nd Semester	
Credit: 1	
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.	

Suggested Internship Project Work in 3rd Semester

After the **2nd Semester**, for **Internship-I**, students are required to be involved in Inter/ Intra Institutional activities viz; Learning at Departmental Lab/ Institutional workshop; Training and simulation program with different Institutes like Workshop of ITI, Other Polytechnics and other Technical Institutes Institutions; Soft skill training organized by Training and Placement Cell of the respective institutions; contribution at innovation /entrepreneurship cell of the institute; participation in workshops/ competitions etc.

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

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

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

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

Sl. No.	Criteria for evaluation of Internship Seminar [40 marks]
1.	Quality of content presented
2.	Proper planning for presentation
3.	Effectiveness of presentation
4.	Depth of knowledge and skills
5.	Viva voce
Total Marks: 100	
Pass criterion for Internship-I = 40 Marks [Minimum]	

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



Syllabus
of

Diploma in Mechanical Engineering
(Production) [MEP]

Part-II (3rd Semester)

Revised 2022

**CURRICULAR STRUCTURE FOR PART-II (SEMESTER 3) OF THE
FULL-TIME DIPLOMA COURSES IN MECHANICAL ENGINEERING(PRODUCTION)**

SL NO.	CATEGORY	Code No	Course Title	L	P	TOTAL CLASS PER WEEK	CREDIT	FULL MARKS	INTERNAL MARKS	ESE MARKS
1	Program core	MEPC201	MECHANICAL ENGINEERING DRAWING	2	0	2	2	100	40	60
2	Program core	MEPC203	MECHANICAL ENGG. MATERIALS	3	0	3	3	100	40	60
3	Program core	MEPC205	STRENGTH OF MATERIALS	3	0	3	3	100	40	60
4	Program core	ME(P)PC207	INDUSTRIAL PRODUCTION TECH.-I	3	0	3	3	100	40	60
5	Program core	ME(P)PC209	HEAT POWER ENGG.-I	3	0	3	3	100	40	60
6	Program core	MEPC211	M.E. DRAWING PRACTICE	0	4	4	2	100	60	40
7	Program core	MEPC213	MATERIALS TESTING LAB	0	2	2	1	100	60	40
8	Program core	ME(P)PC215	HEAT POWER ENGG. LAB	0	2	2	1	100	60	40
9	Program core	ME(P)PC217	INDUSTRIAL PRODUCTION TECH.-1 LAB	0	4	4	2	100	60	40
10	SUMMER INTRENSHIP-1(4WEEKS) AFTER SEM-II	S1201	SUMMER INTERNSHIP AFTER 2ND SEM	0	0	0	1	100	60	40
TOTAL CREDITS AND MARKS				14	12	26	21	1000		



West Bengal State Council of Technical Education
(A statutory Body under West Bengal Act XXI 1995)

Name of the Course: Diploma in Mechanical Engineering(Production)	
Category: Programme Core	Semester : Third
Code No. : MEPC201	Theory : 100 Marks
Course Title : Mechanical Engineering Drawing (Same with Mechanical Engg.)	Examination Scheme: i) External Assessment: 60 Marks (End Semester Examination) ii) Internal Assessment: 40 Marks [Class test: 20 Marks Home assignments: 10 Marks Class attendance: 10 Marks]
Duration : 17 weeks (Total hours per week = 2)	
Total lecture class/week: 2	
Credit : 2	
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.	

1. Course Outcomes: After completion of this course the students will be able to

- i) Comprehend the methods of development of lateral surfaces of different truncated and frustum objects, such as tray, funnel, hopper, bend pipe, transition pieces, etc.
- ii) Realise the curves of intersection of commonly used two interpenetrating solids.
- iii) Interpret machining symbols and surface texture on production drawings.
- iv) Interpret various drawing symbols, codes and conventions as per IS: SP-46.
- v) Realise the sectional views of various casting / machining components.
- vi) Interpret assembly drawing and detailed drawings of various objects such as machine tool parts, power transmission elements, bearings, valves etc.

2. Theory Components:

Unit	Topics & Sub-topics	Teaching Hours
Unit: 1 Development of Surfaces	1.1 Developments of lateral surfaces of the regular oblique solids for the following cases: Truncated oblique prism, truncated oblique cylinder, truncated / frustum oblique pyramid and truncated / frustum oblique cone. 1.2 Applications of development of surfaces such as hopper, funnel, tray, transition piece (square to circular).	06
Unit: 2 Intersection of Surfaces of Two Interpenetrating Solids	2.1 Curves of intersection of the two interpenetrating regular solids for the following cases: Square prism with square prism, Cylinder with cylinder when the axes of them are at 90° and bisecting. Cylinder with cone when the cone is resting vertically on HP and the axis of cylinder is parallel to both HP and VP and axes of them are intersecting at 90°.	05
Unit: 3 Standard Convention for Engineering Drawing using SP 46 : 2003	3.1 Conventional representation of the following materials: Cast Iron, Mild Steel, Aluminium, Brass Bronze, Glass, Concrete, Wood & Rubber. 3.2 Conventional long and short break in pipe, rod and shaft. 3.3 Conventional representation of common features like slotted head, knurling, serrated shaft, splined shaft, ratchet & pinion, holes on circular pitch, internal & external thread, square on shafts, repeated parts. 3.4 Conventional representation of standard parts like gears, springs, ball & roller bearings. 3.5 Counter sunk and counter- bored holes. 3.6 Pipe joints and valves. 3.7 Tapers. 3.8 General welding symbols, sectional representation and symbols used in engineering practices.	03
Unit: 4 Limits, Tolerances, Fits and Surface Roughness	4.1 Limits, Fits and Tolerances: a) Introduction to ISO system of Tolerance. b) Selection and representation of dimensional tolerance- number and grade method. Definitions concerning tolerance and limit system, Unilateral and bilateral tolerance, Hole basis and shaft basis system, Clearance fit, Interference fit, Transition fit, Selection of fit for various engineering applications. c) Calculation of limit sizes and identification of types of fit from the given sizes like $\Phi 50H7/c8$, $\Phi 50H6/k5$, $\Phi 50H7/s6$ etc. 4.2 Geometrical Tolerances: Types, terminology for deviation, representation of geometrical tolerance on drawing. 4.3 Machining Symbols and Surface Texture: Indication of machining symbol showing direction of lay, sampling length, machining allowances, manufacturing methods and roughness grades. Representation of surface roughness on drawing.	03
Unit: 5 Sectional Views	5.1 Isometric views to Orthographic views (front view, top view and side view) of the following objects: a) Machine components b) Castings like hanger and shaft support. 5.2 Sectional views of the following casting objects: a) Bearing bracket b) Shaft bracket c) Sliding block.	03
Unit: 6 Assembly Drawings	6.1 Introduction, types of assembly drawing, accepted norms to be observed for assembly drawings, sequence for preparing assembly drawing. Bill of material. 6.2 Assembly drawing from the following detailed drawings: a) Couplings: Rigid flange coupling & Universal coupling. b) Knuckle joint. c) C.I. pulleys: Fast pulley and Stepped cone pulley. d) Bearing: Plummer block. e) Screw jack. f) Bench vice.	04

	g) Square tool post of Lathe machine.	
Unit: 7 Part Drawings (assembly to detailing)	7.1 Detailing of the following assemblies: a) Knuckle joint b) Castor wheel c) Socket and spigot type cotter joint. d) Foot step bearing e) Crane hook f) Drilling jig g) Tail stock of Lathe machine h) Non-return valve. 7.2 Construction of tooth profile of a spur gear – (i) by using approximate construction method, (ii) by using involute method.	04
Sub Total : Total Lecture Classes		28
No. of classes required for conducting Internal Assessment examination		06
Grand Total :		34

3.

Suggested Home Assignment/Student Activities: (At least four assignments)

Other than practice work in classroom, students should conduct the following suggested activities in group or individual, which are suitable for this subject as per instruction of the subject teacher:

- (a) Students should maintain a separate A3 size sketch book which will be their part of practice work and has to submit that sketch book along with drawing sheets in scheduled time. Following additional Home Assignments are to be attempted on this sketch book (not to scale drawing following first angle method of projection) as instructed by the subject teacher for the attainment of the COs of MEPC201:

Unit No.	Topics for Home assignment	Marks
03	a. Conventional representation as per IS: SP-46 (1988) of the following: <ul style="list-style-type: none"> - Materials: Cast Iron, Mild Steel, Aluminium, Brass Bronze, Glass, Concrete, Wood & Rubber. - Conventional long and short break in pipe, rod and shaft. - Common features like slotted head, knurling, serrated shaft, splined shaft, ratchet & pinion, holes on circular pitch, internal & external thread, square on shafts, repeated parts. - Standard parts like gears, springs, ball & roller bearings. - Counter sunk and counter bored holes. - Pipe joints and valves. - Tapers. - General welding symbols, sectional representation and symbols used in engineering practices. 	
04	a. Calculation of limit sizes and identification of types of fit from the given sizes like $\Phi 50H7/c8$, $\Phi 50H6/k5$, $\Phi 50H7/s6$ etc. b. Representation of geometrical tolerance on drawing. c. Machining Symbols and Surface Texture: Indication of machining symbol showing direction of lay, sampling length, machining allowances, manufacturing methods and roughness grades. Representation of surface roughness on drawing.	10
05	Assembly drawing (including bill of materials and conventional representation of tolerances and surface finish symbols) of the following detailed drawings of components: <ol style="list-style-type: none"> a) Universal coupling, b) Stepped cone pulley, c) Plummer block, d) Screw jack, e) Bench vice, f) Square tool post of Lathe machine. 	
06	Part drawing including conventional representation of tolerances and surface finish symbols of the following assembly drawing: <ol style="list-style-type: none"> a) Castor wheel, b) Crane hook, c) Foot step bearing, 	

	d) Drilling jig, e) Tail stock of Lathe machine, f) Non-return valve,	
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- b) They should prepare paper-models of development of lateral surfaces of objects such as tray, funnel, hopper, transition piece etc., and paper-models of two interpenetrating solids showing curves of intersection.
- c) Only one micro-project is planned to be undertaken by each student assigned to him/her by the subject teacher **at the beginning of the semester**. The micro-project could be industry application based, workshop-based or field-based. It should be individually undertaken to build up the skill and confidence in every student so that she/he contributes to the projects of the industry. A suggestive list of micro-projects is given here for the attainment of the COs:
- (i) Visit Institute's workshop (Fitting shop or Machine shop) and prepare assembly drawing and detailed drawings of lathe tool post / lathe tail-stock / shaper tool head / Drilling machine vice etc (as per availability) using proper measuring instruments.
- ii) Visit nearby sheet metal workshop (if possible) and prepare a report related to type of components, dimensions, material, field of applications, operations performed etc.
- iii) Other than practice work, at least one visit for students to nearby industries/workshops is to be arranged for understanding various production drawings. Students should collect production drawings (if possible) and try to **visualise** the object from the given views in collected drawing.
- iv) Any other micro-projects suggested by the subject-teacher on similar field.

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]

Multiple Choice Questions						Subjective Questions					
Group	Unit	To be Set	To be Answered	Marks per Question	Total Marks	Group	Unit	To be Set	To be Answered	Marks per Question	Total Marks
A	1, 2, 3, 4, 6, 7.	25	20	1	20 x 1 = 20	B	1, 2	03	04 (at least one from each Group)	10	10 x 4 = 40
						C	5	02			
						D	6,7	03			
Pass criterion for ESE = 24 marks minimum											

6. Rubrics for the assessment of student's activity [20 marks]:

SI No.	Performance Indicators	Weightage in %
1	Imitation of Solved Drawing, Accomplishing given problem, Performing the drawing task masterfully/expertly using drafting instrument Performing the task following standards and ethics, Submitting assignment sketch book on time, Submitting micro-project related activity	
Total		100

7. Suggested Learning Resources:

Sl. No.	Title of Book	Author	Publication
1	Machine Drawing	N. D. Bhatt V. M. Panchal	Charotar Publishing house Pvt. Ltd. Anand, Gujrat, ISBN: 9789380358635
2	A text book of Machine Drawing	P. S. Gill	S. K. Kataria & Sons, New Delhi, ISBN: 9789350144169
3	A text book of Machine Drawing	R. K. Dhawan	S. Chand & Company New Delhi
4	Production Drawing	K. L. Narayana, P. Kannaiah, K. Venkata Reddy	New Age International Publication, New Delhi, ISBN: 9788122435016
5	Machine Drawing	Basudev Bhattacharya	Oxford University Press ISBN: 0-19-807077-2
6	Engineering Drawing Practice for Schools & Colleges- SP 46 : 1988	Bureau of Indian Standard	Bureau of Indian Standard New Delhi -110002 First Revision July 2003 ISBN: 81-7061-019-2

8. Suggested software / learning website link

i) <https://law.resource.org/pub/in/bis/S01/is.sp.46.2003.pdf>



West Bengal State Council of Technical Education

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Name of the Course: Diploma in Mechanical Engineering(Production)	
Category: Programme Core	Semester : Third
Code no. : MEPC203	Theory : 100 Marks
Course Title : Mechanical Engineering Materials (Same with Mechanical Engg.)	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):

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

a. Explain about crystal structures.

- b. Identify properties of materials.
- c. Classify the ferrous metals and describe their properties and applications.
- d. Describe the non-ferrous metals, cutting tool materials, and composites along with their properties and applications.
- e. Explain various heat treatment processes & their applications on various engineering components for improving their mechanical properties.
- f. Describe plastic moulding process and its applications.
- g. Understand non-destructive testing methods & its applications.

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 and Sub-topics	Teaching Hours
Unit-1: Basics of Engineering Materials	1.1 Introduction, classification of engineering materials. 1.2. Crystal structures: Unit cell and space lattice. Crystal system- The seven basic crystal systems. Crystal structure for metallic elements- BCC, FCC and HCP. Coordination number for simple cubic, BCC and FCC. Atomic radius- definition, atomic radius for simple cubic, BCC and FCC. Atomic packing factor (APF) for simple cubic, BCC, FCC and HCP. Simple problems on finding number of atoms and atomic packing factor for a unit cell. 1.3 Mechanical properties of materials - elasticity, plasticity, ductility, malleability, toughness, hardness, harden ability, brittleness, fatigue, and creep. 1.4. Introduction to corrosion, methods to prevent of corrosion.	06
Unit-II Ferrous Metals and Alloys	2.1. Cooling curve and showing allotropic transformation of iron. Iron- Carbon equilibrium diagram and its explanation. Critical temperatures and its significance. Principal micro constituents of an iron carbon system up to 2.0% C content (austenite, ferrite, cementite, pearlite, eutectoid, hypo-eutectoid & hyper –eutectoid steel) 2.2 Broad classification of ferrous metals (steel, cast iron, wrought iron) according to percentage of carbon. Process flow diagram for production of iron and steel. 2.3 Steel: compositions, properties and applications of - i) Plain carbon steel: low (including dead steel & free cutting steel), medium and high carbon steel; effect of silicon, sulphur, phosphorus and manganese. ii) Alloy steel: low, medium and high alloy steel, purpose of alloying, effects of various alloying elements like chromium, nickel, manganese, tungsten, vanadium, cobalt, and molybdenum. iii) Tool steel: cold work tool steel, hot work tool steel, high speed steel (HSS) - composition and applications. iv) Stainless steel: types and applications. vi). Spring steel: composition and applications. vii) Designation of steels on the basis of chemical composition (IS -7598: 1974). 2.4 Type of Steel used for following: shafts, axles, nuts, bolts, crank shafts, camshafts, house hold utensils, surgical instrument, anti-friction bearings and gears. 2.5 Cast Iron & Wrought Iron: Classification and application of cast iron as white grey, nodular, and malleable. Wrought iron - composition and its use.	09
Unit-III: Heat Treatment of Steel	3.1 Introduction to heat treatment, TTT Diagram for eutectoid steel. 3.2 Heat Treatment Process: Purpose, process and applications of - Annealing, Normalising, Hardening & Tempering. 3.3 Austempering & Martempering: Purpose, process and application. 3.4 Surface hardening: Purpose, process and application of - case hardening, flame hardening, and induction hardening.	10
Unit-IV: Non-Ferrous Metals and Alloys	4.1 Properties and application of copper and its alloys such as brass, muntz metal, gun metal and bronze. 4.2 Properties and application of aluminium alloys such as Y-alloy, hindalium, and duralumin. 4.3 Properties and application of nickel alloys such as inconel, monel metal, and nichrome. 4.3 Properties and application of bearing metals such as white metal, babitt metal, and phosphor bronze.	05
Unit-V:	5.1 Polymeric materials. 5.2 Properties and applications of thermoplastics, thermosetting plastics and rubbers.	

Non-Metallic and Advanced Materials	5.3 Plastic Moulding process: compression moulding, transfer moulding, injection moulding, blow moulding, vacuum forming, extrusion, calendaring, rotational moulding. 5.4 Application of ABS, acrylics, nylons and vinyl, polyesters, epoxies, melamine and bakelite. 5.5 Application of rubbers: neoprene, butadiene, buna and silicon. 5.6 Ceramics - properties and applications of glasses and refractories. 5.7 Composite materials - properties and applications of laminated and fibre reinforced materials. 5.8 Advanced engineering materials- Properties and applications of Nano materials and smart materials.	10
Unit-VI: Non-Destructive Testing	7.1 Importance of non-destructive testing, difference between destructive and non-destructive testing. 7.2 Non-destructive testing methods – Radiography (X-Ray & Gamma Ray), Ultrasonic crack detection, Dye penetration test, Magnaflux test – comparison & applications.	05
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) Prepare a chart of composition and application of the following non-ferrous alloys - a) Babitt metal, b) Phosphor Bronze, c) Brass, d) Bronze, e) Gun metal, f) Bell metal, g) Duralumin, h) Y- alloy, i) German Silver, j) Monel metal, k) Inconel, l) Nichrome.
- ii) Select the type of carbon steel and its composition (approx range of carbon %) and approx Tensile strength for the following components - a) shaft and spindle, b) rails, c) wires, d) boiler plate, e) connecting rod, f) die block, g) cutting tool, h) hand chisel, i) hammer, and j) drill.
- iii). Arrange CI, Mild steel, Wrought Iron, Cu, Al according to their tensile strength, ductility, malleability, hardness, toughness and creep.
- iv). Write down the heat treatment process (heating temperature range, quenching procedure, selection of furnace) of any five of the following components -
a) Gear used in power transmission in lathe, b) HSS cutting tool, c) Crank shaft used in 4- stroke petrol engine, d) Shaft, e) Cast Iron pulley, f) Tyre of rail-wheel, g) balls of ball bearing.
- v) Draw detailed sketch of any two types of heat treatment furnace commonly used in industry.
- vi) Prepare a chart showing coloured picture of microstructure of steel (Ferrite, Pearlite, Cementite, Bainite, Sorbite, Martensite), their BHN, and composition.

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]

Multiple Choice Questions						Subjective Questions					
Group	Unit	To be Set	To be Answered	Marks per Question	Total Marks	Group	Unit	To be Set	To be Answered	Marks per Question	Total Marks

A	1, 2, 3	15	20	1	20x 1 = 20	A	1 2 3	02 02 02	At least two from each group (Total 5 questions)	8	8 x 5 = 40
B	4, 5, 6	10				B	4 5 6	02 01 01			
Pass criterion for ESE = 24 marks minimum											

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

SI No.	Performance Indicators	Weightage in %
1		
2		
3		
4		
5		
Total		100

7. Suggested Learning Resources:

Sl. No.	Title of Book	Author	Publication
1	A Text Book of Materials Science and Metallurgy	O.P.Khanna	Dhanpat Rai and Sons, New Delhi.
2	Materials Science for Polytechnic	R.K.Rajput	S. K. Kataria & Sons, New Delhi, ISBN: 9789350144169
3	Engineering Materials	B.K.Agrawal	McGraw Hill Education, New Delhi.
4	Material Science	R.S. Khurmi,	S. Chand & Co. Ltd., New Delhi, 2005.
5	Material Science & Engineering	Raghavan	PHI

List of assignments are to be performed by the students in subject of **Mechanical Engineering Materials [any two]**:

1. Prepare a chart showing the diagrams and detailed calculations of coordination number, atomic radius and atomic packing factor for BCC, FCC and HCP Crystal Structures for demonstration purpose.
2. Prepare a chart showing the composition and applications of the following materials for demonstration purpose: a) Babbit Metal, b) Phosphor Bronze, c) Brass, d) Bronze, e) Gun Metal, f) Bell Metal, g) Duralumin, h) German silver, i) Monel Metal, j) Inconel, k) Nichrome **[any five]**.
3. Prepare a chart showing the Iron-Carbon Equilibrium Diagrams (drawn in proper scale) and explain its critical temperatures, micro constituencies up to 2% carbon content in tabulated form for demonstration purpose.
4. Prepare a chart showing the selection of material with their composition and proper justifications for the following components: a) Shaft and spindle, b) Rail track, c) Wires, d) Boiler plate, e) Connecting rod, f) Die block, g) Cutting tool, h) Hand chisel i) Hammer, j) Drill bit **[any five]**.
5. Prepare a chart showing the microstructure, composition and properties of the following steels for demonstration purpose: a) Ferrite, b) Pearlite, c) Cementite, d) Binite, e) Sorbite, f) Martensite.
6. Prepare a chart showing the process flow diagram with proper explanations for production of steel from iron ore for demonstration purpose.
7. Prepare a flow chart showing the sequential processes of suggested heat treatment with explanation and proper justifications for enhancing the performances of the following components: a) Gear used in power transmission in lathe, b) Anvil of smithy shop, c) Crank shaft used in 4 stroke engines, d) Cast Iron pulley, f) Rail wheels **[any one]**.
8. Prepare a chart showing sequential process flow diagrams with explanation and specific applications of any two types of non-destructive testing methods generally being used in Industry for material testing.
9. With suitable diagram explain and specify its applications of the following plastic forming processes: a) Compression moulding, b) Transfer moulding, c) Injection moulding, d) Blow moulding, e) Vacuum forming, f) Extrusion **[any two]**.

10. Prepare a chart by organizing the following engineering materials such as Cast iron, Mild steel, Wrought iron, Copper, Aluminum according to their mechanical properties such as Strength, Malleability, Ductility, Hardness and Machinability.



West Bengal State Council of Technical Education

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Name of the Course: Diploma in Mechanical Engineering(Production)	
Category: Programme Core	Semester : Third
Code no. : MEPC205	Theory : 100 Marks
Course Title : Strength of Materials (Same with Mechanical Engg.)	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 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:

- Demonstrate different types of stress induced on components under the action of different types of loading condition.
- Interpret the variation of MOI for different cross-sections of mechanical components.
- Determine stresses, deformations in the simple load carrying members subjected to an axial, transverse, radial, twisting or thermal loading,
- Draw shear force and bending moment diagrams for beams with different support conditions and different load conditions,
- Analyze both solid and hollow shaft subjected to torsion,
- Solve the problems of column for different end conditions using different methods like Euler's Formula & Rankine-Gordon formula,

2. Theory Components:

Unit	Topics & Sub-topics	Teaching Hours
Unit-01: Simple Stresses and Strains	1.1 Definition of SOM & concept of rigid body, deformable body & equilibrium of forces. 1.2 Types of loads (normal and tangential), types of stresses - normal stress (tensile stress and compressive stress) & shear stress, strain -concept, types- longitudinal and lateral strain, and Poisson's ratio. 1.3 Hooke's law, Young's modulus, longitudinal stress and strain values of uniform and stepped bar under the influence of normal force; stress and strain values of uniform bar due to self-weight only. 1.4. Behaviour of ductile and brittle materials subjected to axial tension, stress-strain or load-deformation curve for ductile (MS) and brittle material (CI) - discussion on salient point, limit of proportionality, yielding, permanent set, yield stress and ultimate stress, factor of safety (simple problems on normal stresses and longitudinal strain. No discussion on composite section). 1.5 Direct shear stress (single/double shear) and shear strain, modulus of rigidity, (simple problems on direct shear in riveted joint, punching press).	12

	<p>1.6 Lateral strain, Poisson's ratio, volumetric strain, bulk modulus, relation among elastic constants without deduction.</p> <p>1.7 Thin cylindrical shell - hoop stress, longitudinal stress and relation between them (simple problems).</p> <p>1.8 Temperature stress and strain in case of bodies having uniform cross-section with and without yielding (simple problems but no discussion on composite section).</p>	
<p>Unit-02: Moment of Inertia</p>	<p>2.1 Definition of area and mass moment of inertia.</p> <p>2.2 Parallel axis theorem, Perpendicular axis theorem, Polar moment inertia, Radius of gyration.</p> <p>2.3 MOI about axes passing through the centroid (for solid having square, rectangular, circular, semi-circular, triangular sections and for hollow having square, rectangular, circular sections only)</p> <p>2.4 MOI of angle section, channel section, Tee section, and I-section about centroidal axis and any other axis parallel to centroidal axis. Polar moment of inertia of circular sections (solid and hollow).</p> <p>2.5 Simple problems.</p>	06
<p>Unit-03: Shear Force & Bending Moment of Beam</p>	<p>3.1 Types of beams, types of loads (point load, uniformly distributed load, UVL, VL), and types of supports.</p> <p>3.2 Meaning of SF, BM of beam, and relation between them, sign convention of SF & BM.</p> <p>3.3 Shear force and bending moment diagram (for simply supported beam and cantilever subjected to point loads/uniformly distributed load/their combination).</p> <p>3.4 Location of point of maximum bending moment for simply supported beam.</p> <p>3.5 Concept of overhanging beam and point of contra flexure.</p> <p>3.6. Problems on cantilever and simply supported beam.</p>	08
<p>Unit-04: Bending stresses in Beams</p>	<p>4.1. Theory of pure bending, assumption in theory of bending, flexural formula, neutral axis.</p> <p>4.2 Moment of resistance, section modulus and neutral axis.</p> <p>4.3 Simple problems on bending stress in beams having rectangular, circular, and I-section (symmetrical section about both axes).</p>	04
<p>Unit-05: Deflection of Beams</p>	<p>5.1 Concepts of deflection, maximum deflection and slope in a beam.</p> <p>5.2 Maximum deflection and slope of simply supported beam subjected to point load at mid span and / or uniformly distributed load on entire span (no deduction).</p> <p>5.3 Maximum deflection and slope of cantilever beam subjected to point load at free end and / or uniformly distributed load on entire span(no deduction)</p> <p>5.4 Simple problems on maximum deflection and maximum slope of simply supported beam and cantilever subjected to above mentioned loading.</p>	03
<p>Unit-06: Columns & Struts</p>	<p>6.1 Introduction, difference between strut and column, types of column.</p> <p>6.2 Concept of slenderness ratio, equivalent length of column for different end conditions.</p> <p>6.3 Euler's formula, assumptions, formula for critical/buckling loads of columns for different end conditions (no deduction), safe load, limitations of Euler's formula.</p> <p>6.4 Rankin's formula, calculation of critical / buckling load.</p> <p>6.5 Simple problems.</p>	04
<p>Unit-07: Torsion of circular shafts</p>	<p>7.1 Concept of pure torsion, field of applications (shaft, flange couplings, shear bolts), torsional rigidity, angle of twist, polar modulus, torsional equation for solid and hollow circular shafts, assumptions made for deriving the pure torsion equation.</p> <p>7.2 Torsional resistance for solid and hollow circular shafts, comparison between them, power transmitted by shaft.</p> <p>7.3 Simple problems on pure torsion.</p>	05
<p>Unit-08 Springs:</p>	<p>8.1 Function, types, materials used, practical applications.</p> <p>8.2 Coiled spring terminology - spring stiffness, solid length, spring index, and mean radius of coil.</p> <p>8.3 Angle of twist in the spring wire, deformation, and energy stored in the closely coiled helical spring subjected to an axial load. [No Derivation; Only Formula use]</p> <p>8.4 Equivalent stiffness of coiled springs in series & parallel.</p> <p>8.5 Simple problems on closed-coil helical spring subjected to an axial load.</p>	03
Sub Total : Total Lecture Classes		45
No. of classes required for conducting Internal Assessment examination		06

Grand Total :	51
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3. Suggested Home Assignments/Students' Activities: Students are to solve 4 assignments from the set of assignment attached in separate sheet (Annexure 1).

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]

Multiple Choice Questions						Subjective Questions					
Group	Unit	To be Set	To be Answered	Marks per Question	Total Marks	Group	Unit	To be Set	To be Answered	Marks per Question	Total Marks
A	1, 2,3	15	20	1	20 x 1 = 20	A	1, 2,3	05 (2+1+2)	Total 5 questions to be answered taking at-least 2 from each group	08	5 x 8 = 40
B	4, 5,6, 7,8	10				B	4, 5,6, 7,8	05 (1+1+1+1+1)			
Pass criterion for ESE = 24 marks minimum											

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

SI No.	Performance Indicators	Weightage in %
1		
2		
3		
4		
5		
Total		100

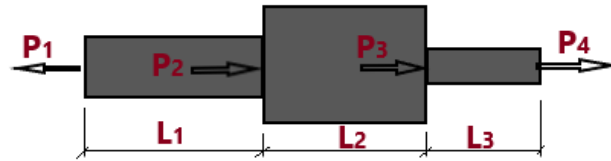
7. Suggested Learning Resources:

Sl. No.	Title of Book	Author	Publication
1	Strength of Materials	R.S. Khurmi	S.Chand
2	Strength of Materials	R. Subramanian	Oxford
3	Strength of Materials	S.S. Rattan	McGraw Hill Education
4	Strength of Materials	R.K Rajput	S. Chand
5	Strength of Materials	S. Ramamurtham	Dhanpat Rai Publishing.

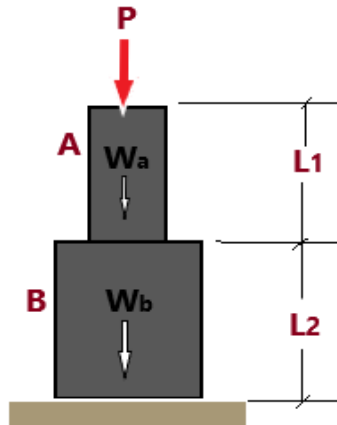
(Annexure 1)

(any two from first four and any two from next six)

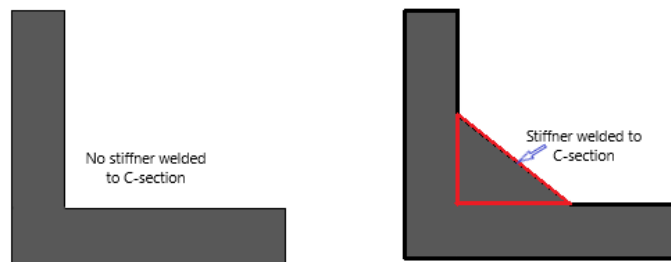
1. To find the induced stress and its nature, and deformation in each part and the resultant deformation of whole body. Given – E and cross sectional area of each part.



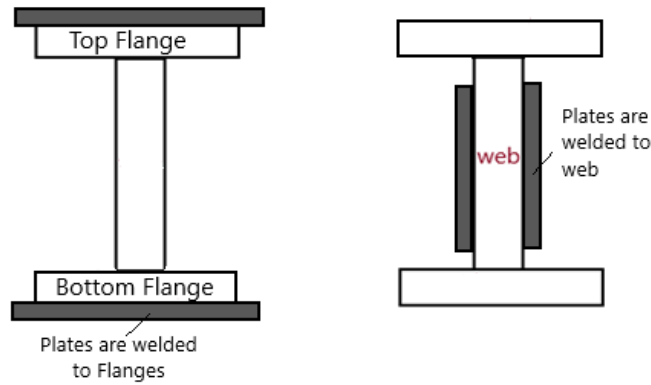
2. To find the decrease in length of the body made up of different materials A and B, under the action of axial compressive load. Given E_A , E_B , cross sectional area of each section, considering the self weight of W_A , W_B and axial load P .



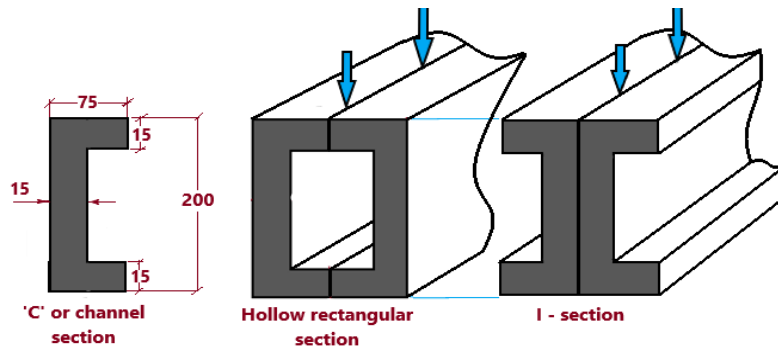
3. To justify the joining of stiffener to the C-section as shown below and determine the increase of moment of resistance of C-section with stiffener in comparison to without stiffener. Given, various dimensions associated with sketches, bending stress.



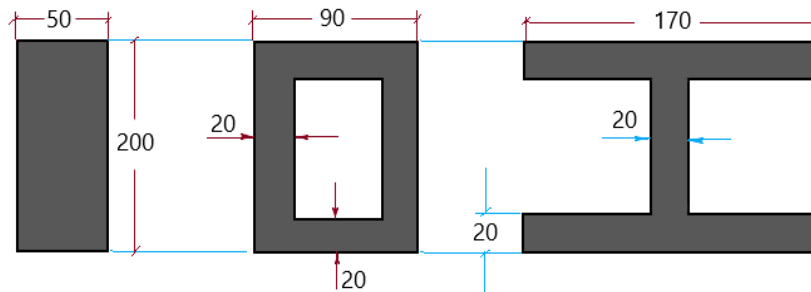
OR, To choose the best option from two given alternatives in which two identical plates are welded to the (i) flanges of symmetrical I-section, and (ii) web of symmetrical I-section as shown. Given, various dimensions associated with sketches and bending stress.



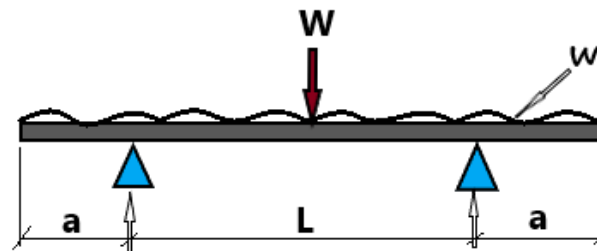
4. Compare the bending strength of the two beams having different cross section (one is of hollow rectangular cross section and other is of I-section). I-section is formed by welding of back to back webs of two 'C' sections whereas hollow rectangular section is formed by welding of face to face top & bottom flange of two 'C' sections as shown.



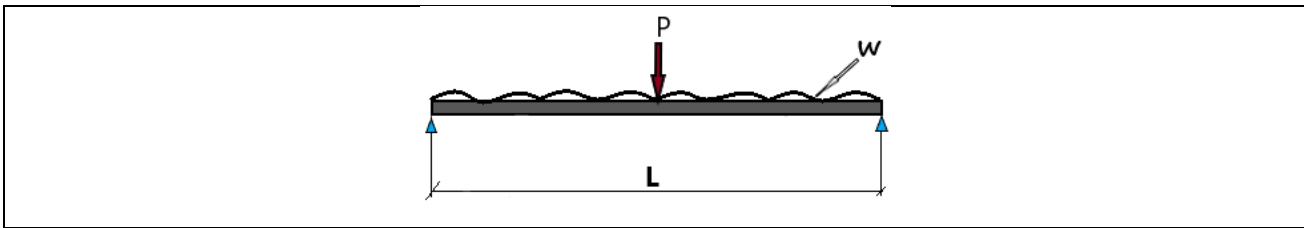
OR, Compare the bending strength of three sections of the same cross sectional area and depth if one of them has a solid rectangular section (50 mm wide and 200 mm deep), the second one is of hollow rectangular section (external dimensions of 90 mm wide and 200 mm deep with 20 mm wall thickness), and the last one is an I-section of equal flanges (170 mm wide web and flange thickness equal to 20 mm).



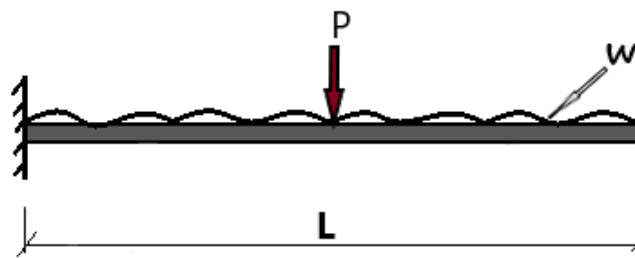
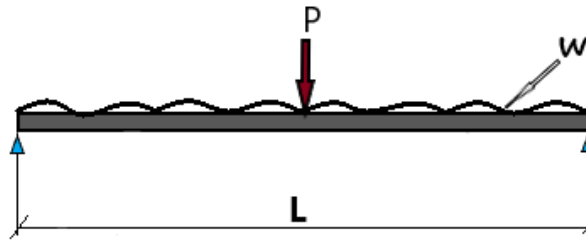
5. To determine the position of two supports of an equally overhanging beam for the least maximum BM, draw SF and BM diagram of such loaded beam. To find the point of contra flexure, if any.



6. To determine the economical cross-section of a simply supported beam subjected to combined loading from the given two options - square cross section and circular cross section. Given, allowable bending stress, length of beam, magnitude of point load and intensity of u.d.l.

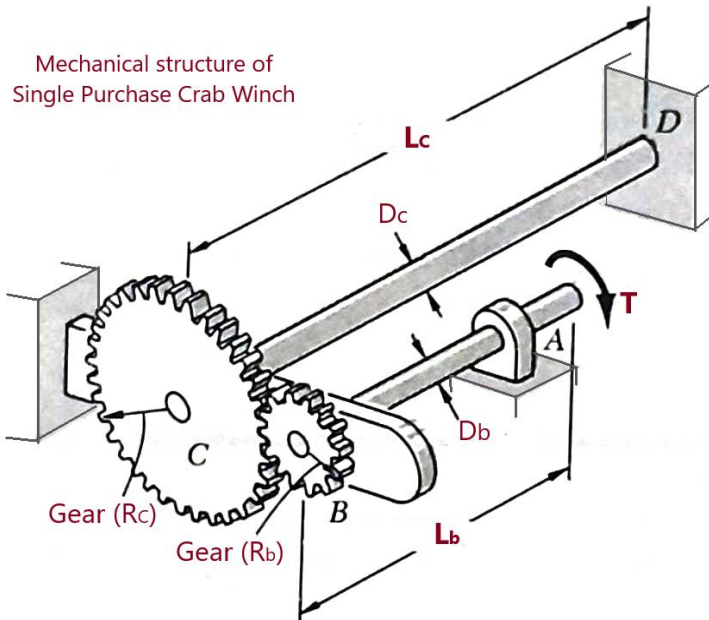


7. To draw the elastic curve and determine maximum deflection and maximum slope of cantilever and simply supported beam subjected to combined loading. Given, E , length of beam and moment of inertia of the cross section of beam.



8. To compare the crippling loads given by the Rankin's formula and Euler's formula for a column. Given, cross section of column and its MOI about centroidal axes (I_{GX} , I_{GY}), allowable crushing stress f_c , modulus of elasticity E , value of α , length and end condition of column.

9. To design the hollow shaft and determine the % saving in material for the replacement a solid shaft by a hollow shaft of same material. Given, maximum allowable shear stress is same for both the shafts, diameter of solid shaft, and ratio of the outer and inner diameter of hollow shaft.
10. Mechanical structure of a single purchase crab winch is shown in figure where two solid steel shafts AB & CD of same material are connected by two gears. Determine the largest torque 'T' that can be applied to the end A of shaft AB and the corresponding angle of twist for each shaft. Given, modulus of rigidity and allowable torsional shear stress of the shaft material, L_c & L_b , D_c & D_b , R_c & R_b .



11. A solid circular shaft is transmitting 100 kW at 180 rpm. The shaft is not to twist more than 1° in a length of 3 meters. The allowable torsional shear stress of the shaft material is 60 N/mm^2 . Assume modulus of rigidity of the shaft material is 80 kN/mm^2 . Determine the suitable shaft diameter for this purpose.

12. Two close-coiled helical springs wound from same wire having same length but with different core radii and are placed one into the other between two rigid plates at their two extreme ends. This mechanical structure is being subjected to compressive load. Determine the maximum shear stress induced in each coil spring. Given, diameter of wire, compressive load applied between the two rigid plates, and core radii of the two springs.



West Bengal State Council of Technical Education

(A statutory Body under West Bengal Act XXI 1995)

Name of the Course: Diploma in Mechanical Engineering (Production)	
Category: Programme Core	Semester : Third
Code no. : ME(P)PC207	Theory : 100 Marks
Course Title : Industrial Production Technology-I	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.

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:

- Understand the fundamental concept of manufacturing and identify different manufacturing processes to be performed for the given job.
- Prepare products using different metal forming processes.
- Prepare products using different casting processes.
- Assess and apply different metal joining processes to produce jobs.
- Illustrate the concept of powder metallurgy

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	1.1 Concept of manufacturing 1.2 Importance of manufacturing 1.3 Classification-Metal casting process, metal forming processes, metal joining processes, metal machining processes and metal finishing processes.	02
Unit: 2 Foundry Technology	2.1 Casting: Definition, Advantages and limitations, processes involved in casting 2.2 Patterns: Definition - types of patterns – solid piece – split piece – match plate – sweep– skeleton – segmental – pattern materials – pattern allowances. 2.3 Core making: Cores-core print-Gating System-Elements of gating system. 2.4 Moulding: Types of moulding sand – properties of moulding sand moulding tools – types of moulds – Green sand moulding-Pit moulding-Shell moulding – Machine moulding – Jolting – Squeezing – Sand slinging 2.5 Melting furnaces: Furnaces, construction and working of cupola furnace and electric arc furnace. 2.6 Special Casting: Shell mould casting – Investment casting – Die casting – Centrifugal casting – Continuous casting 2.7 Defects in casting: causes and remedies.	14
Unit: 3 Welding Technology	3.1 Arc Welding: Definition – arc welding equipment – electrode types – filler and flux materials – arc welding methods – Metal arc – Metal Inert gas (MIG) – Tungsten inert gas (TIG) - Submerged arc -Electro slag welding – Resistance welding – Spot welding – Seam welding – Plasma arc welding – Thermit welding – Electron beam welding – Laser beam welding – Friction welding– Ultrasonic welding. 3.2 Gas welding: Oxy-acetylene welding – advantages – limitations – gas welding equipment –three types of flames – welding techniques. 3.3 Soldering – brazing – difference between soldering and brazing. 3.4 Merits and demerits of welded joints. 3.5 Defects in welding – causes and remedies.	12
Unit: 4 Forming Technology	4.1 Forging: Hot working, cold working – advantages of hot working and cold working – forging operations, smith forging, drop forging, upset forging, press forging-forgeable materials-forgeability-forging temperature. 4.2 Rolling and Extrusion: Basic principles of rolling and extrusion, Hot and cold rolling, Types of rolling mills: 2 Hi, 3 Hi & 4 Hi mills, rolling defects, Hot and cold	8

	extrusion, Methods of extrusion: Direct, Indirect, Backward & impact Extrusion, Advantages, disadvantages & applications of rolling & extrusion.	
Unit: 5 Powder Metallurgy	5.1 Basic concept of powder metallurgy 5.2 Production of metal powders – atomization, reduction and electrolytic deposition –blending- compacting – sintering – finishing operation.	4
Unit: 6 Press & Press Working	6.1 Press Working: Types of presses – mechanical and hydraulic presses – press tools and accessories, 6.2 Press working operations: Cutting, bending, drawing, punching, banking, notching, lancing, piercing, coining and embossing.	5

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:

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:

- It may be submission of home assignment (at least three) 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 or present seminar on specific topic which is suitable for the given subject as per instruction of subject teacher as explained in 5.2 and 5.3.
- Students may conduct one of the following activities in group and prepare reports for their (student's) activity, also collect / record physical evidences for their (student's) portfolio which will be useful for their placement interviews.
- Visit an / a Industry / Workshop where processes like metal forming (forging / rolling / extrusion / press work) or machining (Lathe operations) or casting or welding are carried out. Collect information on types of machines in operation, their specifications; observe various activities performed and characteristic of output products.
- Collect information of recent advancement in manufacturing processes like metal forming or machining or casting (Machines / Tools / Equipments) and also collect their specification, manufacturer's name & application in industry.
- Collect information on present status and recent advancement in welding. Also collect information on process specific machines, accessories required and their applications in industry.
- Students may undertake one micro projects for their (student's) activity. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based, or field-based. The micro-project may be executed by the individual or by a group of students but the number of students in the group should not exceed five students. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it at the time of submission (ie. end of semester). The total duration of the micro-project should not be less than 16(sixteen) student engagement hours during the course.

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

- Prepare a cast product of different mechanical engineering drawing models with wax material.
- Prepare various types of welding joints (with metal components) for display and demonstration purposes.
- Prepare different types of keys (with metal components) for display and demonstration purpose.
- Prepare various types of patterns / core / core box etc. with suitable material.
- Prepare model or suitable chart of the drive mechanism generally being used in Lathe.
- Prepare working model of direct extrusion process for display and demonstration purposes.
- Prepare hammer forging working model for display and demonstration purposes.
- 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-least 1 from each group.	08	[5 x 8] = 40
B	3 & 4	08				B	3 & 4	04			
C	5 & 6	06				C	5 & 6	03			
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

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>



West Bengal State Council of Technical Education

(A statutory Body under West Bengal Act XXI 1995)

Name of the Course: Diploma in Mechanical Engineering (Production)	
Category: Programme Core	Semester: Third
Code no.: ME(P)PC209	Theory: 100 marks
Course Title: Heat Power Engineering - I	Examination Scheme: a) External Assessment: 60 marks (End Semester Examination) i) Internal Assessment: 40 marks [Class test: 20 marks Quizzes, assignment, viva voce: 10 marks Class attendance: 10 marks]
Duration: 17 weeks (Total hours per week = 3)	
Total Theoretical class/week: 3	
Credit: 3	
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both continuous assessment and end semester assessment separately.	

1. Course Outcomes (COs):

- i. Understand fundamental concepts of thermodynamic systems and different laws of thermodynamic.
- ii. Understand various properties of perfect gas.
- iii. Apply 1st law of thermodynamics on open system and on closed system containing ideal gas executing thermodynamic processes.
- iv. Understand the formation and properties of steam.
- v. Solve simple numerical on properties of steam by using steam table / Mollier chart.
- vi. Determine dryness fraction of steam
- vii. Understand the working of different types of boilers and necessity of boiler mountings & accessories.

2. Theory Components:

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

Unit	Topics & Sub-topics	Teaching Hour
UNIT 1: Basics of thermodynamics	1.1. Basic concept of thermodynamics. 1.2. Thermodynamic System, Boundary, Surrounding. Classification of thermodynamic system: open system, closed system and isolated system. 1.3. State of a thermodynamic system, change of state, path, thermodynamic process and cycle. 1.4. Thermodynamic properties of system (Intrinsic and Extrinsic properties) 1.5. Thermodynamic equilibrium of a system (mechanical, thermal and chemical equilibrium), thermodynamic cycle. 1.6. Zeroth law of thermodynamics and concept of temperature.	3
UNIT 2: Fundamental Laws of Thermodynamics	2.1 Heat and work: Concept of N.T.P, Energy- definition and units of transient energy (heat & work) and stored energy (PE, KE & IE), Point function & path function, Displacement work & flow work, P-dv work for different quasi-static processes, simple numerical. 2.2 First law of thermodynamics: Principle of energy conservation, Concept of perpetual motion machine of 1st kind, enthalpy, specific heat and latent heat, first law of thermodynamics for different processes, simple energy equation for non-flow process, steady flow energy equation and its application to various thermodynamic system like boiler, nozzle, turbine, compressor & condenser, limitations of First law of thermodynamics, simple numerical. 2.3 Second law of thermodynamics: Cyclic heat engine, Kelvin–Planck statement & Clausius statement, application of 2 nd laws to various thermodynamic system	14

	like heat engine, heat pump and refrigerator, thermal efficiency, coefficient of performance, concept of perpetual motion machine of 2 nd kind, concept and units of entropy, simple numerical.	
UNIT 3: Properties of Perfect Gas	<p>3.1 Concept of ideal gas & real gas.</p> <p>3.2 Laws of perfect gases such as Charle's law, Boyle's law, Gay-Lussac's law and Avogadro's hypothesis, equation of state ($PV = m RT$), characteristic gas constant and universal gas constant.</p> <p>3.3 Relation among two specific heats (C_p & C_v) with characteristic gas constant (R).</p> <p>3.4 Ideal thermodynamic processes of gas: governing equation of processes like constant pressure process, constant volume process, constant temperature process, adiabatic process & polytropic process, representation of all the above processes on p-V and T-s plane, deduction of work transfer, heat transfer, change in internal energy, change in enthalpy and change in entropy for each process.</p> <p>3.5 Simple numerical on above-mentioned perfect gas processes.</p>	8
UNIT 4: Properties of Steam	<p>4.1 Explanation of steam generation process with the help of p-V, T-s diagram.</p> <p>4.2 Basic terms and properties of steam such as saturation temperature, saturation pressure, saturated liquid, saturated steam (wet steam, dry saturated steam), superheated steam, critical point, triple point, dryness fraction, degree of superheat, degree of undercooling, enthalpy of steam, sensible heat, latent heat of vaporization, superheat, specific volume, entropy and internal energy of steam.</p> <p>4.3 The P-v, T-s and h-s diagram for a pure substance.</p> <p>4.4 Determination of dryness fraction of steam using (a) separating calorimeter, (b) throttling calorimeter, & (c) combined separating & throttling calorimeter.</p> <p>4.5 Steam table & its use, enthalpy- entropy (h-s) diagram of steam (Mollier chart) and its use.</p> <p>4.6 Vapour processes such as constant pressure processes, constant volume processes, constant entropy, constant temperature processes & constant enthalpy process and representation of the processes on p-V, T-s & h-s diagram.</p> <p>4.7 Comparison of gas & vapour.</p> <p>4.8 Simple numerical on steam properties only using steam table and Mollier diagram.</p>	12
UNIT 5: Boilers (Steam Generator)	<p>5.1 Definition and classification of boilers.</p> <p>5.2 Fire tube & water tube boilers with example, working principle, difference and applications.</p> <p>5.3 Construction & working principle of Cochran boiler, Lancashire boiler, Babcock and Wilcox boiler and La-Mont boiler.</p> <p>5.4 Definition of boiler mountings and accessories, Functions of boiler mountings and important accessories.</p> <p>5.5 Basic concept of stoker fired, fluidized bed and pulverized fuel boilers.</p> <p>5.6 Boiler performance and sources of heat loss.</p> <p>5.7 Boiler draught, classification and comparison of boiler draught and calculation of chimney height.</p> <p>5.8 Necessity of boiler feed water treatment.</p> <p>5.9 Concept of modern high-pressure boiler.</p> <p>5.10 Simple numerical on boiler performance and chimney heights calculation.</p>	8

3. Suggested Home Assignments/ Student Activities:

1. Draw P-V, T-S & H-S plane of steam and display saturated liquid line, dry saturated vapour line, wet saturated steam zone, critical point, triple point, superheated zone & under cooled liquid zone.
2. Draw P-V, T-S, H-S & P-T plane of steam and show constant pressure, constant temperature, constant volume & constant entropy line.

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	12	20	01	[20 x 1] = 20	A	1 & 2	05	Total Five questions are to be answered taking at least two from each group.	08	[5 x 8] = 40
B	3 & 4	13				B	3 & 4	05			
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

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	Engineering Thermodynamics	P K Nag	Tata McGraw Hill



West Bengal State Council of Technical Education

(A statutory Body under West Bengal Act XXI 1995)

Name of the Course: Diploma in Mechanical Engineering(Production)				
Course Title : Mechanical Engineering Drawing Practice (Same with Mechanical Engg.)		Semester : Third		
Category: Programme Core		Full Marks: 100		
Code no. : MEPC211		Sessional Examination Scheme:		
Duration : 17 weeks (4 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	
Total Practical class/week : 4		Internal Assessment		
		Submission of drawing sheets (in scheduled time)	40	60 marks
		Class performance & attendance	10	
Credit: 2	Viva voce (after submission of drawing sheets)	10		
		Total marks		100 marks
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.				
Pre requisite: <ul style="list-style-type: none">• Knowledge of Mechanical Engineering Drawing [Code No. – MEPC 201]				

1. Course Outcomes (COs):

The practical exposures related with this course are to be taught and implemented, so that the student will be able to demonstrate the following industry oriented COs.

- i) Draw the development of lateral surfaces of different truncated and frustum objects, such as tray, funnel, hopper, bend pipe, transition pieces, etc.
- ii) Draw the curves of intersection of commonly used two interpenetrating solids.
- iii) Exercise various drawing symbols, codes and conventions as per IS: SP-46.
- iv) Apply machining symbols and surface texture on production drawings.
- v) Draw the sectional views of various casting / machining components.
- vi) Draw assembly drawing and detailed drawings of various objects such as machine tool parts, machine components, power transmission elements, bearings, valves etc.

2. Suggested Assignments for Continuous Assessment:

Following assignments are to be attempted on A1 drawing sheets (to scale drawing by using requisite drawing instruments and following the First angle method of projection) for the attainment of COs of MEPC211:

Sheet No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hours required	Marks per sheet
Sheet No. -1 (containing at least five problems)	1a. Develop plain / single curved lateral surfaces of oblique solids like prisms and cylinders.	01	08	5

	1b. Develop plain / single curved lateral surfaces of oblique solids like pyramids and cones.			
Sheet No. -2 (containing at least five problems)	2a. Develop lateral surfaces of compound solids like funnel, tray, oil can, hopper, transition piece (square to circular).	01	08	5
Sheet No. -3 (containing at least 3 problems)	3a. Draw curves of intersection of two interpenetrating solids having plane surfaces (vertical square prism with horizontal square prism). 3b. Draw curves of intersection of two interpenetrating solids having single curved surface (vertical cylinder with horizontal cylinder). 3c. Draw curves of intersection of two interpenetrating solids having single curved surface (horizontal cylinder with vertical cone).	02	08	5
Sheet No. -4 (containing at least five problems)	4a. Draw different orthographic views from the given isometric view. 4b. Draw sectional front view, top view and side view from the given isometric view of machine component, castings etc. (using conventions of sections)	04	10	5
Sheet No. -5 (containing at least three problems) [Preferably shaft Coupling, C.I. Pulley and Knuckle joint]	5a. State the procedure for assembly from the given detailed drawing. 5b. Draw assembly drawing (sectional front view and side view) from the given detailed drawings of components including conventional representation of tolerances and surface finish symbols. 5c. Prepare Bill of materials. (See Annexure-5b: sample of industrial drawing).	05	12	10
Sheet No. -6 (containing at least three problems) [Preferably Knuckle joint, Socket & spigot type cotter joint and construction of tooth profile of a Spur Gear]	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. 6d. Construct the tooth profile of a spur gear from given module, pressure angle and number of teeth.	06	14	10
Sub Total: Practical Classes			60 hrs.	40 marks
Preparation for ESE			08 hrs.	
Grand total :			68 hrs.	

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

SI 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



West Bengal State Council of Technical Education
(A statutory Body under West Bengal Act XXI 1995)

Name of the Course: Diploma in Mechanical Engineering(Production)	
Category: Programme Core	Semester : Third
Code No. : MEPC 213	Total Marks : 100
Course Title : Materials Testing Lab (Same with Mechanical Engg.)	Examination Scheme: (i) Internal Assessment: 60 marks [Continuous assessment of class performance and in time submission of assignment : 30 marks Viva voce : 20 marks Class attendance : 10 marks] (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]
Duration : 17 weeks (2 hours per week)	
Total practical class /week : 2	
Credit : 1	
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.	
Pre requisite: <ul style="list-style-type: none">• Knowledge of Strength of Materials [Code No. – MEPC 205]• Knowledge of Mechanical Engineering Materials [Code No – MEPC 203]	

1. Course Outcomes:

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

CO1: Handle, maintain and operate different material testing machines.

CO2: Determine the various types of stress and plot the stress-strain diagram for mild steel specimen subjected to axial tensile load.

CO3: Determine the shear stress of given materials due to direct shear.

CO4: Determine the impact load of given materials.

CO5: Determine the hardness of given materials.

CO6: Determine the torsional shear stress of given materials subjected to torque.

CO7: Identify the external surface cracks in the test specimen by using Visual inspection and ring test, Die penetration test, and Magnetic particle test.

CO8: Determine the modulus of rigidity, strain energy, shear stress and stiffness of coil spring.

2. Suggested Assignments for Continuous Assessment: (Any Five)

Sl.No.	Practical Outcome (PrOs)	List of Practical
1.	a) Determine the mechanical properties (such as yield stress, ultimate stress, percentage elongation, Young's modulus) of common engineering materials. b) Interpret the failure patterns of common ductile metals under tensile force.	Tensile test on mild steel/ aluminum on UTM.

2.	Determine shear strength of common ductile material.	To determine shear strength of mild steel by Direct Shear Test on UTM.
3	a) Operate Izod impact testing machine, carry out experiment and take reading and interpret the result. b) Determine toughness of common ductile material.	To find out the resistance of a standard specimen of common engineering materials against impact load by Izod and Charpy test.
4.	a) Handle, maintain and demonstrate the sequential operations of the Brinell Hardness Tester. b) Determine hardness number of common engineering materials and validate.	To determine the hardness value of mild steel / aluminum by Brinell Hardness tester.
5.	a) Handle, maintain and demonstrate the sequential operations of the Rockwell Hardness Tester. b) Determine hardness number of common engineering materials and validate.	To determine the hardness value of mild steel / aluminum by Rockwell Hardness tester.
6.	a) Find out the relation between applied torque and corresponding angle of twist. b) Understand the relation between torque and angle of twist. b) Determine modulus of rigidity of a standard specimen of common engineering material and validate.	Torsion test on mild steel/ Aluminum bar.
7.	a) Learn the procedure for identifying the surface cracks on various engineering components depending on scope and availability. b) To distinguish between delicate surface crack and scratch on various engineering components.	To Detect the exterior surface cracks in the specimen using (i) Visual inspection and ring test, (ii) Die penetration test, (iii) Magnetic particle test.
8.	a) Determine the stiffness of coiled spring.	Determination of modulus of rigidity, strain energy, shear stress and stiffness by load deflection method (Closed coil helical spring)

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

SI No.	Performance Indicators	Weightage in %
1	Awareness about the significance of particular test	15

- iii. Gain practical concept about different types of fire tube and water tube boilers used in industries.
- iv. Get practical concepts regarding different types of boiler mounting and accessories.
- v. Get basic practical idea about a thermal power plant.

2. Suggested Assignments for Continuous Assessment: (At least Five Practical)

Sl. No.	Practical Outcome (PrOs)	List of Practical
1.	Can know the working principal of Bourden tube pressure gauge which are used in different industries including thermal power plant.	Observation of the working principle of Bourden tube pressure gauge
2.	Can get practical knowledge about the measurement of calorific value of a solid fuel.	Study and measurement of calorific value of solid fuel using Bomb Calorimeter.
3	Get practical concept about the process of steam formation and different properties of it	Measurement of Dryness Fraction of Steam by Dryness Fraction Measuring Instrument.
4.	Get the idea about the variation of enthalpy and entropy for different vapour processes.	Use of Mollier Chart by plotting different vapour processes on it.
5.	Get clear concept about the construction of Cochran Boiler and flow process of flue gas and water during working condition of the boiler.	Study of Cochran Boiler (fire tube boiler)
6.	Get knowledge about the construction of Lancashire Boiler and flow process of flue gas and water during working condition of the boiler.	Study of Lancashire Boilers (fire tube boiler)
7.	Get clear concept about the construction of Babcock and Wilcox Boiler and flow process of flue gas and water during working condition of the boiler.	Study of Babcock and Wilcox Boiler (water tube boiler)
8.	Get knowledge about the construction of La-Mont Boiler and flow process of flue gas and water during working condition of the boiler.	Study of La-Mont Boiler (water tube boiler)
9	Can know the actual construction and working principal of different boiler mounting and accessories.	Study the boiler mountings and accessories
10	Get overall knowledge about the layout of a power plant.	Study of schematic layout of Steam Power Plant

3. Rubrics for internal assessment of Heat Power Engg Lab (30 marks)

SI No.	Performance Indicators	Weightage in %
1	Awareness about the significance of particular test	15
2	Understanding working principle of machine	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

Reference Books:

Title of the Book	Name of the Author(s)	Name of the Publishers
Thermal Power Plant- Pre-Operational Activities	Dipak K. Sarkar	ELSEVIER
Power Plant Engineering.	R.K. Rajput	Laksmi Prakashani
Engineering Thermodynamics (Principles & Practices)	D.S.Kumar	S.K. Kataria & Sons
A text book of Thermal Engineering.	R. S. Khurmi	S. Chand & Co.
A Course in Thermal Engineering.	P. L. Ballaney	Khanna Publishers

**West Bengal State Council of Technical Education**

(A statutory Body under West Bengal Act XXI 1995)

Name of the Course: Diploma in Mechanical Engineering(Production)	
Category: Programme Core	Semester: Third
Code no.: ME(P)PC217	Total Marks: 100
Course Title: Industrial Production Technology-I Lab	Examination Scheme:
Duration : 17 weeks (4 hours per week)	(i) Internal Assessment: 60 Marks
Total practical class/week: 4	[Continuous assessment of class performance and in time submission of Assignments : 30 Marks Viva Voce : 20 Marks Class Attendance: 10 Marks]
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 [Code 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:

- Understand the fundamental concept of manufacturing and identify different manufacturing processes to be performed for the given job.
- Prepare products using different metal forming processes.
- Prepare products using different casting processes.
- Assess and apply different metal joining processes to produce jobs.
- Knowledge of different parts of Press working machines and produce jobs involving different press working operations.

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 basic manufacturing processes.
2. Understand the various methods of Smithy and forging.

3. Understand the various methods of casting.
4. Identify joining methods for fabrication.
5. Identify different Press machines.

Motor Skills:

1. Use smithy/forging equipment.
2. Use moulding machines.
3. Use different casting machines.
4. Use welding machines and equipment.
5. Operate different Press Machines
6. Knowledge of different Press working operations.

3. 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)	Unit No.	Hours (Min ^m .)
01	Practice on making a solid wooden pattern as per given drawing.	2	04
02	Practice on making a mould by using a solid or split pattern as per given drawing.	2	04
03	Study of different casting processes- die casting, centrifugal casting.	2	04
04	Study of different melting furnaces with special reference to Cupola.	2	02
05*	Study of different equipment of Electric Arc Welding set-up or gas welding set-up or electric resistance 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.	3	04*
06*	Practice on making welding joint (lap joint or butt joint or tee joint or corner joint) as per given drawing by utilizing available facilities of welding shop.	3	04
07	Practice on making a job on utility items like chain links, door rings, hooks etc. as per given drawing by utilizing smithy or forging shop's facilities.	3	04
08*	Study of different tools and machines generally used in Smithy or Forging Shop and practice on different basic Smithy or Forging operations such as Upsetting, Drawing down, Setting down, Necking, Cutting, Bending, Fullering, Swaging, Punching and Drifting etc.	3	04
09	Study of manufacturing components using Powder metallurgy techniques.	5	04
10	Study of different Press working machines	6	04
11*	Practice on different Press working operations- Blanking, Punching etc.	6	04*

Note:

- A suggested list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicious mix of minimum 06 or more practicals need to be performed out of which the practical marked as '*' are compulsory, so that the student reaches the desired level as generally required by the industry.

4. 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 comprise 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.

5. 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 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.

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



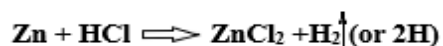
Name of the Course: Diploma in Mechanical Engineering(Production)	
Category: Summer Internship-I (4 weeks) after 2nd Semester (Same with Mechanical Engg.)	Semester: Third
Code no.: SI201	Total Marks: 100
Course Title: Summer Internship after 2nd Semester	Examination Scheme:
Duration : 4 weeks (After 2 nd semester)	Internal Assessment: 60 Marks
Total lecture/practical class/week: 0	[Continuous assessment of performance on internship and in time submission of Report : 30 Marks Viva Voce : 30 Marks]
Credit: 1	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 Physics, Chemistry, Mathematics, Engineering Mechanics and Computer Applications.	

Suggested Internship Project Work in 3rd Semester on Chemistry

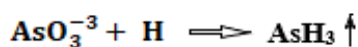
Project 1:

- **Title - Qualitative detection of Arsenic in water.**
- **Objective** – To detect the Arsenic from contaminated water.
- **Related Theory** - Arsenic in arsenite (AsO_3^{-3}) form is detected by adding zinc (Zn) granules and diluted acid (H_2SO_4 / HCl) to the contaminated water.
- **Reagents Required** – Zinc granules, Diluted H_2SO_4 / HCl acid.
- **Apparatus Required** – Conical or normal flask, Adaptor, Dropping funnel, $HgCl_2$ soaked paper.
- **Procedure** – The contaminated water is taken into a conical or normal flask and few pieces of zinc granules are added with it. Then a mouth adaptor is set at the top of the flask. To the top of the mouth adaptor, a dropping funnel is attached through which diluted acid is added to the water contaminated by arsenic. Finally, $HgCl_2$ soaked paper is introduced to the side tube of adapter as shown in the experimental set-up.

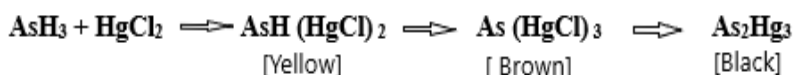
Now, chemical reaction is started due to addition of diluted acid and hydrogen gas is produced.



This hydrogen gas converts arsenite (presents in contaminated water) to gaseous arsine (AsH_3).

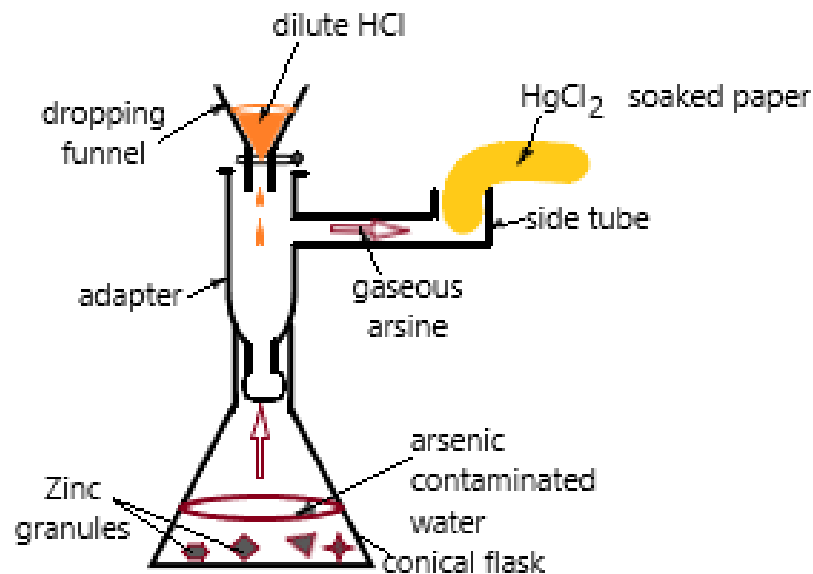


During escaping through side tube of adapter, gaseous arsine (AsH_3) comes in contact with the $HgCl_2$ soaked paper and changes colour to yellow, then to brown or black in course of time. Thus qualitative detection of arsenic in water is confirmed.



Gutzeit's test

➤ **Experimental Set-up**



Project 2:

➤ **Title - Determination of flash point, fire point of lubricants and its importance**

➤ **Objective** – To determine the Flash point and Fire point of a specified lubricant.

➤ **Related Theory** –The flammability of lubricants is indicated by this experiment. The greater the flammability lower will be the flash point.

➤ **Apparatus and consumables required -**

- A Pensky-Martens flash point apparatus.
- Thermometer of suitable range.
- Test samples e.g., Castrol active 4T 20w-40 Flash point (ASTM D93) 203°C

Introduction: Lubricants are used in machineries of different sectors in order to reduce wear & tear, loss of energy in the form of local heating, maintenance cost, sometime as a coolant and sealant. To select the proper lubricant for an operation we have to measure the various parameters of the lubricant. One of the important parameter of liquid & semi-solid lubricant is **flash point** and **fire point**.

What is flash point and fire point?

Flash point is the minimum temperature at which the liquid lubricant must be heated before its vapor state, when mixed with air will ignite momentarily if a tiny flame is brought in close proximity to it. Whereas **Fire point** is the temperature at which the vapor lubricant continues to burn for at least for 5 sec. under certain specified condition.

It is to be remembered that the flash point is not to be confused with the auto ignition temperature (AIT), which is the temperature at which the oil vapors will ignite spontaneously without an ignition source.

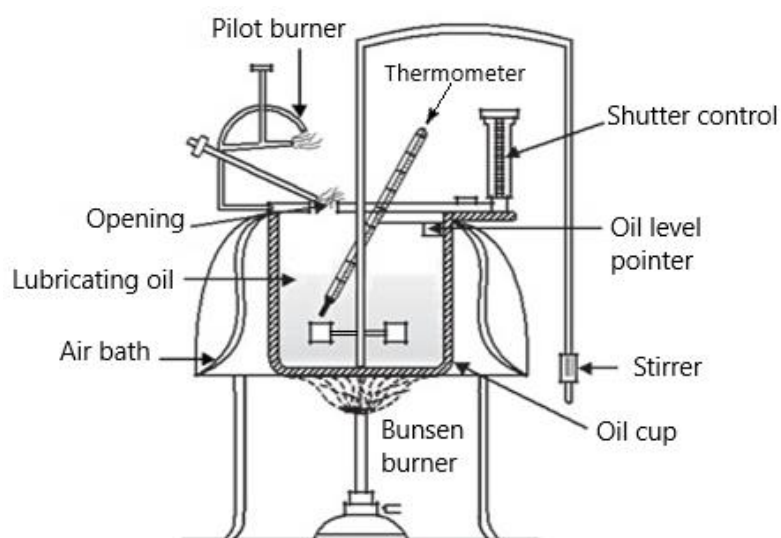
➤ **Procedure –**

These are determined either by *closed cup Pensky Martens apparatus (ASTM D 93)* or *Open cup Cleveland apparatus (ASTM D 92)*. The open cup flash point (temperature) value is usually a few degrees greater than the closed cup flash point. The former method gives more accurate result.

The experimental procedure for determination of flash & fire point by Pensky Martens apparatus involves the following steps:

1. At first, the oil cup is to be filled with the lubricating oil which is to be tested upto the mark.
2. Then top cover is to be fixed. The top cover itself comprises of the stirring device, the thermometer and the flame exposure device.
3. Now, the test flame is to be lighted and adjusted to about 4 mm in diameter.
4. Then the apparatus is to be heated by Bunsen burner slowly at the rate of 5° to 6°C per minute while the stirrer is to be rotated approximately 60 rpm.
5. At every 1°C rise in temperature, the test flame is introduced for about 2 seconds into the oil vapor. This is done by operating the shutter. By rotating the knob, the test flame is lowered and the shutter opens. The moment knob is released, the test flame springs back to its original position and the shutter is closed.
6. The flash point is to be noted when the test flame causes a flash in the interior of the cup. Same steps are to be repeated for three times to have a constant value or mean value.
7. Further, the test oil is to be heated at the rate of 1°C rises in temperature per minute and continued by applying the test flame as stated in point 5.
8. The temperature at which the vapor of the lubricant would give a clear and distinct blue flash sustained for at least five seconds is to be recorded as the fire point of the lubricant.

➤ **Experimental Set-up**



Pensky Marten's Flash Point apparatus

Observations:

Flash point of lubricant

Sl. No.	Flash Point ($^{\circ}\text{C}$)	Mean value of Flash Point
1		
2		
3		

Fire point of lubricant

Sl. No.	Fire point ($^{\circ}\text{C}$)	Mean value of Fire Point
1		
2		
3		

Importance of flash point & fire point:

It gives the idea about the maximum temperature below which the lubricant can be applied without fire hazards.

- It is used as the means of identification of specific lubricant.
- It gives the idea for safe transportation and storing of the lubricants.
- For detection of contamination in the lubricating oil.

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Suggested Internship Project Work in 3rd Semester on Engineering Mechanics

Title of the Project:

Determination of maximum efficiency and maximum mechanical advantage graphically of a given simple lifting machine.

Prerequisite:

1. Type and specification of simple lifting machine will be known to the students so that they can identify or calculate the velocity ratio of the machine.
2. Law of the same lifting machine has to be provided to the students by the concern guiding teacher.

Objective:

1. To determine the maximum efficiency and maximum velocity ratio of the given simple lifting machine graphically.
2. Comparison of the values of maximum efficiency and maximum velocity ratio as obtained in graphical method with the values of the same as obtained by analytical calculations.

Theory:

Theory of such project work should contain the following explanations:

1. Introduction.
2. Explanation of simple lifting machine.
3. Explanation of mechanical advantage of simple lifting machine and its significance.
4. Explanation of velocity ratio of simple lifting machine and its significance.
5. Explanation of efficiency of simple lifting machine and its significance.
6. Derivation of interrelation among efficiency, mechanical advantage and velocity ratio of simple lifting machine.
7. Explanation of law of simple lifting machine.
8. Derivation of maximum efficiency and maximum mechanical advantage from law of simple lifting machine.

Procedure:

1. Calculate or identify the velocity ratio of the given simple lifting machine.
2. Calculate maximum efficiency and maximum mechanical advantage of the given simple lifting machine analytically.
3. Prepare a wide set of values of effort applied and corresponding load lifted from given law of simple lifting machine and tabulate them in a suitable table.
4. Calculate efficiency and mechanical advantage for each set of effort applied and load lifted and tabulate them in the above mentioned table.
5. Plot the curve of efficiency verses load lifted in a suitable graph paper and identify the maximum efficiency from the plotted curve.
6. Plot the curve of mechanical advantage verses load lifted in a suitable graph paper and identify the maximum mechanical advantage from the plotted curve.
7. Compare the values of maximum efficiency and maximum mechanical advantage as obtained graphically with the values of the same obtained analytically.

Calculation:

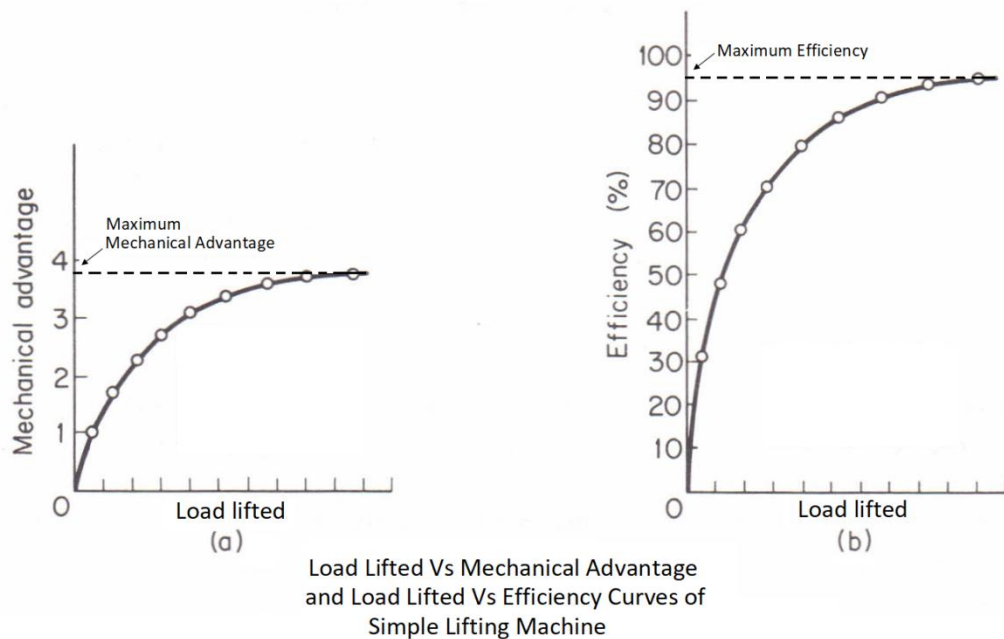
1. Calculate the velocity ratio of the given simple lifting machine.
2. Calculate maximum efficiency and maximum mechanical advantage of the given simple lifting machine analytically.
3. Assume effort applied and calculate corresponding load lifted by using given law of simple lifting machine.
4. Calculate mechanical advantage and efficiency for each set of effort applied and load lifted values.

Suggested Table:

Sl. No.	Effort Applied	Load Lifted	Velocity Ratio	Mechanical Advantage	Efficiency
01					

02					
03					
04					
05					
06					
07					
08					
09					
10					
11					
12					

Graph Plotting:



Result:

Parameters of Simple Lifting Machine	Graphically Obtained	Analytically Obtained
Maximum Mechanical Advantage		
Maximum Efficiency		

Conclusion:

Concluding statement with justification.

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