



Bharatiya Vidya Bhavan's
SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)
Munshi Nagar, Andheri (W) Mumbai – 400058



ENDSEM/RE - EXAMINATION JAN. 2024-25

Program: B.Tech Mechanical (Working Professional)

Duration: 3 hrs.

Course Code: PC-BTM305

Maximum Points: 100.

Course Name: Computer Aided Mechanical Drawing

Semester: III

Important Notes:

1. Question 1 is compulsory.
2. Attempt any three out of remaining five questions.
3. Create a new folder and rename it to <Reg. No. _ENDSEM>
4. Create separate .dwg file for each question and save in the above created folder only. File name should be <Q1_Reg. no.>.
5. Answers to free hand sketches should be drawn on given A4 answer sheet and submit is back.
6. Students to carry only Admit Card, Pen, Pencil, eraser and sharpener in Exam Hall. Use of scale and any geometric instrument is prohibited in Exam Hall.
7. At the end of exam, your folder with autocad and pdf files will be uploaded by the authorized person. Before leaving the exam seat, student have to confirm that his/her folder is uploaded by the authorized person.
8. Assume suitable data wherever only if necessary.
9. Save your Work in AutoCad Regularly.

Q. No.		Points	MO/CO	BL	PI
Q.1	Given in the figure is the details of Spigot and Socket Joint. Complete the following tasks:		03/--	03	5.1.2
	a) Draw detail drawing of each part in 2d.	07	01		
	b) Make one copy of each part and assemble the parts at their functional positions where u can see Sectional Front View of Assembly in 2d.	06	03		
	c) Create a Bill of Material and plot a pdf file of the assembly.	04	04		
	d) Draw Free Hand Sketches of the following:		02/	01	1.4.1
	i. BSW Thread.	04	02		
	ii. ACME Thread.	04			



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Q.2	A vertical cone, base 80 mm side and axis 100 mm is resting on its base on the H.P. A horizontal cylinder, diameter 35 mm, having its axis parallel to both the V.P. and H.P. penetrates the cone. The axis of both the solids intersects each other at right angle and cylinder axis is 30 mm above the cone base.		01/--	03	5.1.2
	a) Create <u>3d models</u> of the Cone and Cylinder.	06	01		
	b) Create a copy of <u>3d models</u> of the cone - cylinder and assemble them as described in problem statement.	05	03		
	c) Plot the projections (F.V., T.V., and S.V.) of the assembly in showing curves of intersections.	06	04		
	d) Draw Free Hand Sketches of the following: 1. Square Neck Stud. 2. Hexagonal Headed Bolt	04 04	02/ 02	01	1.4.1
Q.3	Given in the figure is the Details of Standard Flange Coupling. Complete the following tasks.		04/--	03	5.1.2
	a) Create the Parts with <u>3d modeling</u> .	07	01		
	b) Make one copy of each part and assemble the parts at their functional positions	04	03		
	c) Plot drawings of Front View (Upper Half in section) and Side View of Assembly.	04			
	d) Create a Bill of Material and plot a pdf file of the assembly with given CAMD Exam layout.	05	04		
	d) Draw Free Hand Sketches of the following: 1. Gib Headed Key	05	04/ 02	01	1.4.1



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Q.4	Given in the figure is the Details of Foot Step Bearing. Complete the following tasks.		05/--	03	5.1.2
	a) Create the part drawing of all parts in 2d space.	10	01		
	b) Assemble the parts at their functional positions where u can see Sectional Front View of Assembly in 2d layout	05	03		
	c) Create Bill of Material and Plot a PDF.	05	04		
	d) Calculate the limits for Ø25 H7, g6	05	02/ 02	01	1.4.1
Q.5	Given in the figure is the Expansion Valve Assembly.		06/--	03	5.1.2
	a) Plot the 2d detail drawing for: Body: i) Sectional Front View ii) Side View	8 7	01 01		
	b) Plot the 2d detail drawing for: Neck Bush: i) Sectional Front View ii) Side View	5 5	03 04		
Q.6	Given in the figure is the Drill Jig Assembly.		07/--	03	5.1.2
	a) Plot the 2d detail drawing for Jig Plate: i) Sectional Front View ii) Side View Top View	08 07	03 04		
	b) Plot the 2d detail drawing for Latch Washer: i) Sectional Front View ii) Side View Top view	05 05	03 04		



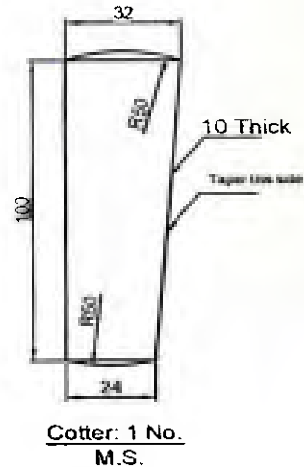
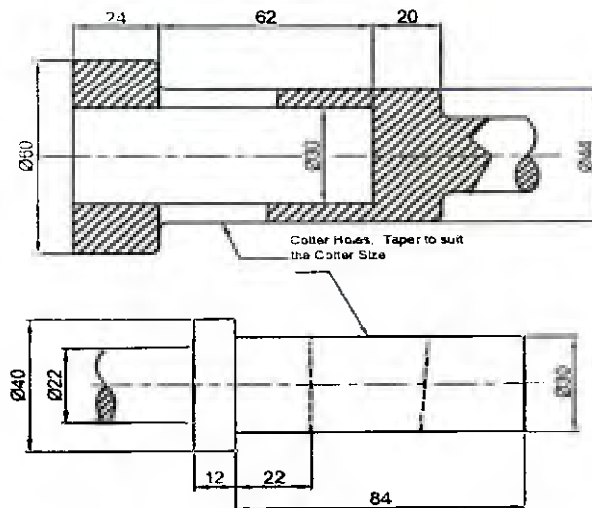
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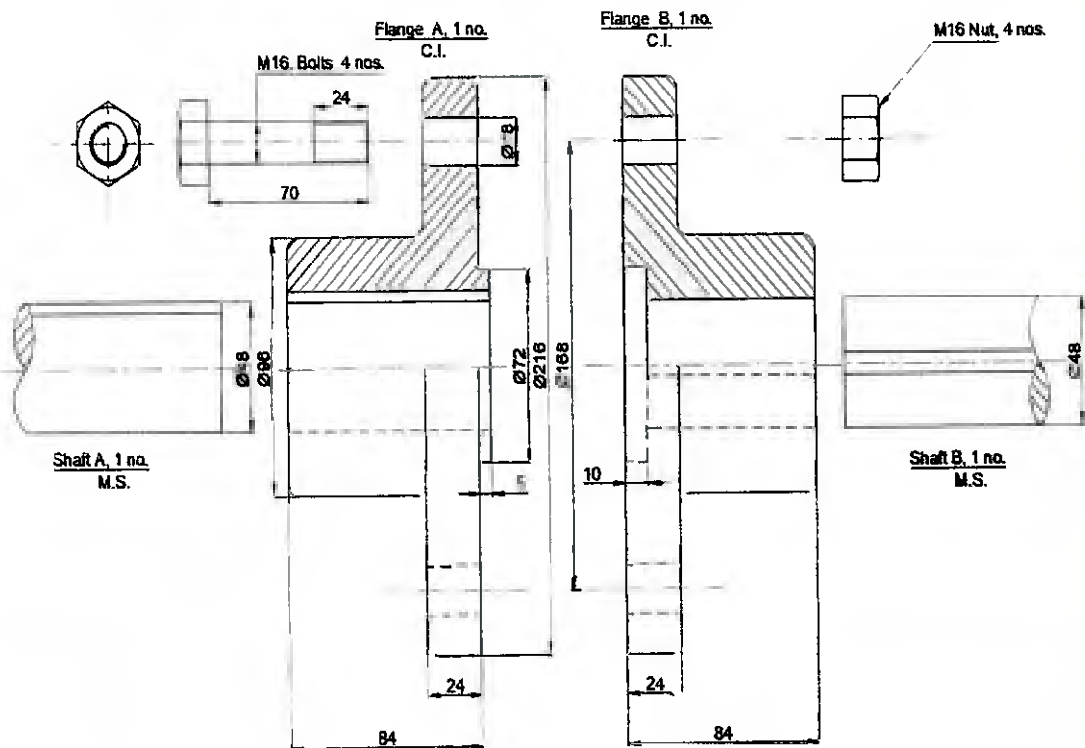
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Socket End: 1 No.
C.I.



Spigot End: 1 No.
C.I.

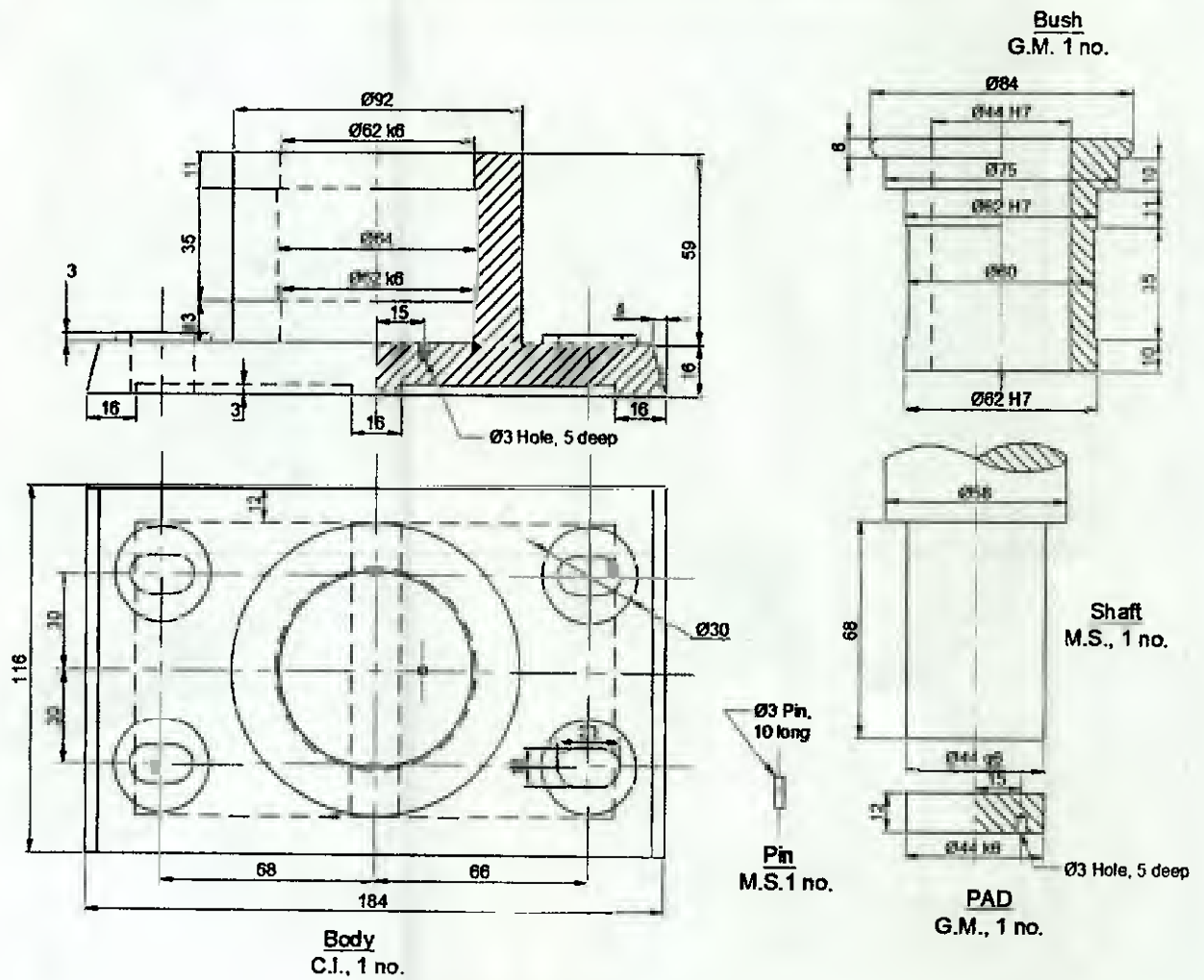
Q.1. Spigot and Socket Joint



Q.3. Standard Flange Coupling



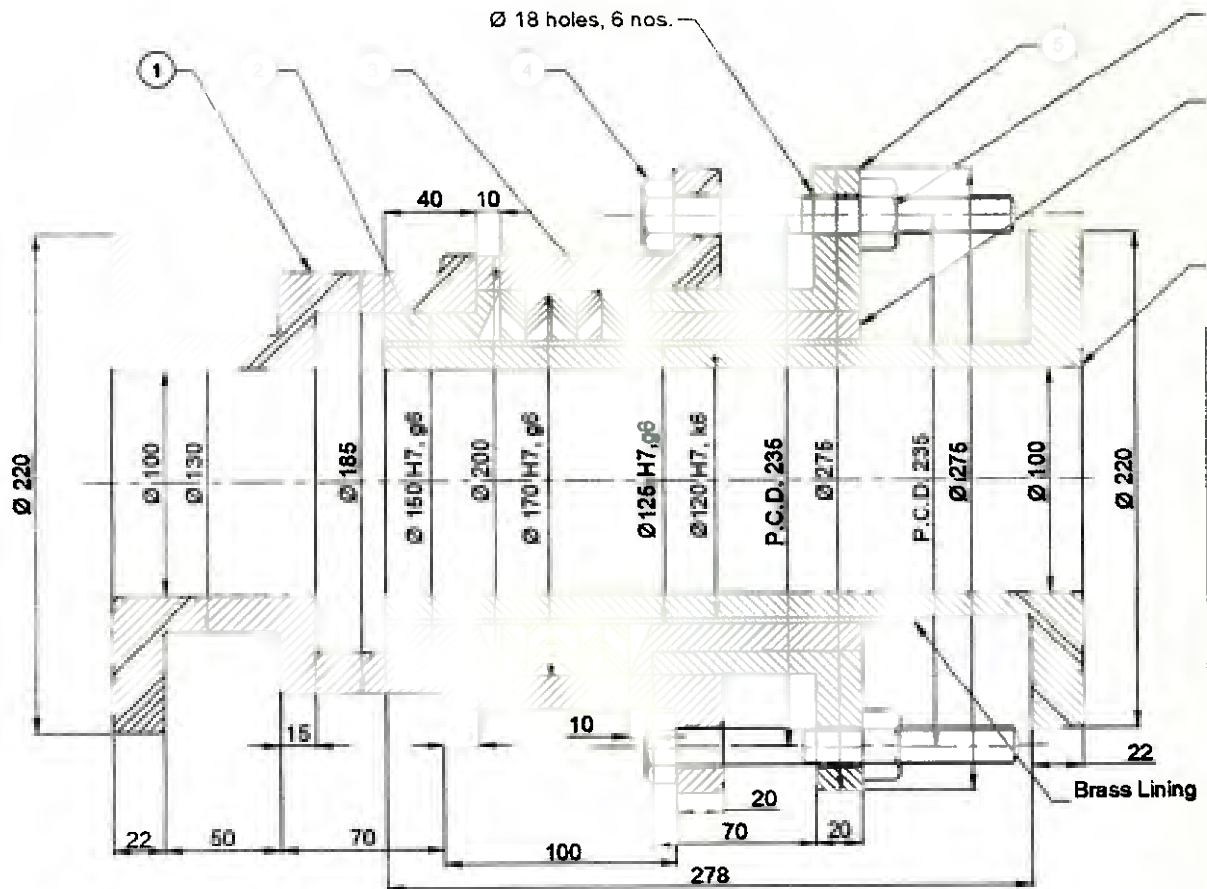
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Q.4. Foot Step Bearing



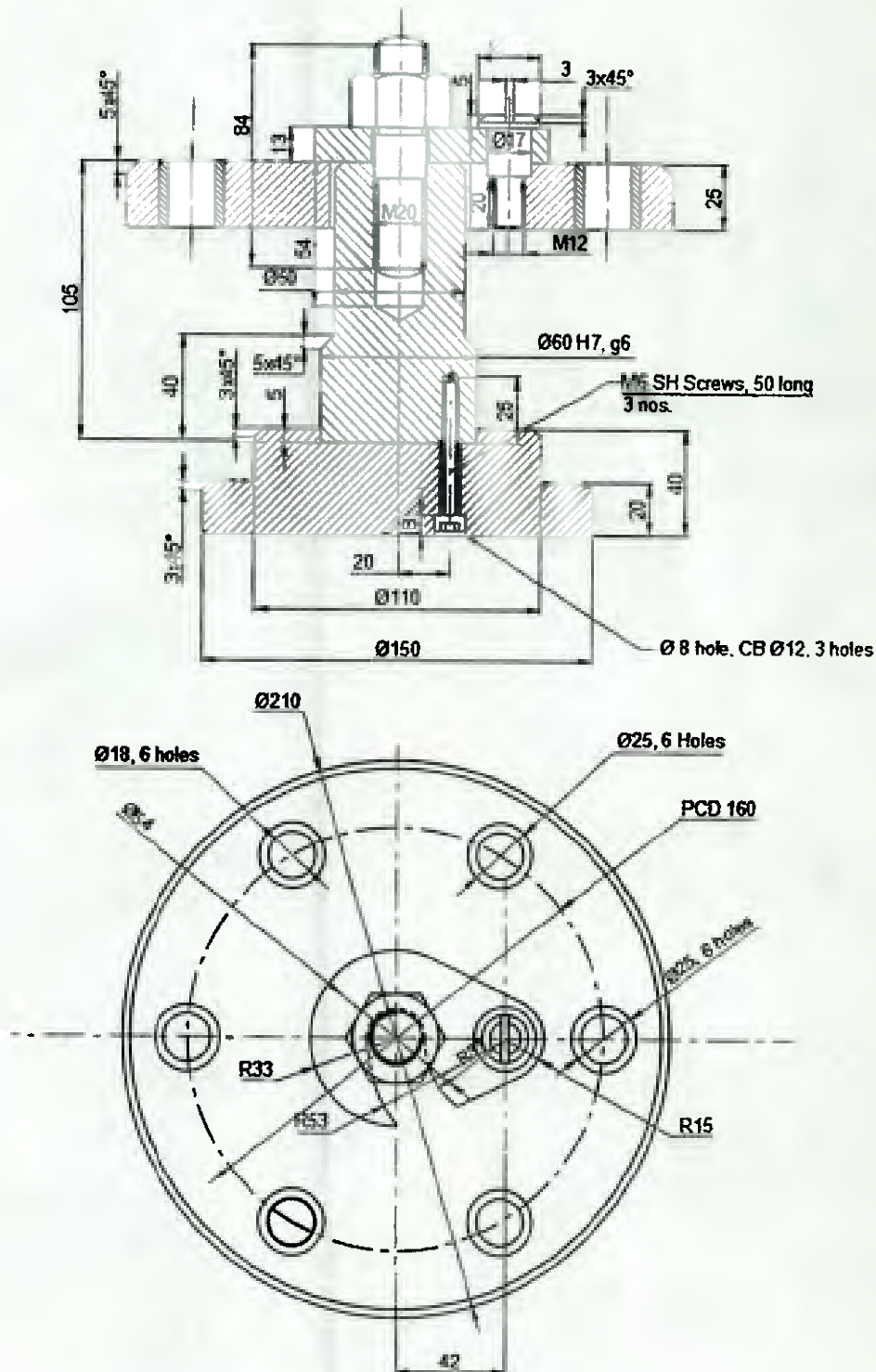
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Q.5. Expansion Joint



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Q.6. Drill Jig Assembly



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Limits, Tolerance Tables

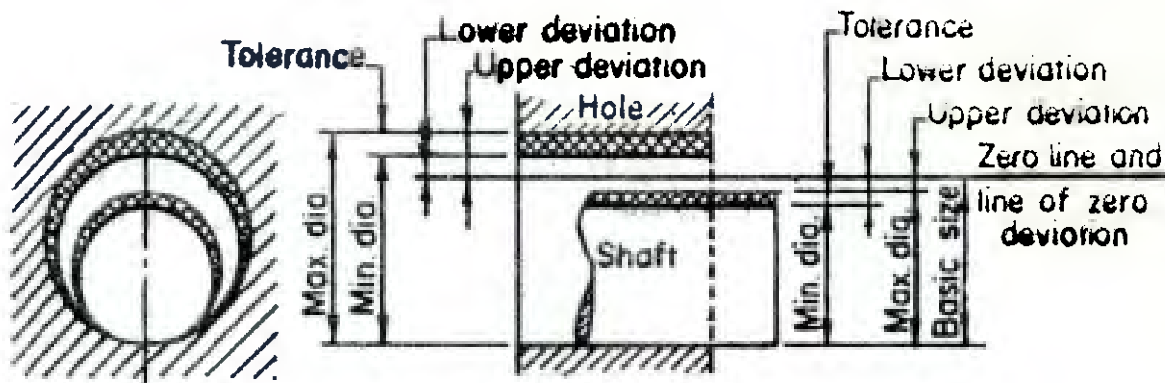


Table 1 Recommended diameter steps upto 500 mm (13 steps)

Over	-	3	6	10	18	30	50	80	120	180	250	315	400
Upto	3	6	10	18	30	50	80	120	180	250	315	400	500

Table 2 Equations to calculate fundamental deviation of shaft size up to 500 mm (D = Geometrical mean dia. in mm)

Symbol	Fundamental deviation in microns	Symbol	Fundamental deviation in microns
d	$-16D^{0.44}$	js	$\pm (IT/2)$
e	$-11D^{0.41}$	k4 to k7	$+0.63D^{1/2}$
f	$-5.5D^{0.41}$	m	$+(IT7 - IT6)$
g	$-2.5D^{0.34}$	n	$+5D^{0.34}$
h	0	p	$+(IT7 + 0 \text{ to } 5)$

Table 3 Fundamental Tolerance for IT grades in terms of i.

IT Grade	IT5	IT6	IT7	IT8	IT9	IT10	IT11	IT12	IT13	IT14	IT15	IT16
Tolerance in Microns	7i	10i	16i	25i	40i	64i	100i	160i	250i	400i	640i	1000i



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END SEM/RE-EXAM EXAMINATION DEC/JAN 2024-25

Program: Mechanical Engineering Working professional Duration: 03 Hrs.

Course Code: PC-BTM303

Maximum Points: 100

Course Name: Material and Manufacturing Science

Semester: III

Notes:

1. Question no 1 is compulsory
2. Attempt any four questions from the remaining six questions.
3. If necessary assume suitable data with justification
4. Draw neatly labeled sketches wherever required.

Q. No.	Questions	Points	CO	BL	Module No.
1A	A 320-mm-wide strip 35 mm thick is fed through a rolling mill with two powered rolls each of radius 250 mm. The work thickness is to be reduced to 32 mm in one pass at a roll speed of 50 rev/min. The work material has a flow curve defined by $K = 272$ MPa and $n = 0.14$, and the coefficient of friction between the rolls and the work is assumed to be 0.12. Determine if the friction is sufficient to permit the rolling operation to be accomplished. If so, calculate the roll force, torque, and horsepower.	10	2	3	7
1B	Draw the Fe-C equilibrium diagram and accurately label the compositions, critical temperatures, and phases. Identify and write the equations for the three key invariant reactions observed in the Fe-C equilibrium diagram. Evaluate the amount of product phases for each of these reactions at equilibrium using the lever rule.	10	3	4,5	1
2A	Explain the gas atomization process used in powder metallurgy. Analyze the key factors affecting the particle size and shape of the powders produced, and discuss their influence on the properties of the final product.	06	4	2	5
2B	A cylindrical workpiece is subjected to a cold upset forging operation. The starting piece is 88 mm in height and 50 mm in diameter. It is reduced in the operation to a height of 42mm. The work material has a flow curve defined by $K = 350$ MPa and $n = 0.17$. Assume a coefficient of friction of 0.1. Determine the force as the process begins, at intermediate heights of 68 mm, 52 mm, and at the final height of 42mm. (initial strain is 0.002)	06	1,2	3	7
2C	Derive an equation for the critical radius of a solid ball essential for solidification growth, supported by a labeled diagram. Analyze the role of Gibbs free energy in the phase transformation from liquid to solid, and explain its significance during the nucleation process.	8	3	4	1



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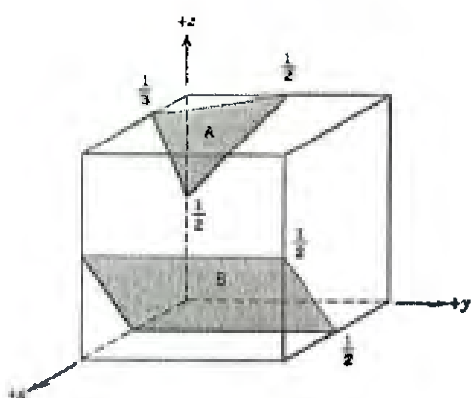
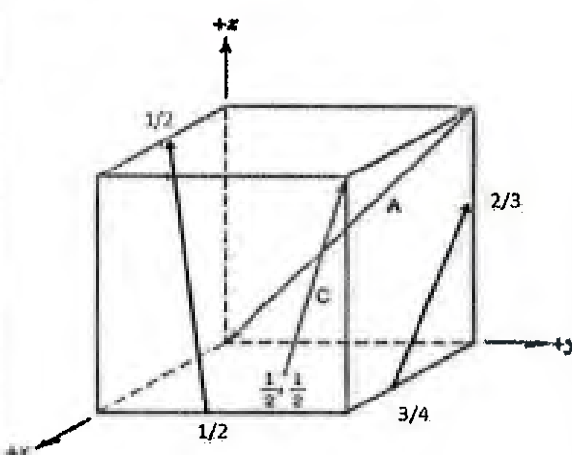
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END SEM/RE-EXAM EXAMINATION DEC/JAN 2024-25

3 A	Determine the Miller indices for the directions and the planes shown in the following unit cell:[Note: provide the stepwise calculations for the given problem]  	10(6 +4)	3	5	1
3B	What is stainless steel? Classify the different types of stainless steel. Analyze the characteristics of martensitic stainless steel.	05	1	4	3
3C	Explain the austempering process in detail. Identify and describe the product formed during the austempering process. Illustrate your explanation with a labeled TTT diagram.	05	4,3	4	2
4A	Discuss each case of the heat treatment process of Fe-0.65% C eutectoid steel rapidly cooled from a preheated temperature of 860°C (>727°C) as follows [NOTE: Analyze the resulting microstructures, evaluate the properties of the final product, and justify the suitability of each process.] 1. Rapidly cool to 500°C and hold for 10³ s, quench to room temperature. 2. Rapidly cool to 190°C, hold for 10³ s and quench to room temperature; 3. Rapidly cool to 450 °C, hold for 10s, rapidly cool to 180 °C hold for 10⁴ s, quench to room temperature;	10	4	4	2



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4B	The tool life equation for HSS tool is $VT^{0.14} f^{0.7} d^{0.4} = \text{Constant}$. The tool life (T) of 35 min is obtained using the following cutting conditions: $V = 42 \text{ m/min}$, $f = 0.42 \text{ mm}$, $d = 2.0 \text{ mm}$. If speed (V), feed (f) and depth of cut (d) are increased individually by 35%, calculate the tool life (in min).	05	4	3	6
4C	Explain the plasma spheroidization process in the context of powder metallurgy. Describe how it enhances the characteristics of powder particles and its significance in improving the properties of sintered components.	05	2	3	5
5A	Different alloy steel compositions are provided below. Analyze the given compositions, and based on the presence of the alloying elements, write the expected properties of each alloy steel. 1. C: 0.6%, Cr: 14.5%, Mo: 0.8%, V: 0.2% 2. C: 0.15 to 1.2%, Mn: 1%, Si: 1%, Cr: 11.5 to 18% 3. C: 0.35%, Ni: 2.5%, Mn: 1%, Pb: 0.3%	06	4	4	03
5B	Define nanomaterials and elaborate on the top-down and bottom-up approaches used in their synthesis. Write any two applications of nanomaterials.	06	4	4	4
5C	Apply your understanding of case hardening to explain its purpose and process. Analyze the following case hardening techniques by describing the elements added, their characterization, and applications: 1. Carbonitriding 2. Boronizing 3. Flame Hardening	08	3,4	4,5	2
6A	Classify composites based on the matrix material and explain the characteristics of each category. Provide a detailed explanation of metal matrix composites and carbon matrix composites, including their properties, applications, and operating temperature ranges.	08	4	4	4



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6B	Apply your knowledge of material compositions to write the chemical composition of the following materials. Analyze their properties and suggest suitable engineering applications for each: 1. Muntz Metal 2. Admiralty gun-metal 3. Nickel Gun Metal	06	3,4	3	3
6C	Analyze a manufacturing scenario where a metal's mechanical properties need to be enhanced after forming. Apply your understanding to explain the roles of cold working, warm working, and hot working in metal forming	06	4	3	7
7A	Mild steel is being machined at a cutting speed of 205 m/min with a tool rake angle of 10° . The width of cut and uncut chip thickness are 2 mm and 0.2mm, respectively. If the average value of coefficient of friction between the tool and chip is 0.5 and the shear stress of the work material is 385N/mm ² . Determine: cutting and thrust components of machining force. Assume $2\Phi + \lambda - \alpha = (\pi/2)$.	06	2,3	4	6
7B	Explain the importance of particle size and powder flowability in the additive manufacturing process, focusing on their role in ensuring consistent material deposition and final part quality. Discuss how variations in particle size directly influence powder flowability and the properties of the final product.	07	1,4	3	5
7C	The following data from an orthogonal cutting test is available Rake angle = 17° , Chip thickness ratio(cutting ratio) = 0.383, Uncut chip thickness = 0.8 mm, Width of cut= 4 mm, Yield stress of material in shear = 285 N/mm ² , Average coefficient of friction on the tool face = 0.75. Determine the normal and tangential forces on the tool face	07	1,3	4,5	6



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End Semester/Re-examination 2024-25

Program: S.Y.B.Tech_WP (Mechanical) *Sum III*

Duration: 3 Hours

Course Code: ES-BTM301

Maximum Points: 100

Course Name: Linear Algebra and Vector Calculus

Semester: III

6/1/25

Note:

1. Attempt Any Five Questions
2. Answers to the sub questions should be grouped together

	Questions	Points	CO	BL	Module
1	a Test the consistency of the following system of linear equations and if possible, solve $\begin{aligned} 2x + 3y - z - 2 &= 0 \\ x + 2y + z + 3 &= 0 \\ 3x + y - 2z - 1 &= 0 \end{aligned}$	6	4	BL5	4
	b Find the sum and product of Eigen values of A^{-1}, where $A = \begin{bmatrix} 3 & 1 & 6 & 8 \\ 0 & 2 & 5 & 7 \\ 0 & 0 & 5 & 3 \\ 0 & 0 & 0 & -1 \end{bmatrix}$	6	4	BL5	4
	c Find Fourier Series of $f(x) = \left[\frac{\pi - x}{2} \right]^2$, $x \in [0, 2\pi]$	8	1	BL3	1
2	a Find Eigen Values and Eigen Vectors of the following matrix $A = \begin{bmatrix} 3 & 4 \\ 4 & -3 \end{bmatrix}$	6	4	BL5	5
	b Find the unit normal vector to the surface $x^2y + 2xz^2 = 8$ at $(1, 0, 2)$	6	3	BL2	3
	c Reduce the following matrix to normal form and hence find its rank.	8	4	BL3	4



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End Semester/Re-examination 2024-25

		$A = \begin{bmatrix} 2 & 1 & 4 & -1 \\ 1 & 2 & 1 & 3 \\ 4 & 5 & -1 & 2 \\ 8 & 7 & 7 & 1 \end{bmatrix}$				
3	a	Obtain Half Range Fourier Cosine Series of $f(x) = Lx - x^2$, $x \in [0, L]$	6	3	BL4	3
	b	Find the Directional Derivative of $\phi = xy^2 + yz^3$ at $(1, -1, 1)$ in the direction of normal to the surface $x^2 + y^2 + z^2 = 9$ at $(1, 2, 2)$	6	1	BL5	2
	c	Verify Cayley Hamilton Theorem for the following matrix and find A^{-1} , if it exists $A = \begin{bmatrix} 0 & c & -b \\ -c & 0 & a \\ b & -a & 0 \end{bmatrix}$	8	4	BL5	5
4	a	Determine constants a, b and c if $A = \frac{1}{3} \begin{bmatrix} 1 & 2 & a \\ 2 & 1 & b \\ 2 & -2 & c \end{bmatrix}$ is orthogonal.	6	4	BL5	4
	b	Find the angle between the surfaces $x^2 + y^2 + z^2 = 9$ and $z = x^2 + y^2 - 3$ at $(2, 1, 2)$	6	2	BL3	1
	c	Obtain Fourier Series expansion of $f(x) = 4 - x^2$, $x \in [0, 2]$	8	1	BL3	2
5	a	Find Fourier Series of $f(x) = x + x^2$, $x \in [-\pi, \pi]$	6	1	BL4, 5	2
	b	Find constants a, b and c if $\vec{f} = (axy + bz^3)\hat{i} + (3x^2 - cz)\hat{j} + (3xz^2 - y)\hat{k}$ is irrotational	6	3	BL4	3
	c	Verify Stoke's Theorem for $\vec{f} = (x^2 + y^2)\hat{i} - 2xy\hat{j}$ taken around the rectangle bounded by the lines $x = -a, x = a, y = 0, y = b$	8	1	BL2 BL4	1



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End Semester/Re-examination 2024-25

6	a	Using Green's Theorem, Evaluate $\oint_C [(3x+4y)dx + (2x-3y)dy]$ where C is the circle $x^2 + y^2 = 9$	6	1	BL5	2	
	b	Find Fourier Series of $f(x) = x^2$, $x \in [-L, L]$	6	1	BL3	1	
	c	For the following matrix A , find two non-singular matrices P and Q such that PAQ is in the normal form. $A = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 2 & 1 & 4 & 3 \\ 3 & 0 & 5 & -10 \end{bmatrix}$	8	4	BL3 BL5	4	
7	a	Evaluate $\int_C \bar{f} \cdot d\bar{r}$ where $\bar{f} = x^2\hat{i} + 2xy\hat{j}$ and C is the arc of the curve $y = x^2$ from $(0,0)$ to $(1,1)$	5	3	BL2 BL3	3	
	b	Obtain Half Range Fourier Sine Series of $f(x) = \cos x$, $x \in [0, \pi]$	5	1	BL5	2	
	c	Find Eigen Values and Eigen Vectors of the following matrix $A = \begin{bmatrix} 2 & 1 & 1 \\ 2 & 3 & 2 \\ 3 & 3 & 4 \end{bmatrix}$	10	4	BL1 BL3	5	

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**End Semester Examination January 2025 (R23)**Program: S.Y. Mechanical Engineering (Working Professional)

Duration: 3 Hour

Course Code: VE- BTM001

Maximum Points: 50

Course Name: Health Safety and Sustainable Environment

Semester: 3

1011125

- Notes: 1. Solve any FIVE main questions.
2. Draw neat schematic diagrams wherever is necessary, highlight important points.
3. Assume suitable data if necessary and mention it.

Q. No.	Questions	Pt	CO	BL	M
Q1 A	Give definition 1 and 2 of occupational health and safety in details?	5	2	1	1
B	Write a short note on cycle of neglect? Draw neat schematic sketch for safety engineer's knowledge base as Primary elements and as Secondary elements?	5	2	2	1
Q2 A	Explain scientific definition of the following; Safety, Risk, Accident, Incident and Hazard?	5	4	2	3
B	What is risk perception factor? Give an example of expressing risk in qualitative and quantitative form? Draw neat sketch of typical safety domain ontology for any case study?	5	4	1	3
Q3 A	Draw Hazard triangle and Peterson accident causation model?	5	1	3	2
B	A stamping machine used in automobile industry is found to have the following risk: process risk score of 0.15, technology risk score of 0.45, physical environment risk score of 0.12, human resource risk score of 0.25, residual risk associated with the system is 0.03. Calculate system risk? Write a short note OHSAS 18001 and its PDCA tool?	5	2	1	2
Q4 A	Draw neat sketch Up-Down (Function) approach applied to a system using failure mode and effect analysis (FMEA) technique? Draw its worksheet?	5	1	2	4
B	Give all steps involved in implementation PHL hazard analysis techniques?	5	2	2	4
Q5 A	List down benefits and commitment to be followed by the participating parties in RAMSAR convention for wetland conservation?	5	3	2	7
B	Give functions and values offered by wetlands?	5	4	1	7
Q6 A	Give classification of waste according to different criteria's?	5	3	1	6

**End Semester Examination January 2025 (R23)**

B	Give different ways by which we can dispose waste more effectively? Also how to reduce different types of waste generation?	5	3	1	6
Q7	Write a short note on cut set method?	5	2	3	5
A	Explain MOCUS type approach to obtain cut set? (Stepwise answer expected)				
B	Quantify the top event failure probability for given fault tree. Show all calculations and formulae in detailed?	5	2	3	5

Damage to Reactor due to high temp T T - Top Event

AND

No flow from quench tank G1

Reactor inlet valve remain open G2

OR

Quench tank empty B1 10^{-4}

OR

Quench tank valve does not open G3

AND

Alarm fails to alert operator B3 10^{-3}

Temp. Sensor fails to detect temp rise B4 10^{-3}

OR

Operator fails to close inlet valve G4

OR

Inlet valve fail to close B2 10^{-4}

OR

Alarm fails to alert operator B5 10^{-2}

OR

Operator fails to obey alarm & close inlet valve B6 10^{-2}



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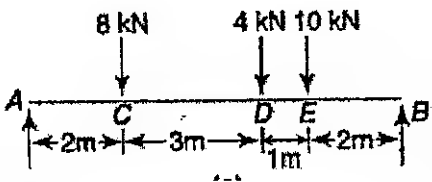
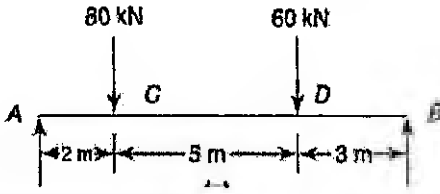
WP_END-SEM/Re/ EXAMINATIONS Jan 2025/Feb 2025

Program : BTech Mechanical engg *S. Y. C. M.* Duration : 3 hr
Course Code : PC-BTM304 *Sc III* Maximum Points : 100
Course Name : Strength of Materials.
Semester : III
Instruction : Refer below

13/1/25

1. Question No. 1 is compulsory
2. Solve any four out of remaining six.
3. Answers to each sub-questions are grouped together
4. Use of scientific calculator is allowed
5. Begin answer to each question on new page.
6. Keep some margin on left side of answer paper
7. **Candidates should write the answer legibly**

Q. no.	Description	Pts	CO	BL
1	a) What do you mean by pure bending? Explain the concept with suitable diagram. b) Derive the relationship between the bending moment, shearing force, and intensity of loading of a laterally loaded beam. c) The ratio of maximum shear stress to average shear stress in beams of rectangular cross section is 1.5; prove it. d) What do you mean by thin and thick cylinder? Derive expression for hoop and longitudinal stresses in thin cylinder.	5 5 5 5	1,2 3	2,3
2	a) The state of a stress on two mutually perpendicular planes is, $\sigma_{xx} = -60$ MPa, $\sigma_{yy} = 90$ MPa, $\tau_{xy} = 30$ MPa. Determine the magnitudes of the principal stresses and their orientations, maximum shear stress, normal stress on the plane of max. shear stress. Also find the state of a stress on plane making 25° with 'x' plane in clock-wise direction. b) Represent the state of a stress above with the help of Mohr's circle.	15 5	3	2,3
3	A 6 meter long simply supported beam carries a point load of 15 kN load at the right end and uniformly distributed load of 15 kN/m over the entire span. The two supports are 4 meter apart, the left hand support being at the left end. Calculate and draw the SFD, BMD and key points on it.	20	2	
4	An I-section beam of 280 mm x 120 mm having flange thickness 8 mm and web thickness of 4 mm is subjected to shear force of 150 kN. Determine the maximum and minimum shear stress in the web. Also calculate shear stress in the flange.	20	2	3,4

5	a) Calculate the maximum bending stress induced for beam (as shown in figure) having cross section 80mm deep and 35 mm wide. b) What is section modulus? How does it influence bending stress?		15	2	3,4
6	a) A cylindrical shell, 1000 mm in diameter, thickness of metal 10 mm and 3.0 m long, is subjected to internal pressure of 1.8 MPa. Calculate the change in diameter, length and volume of shell under pressure. Use thin cylinder theory. $E = 210 \text{ GPa}$, Poisson's ratio = 0.25. b) A circular shaft transmits 36 kW at 600 rpm. It is supported in bearings 6 meters apart and at 2 meters from one bearing, it carries a rotor exerting a transverse load of 12 kN on the shaft. Determine a suitable diameter for the shaft taking into account both bending and torsional stresses if the maximum shear stress is not to exceed 48 MPa.		10	2	3,4
7	Find the slope and deflection under each load and maximum deflection. $E = 200 \text{ GPa}$, $I = 150 \times 10^6 \text{ mm}^4$		20	4	3



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WORKING PROFESSIONALS END SEM / RE-EXAMINATION A.Y. 2024-25

Program: B.Tech. Mechanical

Duration: 3 Hour

Course Code: PCC-BTM302

Maximum Points: 100

Course Name: Thermodynamics

Semester: III

Notes:

- 1) Solve: Any FIVE Questions.
- 2) Answers must be **SPECIFIC** and in **LEGIBLE** handwriting.
- 3) Draw neat system diagram/s and process diagrams wherever necessary.
- 4) Use **Steam tables** and **Mollier Chart** provided by **Examination section**, if required.
- 5) Illustrate your answers with suitable examples as and where necessary.
- 6) Assume suitable data wherever necessary and state the same.

Q. No.	Question	Points	CO	BL	Modul
1.	a) Explain: the concept of thermodynamic work with an illustrative example. Derive: Expression for displacement work transfer in an isentropic process. Draw: neat system diagram and process diagram wherever necessary.	10	1	II, III, VI	1
	b) Explain: PMM1 and its converse. Draw: Neat sketches. A fluid, contained in a horizontal cylinder fitted with a frictionless leakproof piston, is continuously agitated by means of a stirrer passing through the cylinder. The cylinder diameter is 0.40 m. During the stirring process lasting 10 minutes, the piston slowly moves out by 0.485 m against the atmosphere. The net work done by the fluid during the process is 2 kJ. The speed of the electric motor driving the stirrer is 840 rpm. Evaluate: i) Torque in the shaft and ii) output power of the motor. Draw: Neat system diagram,	10	1, 2	II, III, VI	1, 2
2.	a) Derive: General form of steady flow energy equation for a control volume. Draw: Neat system diagram. Using the general form of steady flow energy equation, Derive: Steady flow energy equation for nozzle. State: Assumptions made and Draw: neat system diagram.	10	1, 2	I, III, IV,	2
	b) Steam expands isentropically in a nozzle from 1 MPa, 250°C to 10 kPa. The mass flow rate of steam is 1 kg/s. Neglecting the K.E. of	10	1, 2	III, VI	2, 5



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	steam at inlet to the nozzle, Evaluate: i) Velocity of steam at exit from the nozzle, ii) the exit area of the nozzle. Draw: Neat T-s and h-s diagram for the process.				
3.	a) Explain: Kelvin-Planck statement and Clausius statement of second law of thermodynamics. Draw: Neat block diagrams for each statement. Illustrate: One practical example of a device / cycle which operates following each statement.	10	1, 2	II, III	3
	b) Explain: Principles of working of Refrigerator and heat pump. Draw: neat block diagram of each. Justify: $CoP_{HP} = CoP_R + 1$.	10	1, 2	I, VI	3, 7
4.	a) Explain: Working of an ideal Reheat cycle for steam power plant. Draw: Neat i) system diagram, ii) T-s and h-s diagrams and Derive: Expression for efficiency of the cycle.	10	2, 3	III, IV	5
	b) 1 kg of ice at -5°C is converted to superheated steam at 250°C . The pressure during this conversion process is constant at 1 atm. Identify and Explain: Stages/steps of this entire conversion process. Draw: T-s diagram for the entire process showing each stage of the entire process, without the saturated solid, liquid and vapor curves. Evaluate: i) Change in entropy for each stage of the conversion process Refer the following data: c_p of ice = 2.093 kJ/kg.K , latent heat of fusion of ice, $h_{sf} = 336.96 \text{ kJ/kg}$, c_p of water = 4.187 kJ/kg.K , latent heat of vaporization of water, $h_{fg} = 2257 \text{ kJ/kg}$, c_p of steam = 2.093 kJ/kg.K .	10	2, 3	II, VI	4, 5
5.	a) Explain: i) Subcooled liquid ii) Wet steam and dryness fraction iii) Superheated steam. Illustrate: Each state on a p-V and T-s diagram. Justify: For wet steam of unit mass with dryness fraction x , $v = v_f + x \cdot v_{fg}$.	8	2, 3	II, III, VI	5
	b) A steam power plant works on an ideal Rankine cycle. Steam turbine receives the steam at 15 bar and 350°C and is exhausted to condenser at 0.06 bar. Evaluate: Thermal efficiency of the plant. Draw: Neat i) system diagram, ii) T-s and h-s diagram for the cycle.	12	4	I, V	5
6.	a) Explain: Working of an air standard Otto cycle for petrol engine. Draw: Neat p-V and T-s diagrams. Justify: Air standard efficiency	8	2, 3	II, III, V	6



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	of an Otto cycle is independent of temperature and pressure in the engine cycle with necessary derivation.				
	b) An engine is operating on the air standard Otto cycle. The conditions at the start of the compression are 27°C and 100 kPa. The heat added is 1840 kJ/kg. The compression ratio is 8. Determine: i) The temperature and pressure at each point in the cycle, ii) Thermal efficiency and iii) mean effective pressure.	12	4	VI	6
7.	Write short notes on ANY THREE of the following. Draw: Neat system and process diagrams wherever necessary.	20	1, 2	II	
	a) Joule's Experiment				2
	b) Thermodynamic systems and thermodynamic equilibrium				1
	c) Diesel and dual cycle				6
	d) Vapor Compression Refrigeration cycle				7
	e) Fuel cells				7



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ENDSEM/RE - EXAMINATION JAN. 2024-25

Program: B.Tech Mechanical (Working Professional)

Duration: 3 hrs.

Course Code: PC-BTM305

Maximum Points: 100.

Course Name: Computer Aided Mechanical Drawing

Semester: III

Important Notes:

1. Question 1 is compulsory.
2. Attempt any three out of remaining five questions.
3. Create a new folder and rename it to <Reg. No. _ENDSEM>
4. Create separate .dwg file for each question and save in the above created folder only. File name should be <Q1_Reg. no.>.
5. Answers to free hand sketches should be drawn on given A4 answer sheet and submit is back.
6. Students to carry only Admit Card, Pen, Pencil, eraser and sharpener in Exam Hall. Use of scale and any geometric instrument is prohibited in Exam Hall.
7. At the end of exam, your folder with autocad and pdf files will be uploaded by the authorized person. Before leaving the exam seat, student have to confirm that his/her folder is uploaded by the authorized person.
8. Assume suitable data wherever only if necessary.
9. Save your Work in AutoCad Regularly.

Q. No.		Points	MO/ CO	BL	PI
Q.1	Given in the figure is the details of Knuckle Joint. Complete the following tasks: a) Draw detail drawing of each part in 2d. b) Make one copy of each part and assemble the parts at their functional positions where u can see Sectional Front View of Assembly in 2d. c) Create a Bill of Material and plot a pdf file of the assembly.	07 06 04	01 03 04	03	5.1.2
	d) Draw Free Hand Sketches of the following: i. BSW Thread. ii. ACME Thread.	04 04	02/ 02	01	1.4.1

**ENGINEERING - EXAMINATION JAN. 2024-25**

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Q.2	A vertical cone, base 80 mm side and axis 100 mm is resting on its base on the H.P. A horizontal square prism, side 35 mm, having its axis parallel to both the V.P. and H.P. and sides equally inclined to V.P. penetrates the cone. The axis of both the solids intersects each other at right angle and prism axis is 25 mm above the cone base.	06	01	01/--	03	5.1.2
	a) Create 3d models of the Cone and Prism. b) Create a copy of 3d models of the cone - prism and assemble them as described in problem statement. c) Plot the projections (F.V., T.V., and S.V.) of the assembly in showing curves of intersections.	05	03			
	d) Draw Free Hand Sketches of the following: 1. Round Neck Stud. 2. Hexagonal Nut	06	04			
		04	02	02/	01	1.4.1
		04				
Q.3	Given in the figure is the Details of Protected Flange Coupling. Complete the following tasks.			04/--	03	5.1.2
	a) Create the Parts with ^{2d} 3d modeling.	07	01			
	b) Make one copy of each part and assemble the parts at their functional positions	04	03			
	c) Plot drawings of Front View (Upper Half in section) and Side View of Assembly.	04				
	d) Create a Bill of Material and plot a pdf file of the assembly with given CAMD Exam layout.	05	04			
	d) Draw Free Hand Sketches of the following: 1. Gib Headed Key	05	04/	04/	01	1.4.1
			02			



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Q.4	Given in the figure is the Details of Foot Step Bearing. Complete the following tasks.		05/--	03	5.1.2
	a) Create the part drawing of all parts in 2d space.	10	01		
	b) Assemble the parts at their functional positions where u can see Front View (Right Half in Section) of Assembly in 2d layout	05	03		
		05	04		
	c) Create Bill of Material and Plot a PDF.				
	d) Calculate the limits for Ø25 H7, g6	05	02/ 02	01	1.4.1
Q.5	Given in the figure is the Expansion Valve Assembly.		06/--	03	5.1.2
	a) Plot the 2d detail drawing for: Body: i) Sectional Front View	8	01		
	ii) Side View	7	01		
	b) Plot the 2d detail drawing for: Neck Bush: i) Sectional Front View	5	03		
	ii) Side View	5	04		
Q.6	Given in the figure is the Drill Jig Assembly.		07/--	03	5.1.2
	a) Plot the 2d detail drawing for Jig Plate:				
	i) Sectional Front View	08	03		
	ii) Side View Top View	07	04		
	b) Plot the 2d detail drawing for Latch Washer:				
	i) Sectional Front View	05	03		
	ii) Side View Top View	05	04		

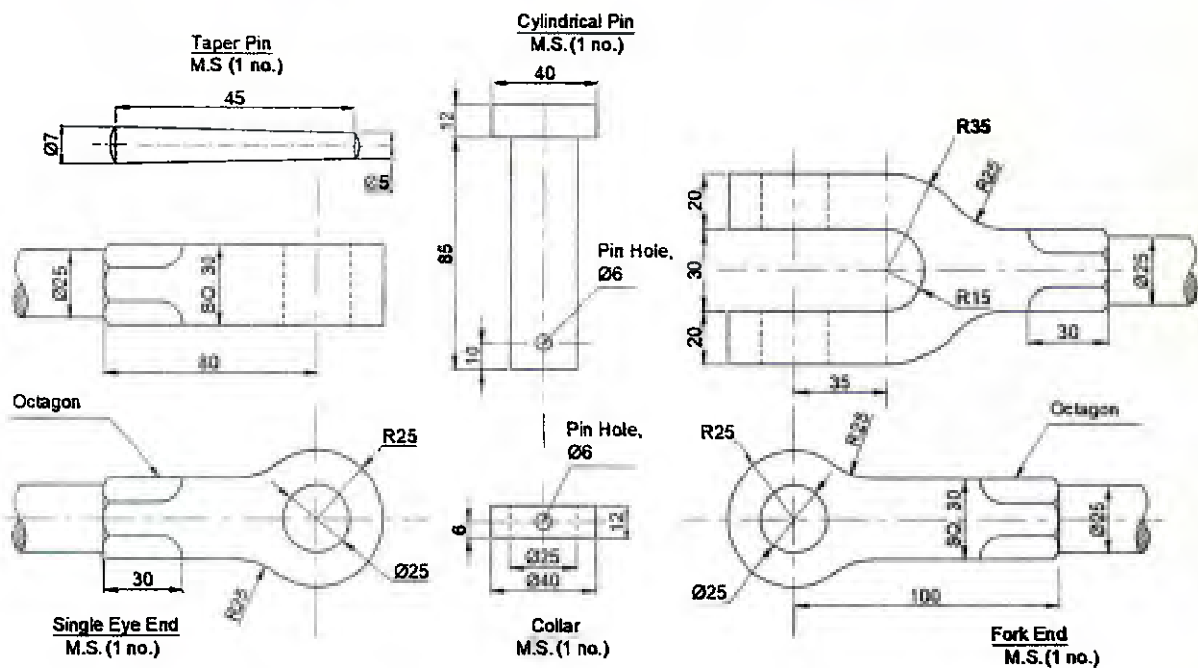


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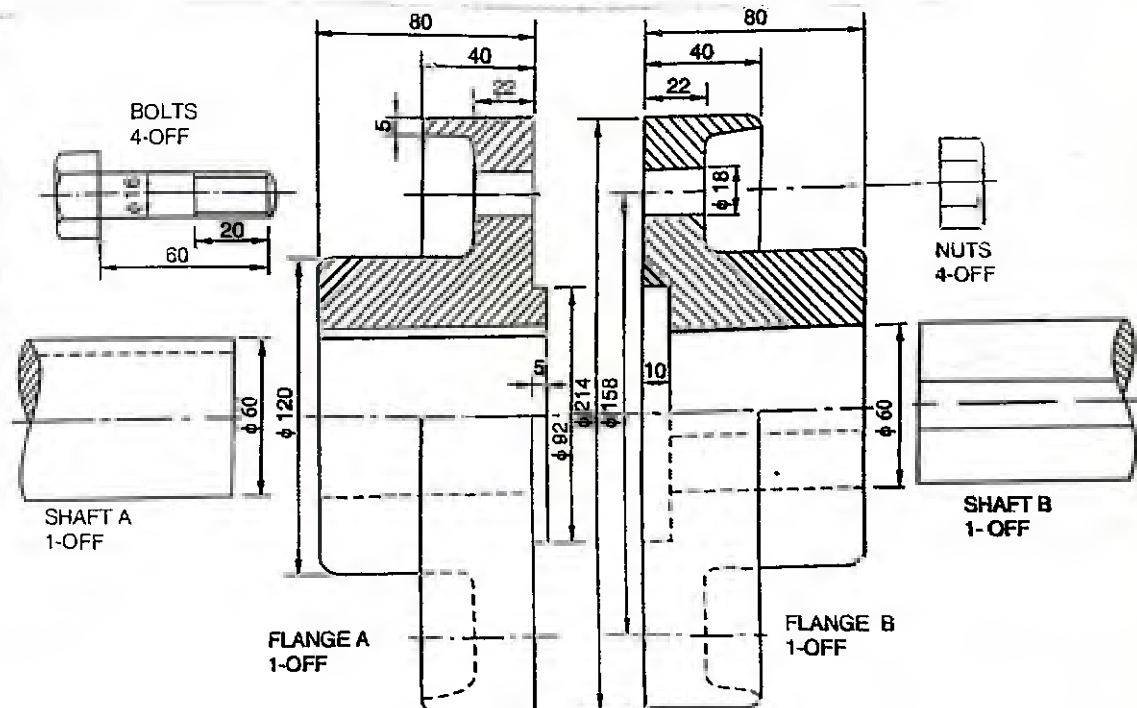
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Q.1. Knuckle Joint



Q.3. Standard Flange Coupling

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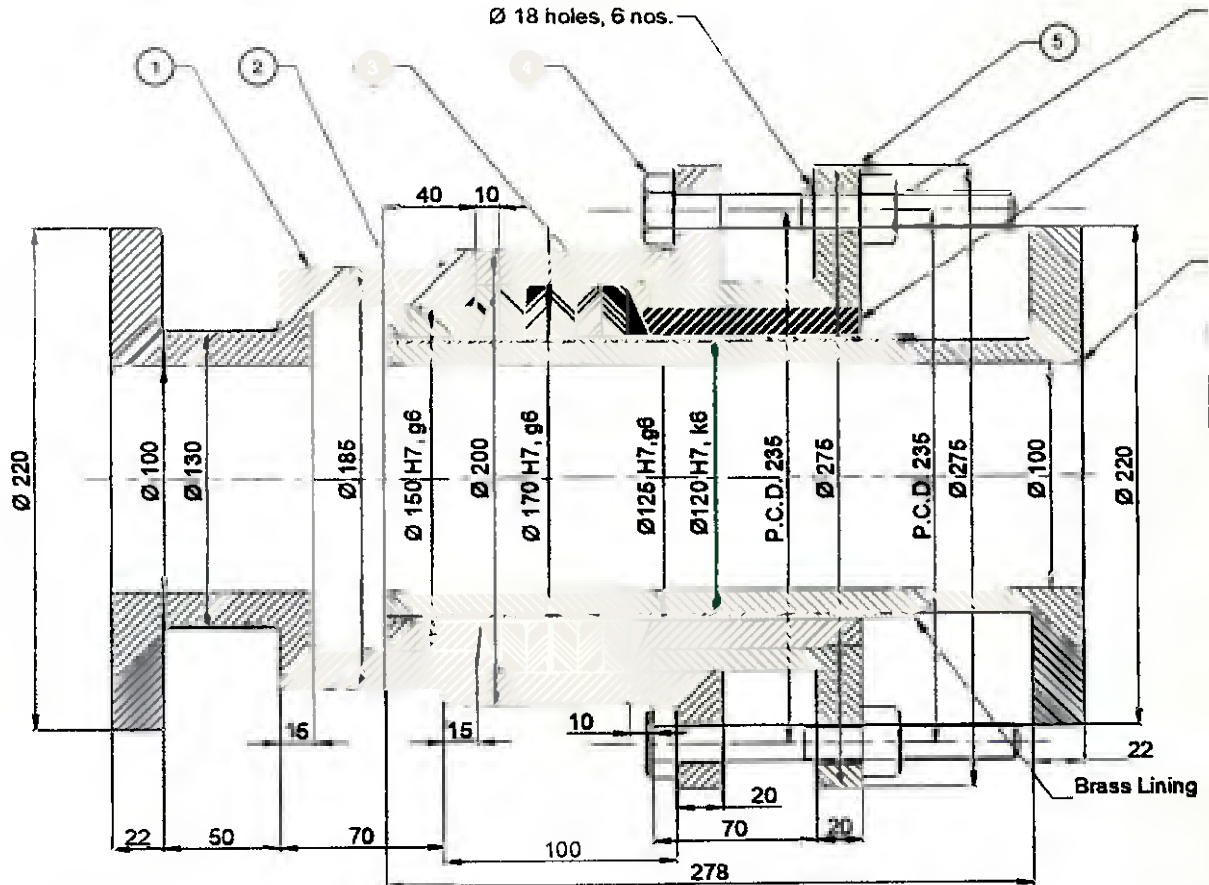


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Q.5. Expansion Joint



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Limits, Tolerance Tables

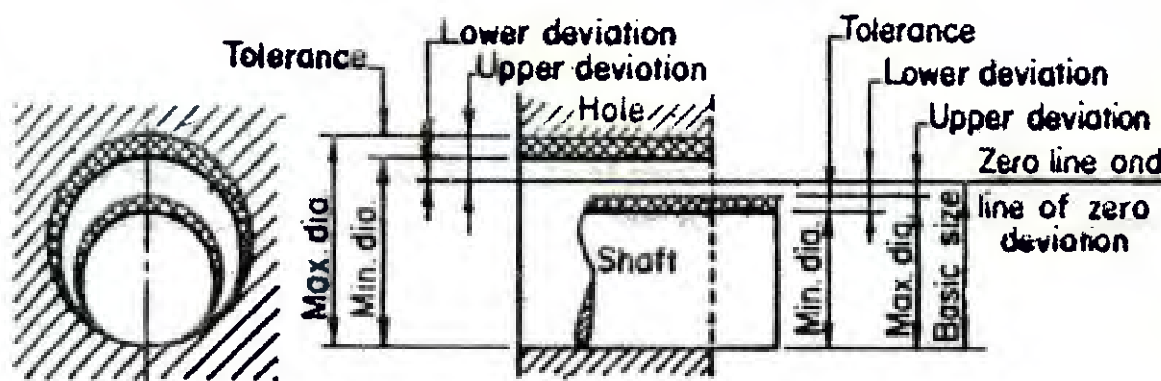


Table 1 Recommended diameter steps upto 500 mm (13 steps)

Over	-	3	6	10	18	30	50	80	120	180	250	315	400
Upto	3	6	10	18	30	50	80	120	180	250	315	400	500

Table 2 Equations to calculate fundamental deviation of shaft size up to 500 mm (D = Geometrical mean dia. in mm)

Symbol	Fundamental deviation in microns	Symbol	Fundamental deviation in microns
d	$-16D^{0.44}$	js	$\pm (IT/2)$
e	$-11D^{0.41}$	k4 to k7	$+0.63D^{1/2}$
f	$-5.5D^{0.41}$	m	$+(IT7 - IT6)$
g	$-2.5D^{0.34}$	n	$+5D^{0.34}$
h	0	p	$+(IT7 + 0 \text{ to } 5)$

Table 3 Fundamental Tolerance for IT grades in terms of i.

IT Grade	IT5	IT6	IT7	IT8	IT9	IT10	IT11	IT12	IT13	IT14	IT15	IT16
Tolerance in Microns	7i	10i	16i	25i	40i	64i	100i	160i	250i	400i	640i	1000i



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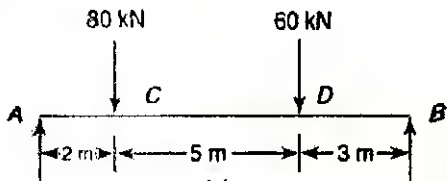
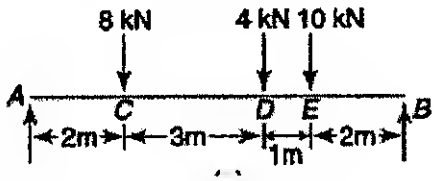
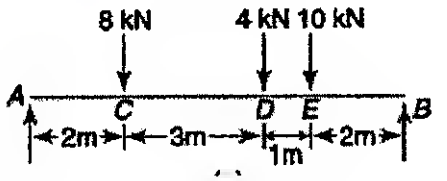


WP_~~END SEM~~/Re/ EXAMINATIONS /~~Jan 2025~~/ Feb 2025

Program : BTech Mechanical engg *Sumit* **Duration** : 3 hr
Course Code : PC-BTM304 **Maximum Points** : 100
Course Name : Strength of Materials.
Semester : III
Instruction : Refer below

1. Question No. 1 is compulsory
2. Solve any four out of remaining six.
3. Answers to each sub-questions are grouped together
4. Use of scientific calculator is allowed
5. Begin answer to each question on new page.
6. Keep some margin on left side of answer paper
7. **Candidates should write the answer legibly**

Q. no.	Description	Pts	CO	BL
1	a) Draw Stress-Strain diagram for mild steel and show key features on it. b) Derive the relationship between the bending moment, shearing force, and intensity of loading of a laterally loaded beam. c) The ratio of maximum shear stress to average shear stress in beams of rectangular cross section is 1.5; prove it. d) What do you mean by thin and thick cylinder? Derive expression for hoop and longitudinal stresses in thin cylinder.	5 5 5 5	1,2 ,3	2,3
2	a) The state of a stress on two mutually perpendicular planes is, $\sigma_{xx} = 50$ MPa, $\sigma_{yy} = -10$ MPa, $\tau_{xy} = 40$ MPa. Determine the magnitudes of the principal stresses and their orientations. Calculate maximum shear stress and normal stress on the plane of max. shear stress. Also find the state of a stress on plane making 40° with 'x' plane in clock-wise direction. (Solve analytically). b) Represent the state of a stress above with the help of Mohr's circle.	15 5	3	2,3
3	A 5 meter long simply supported beam carries a point load of 15 kN load at the right end and uniformly distributed load of 10 kN/m over the entire span. The two supports are 4 meter apart, the left hand support being at the left end. Calculate and draw the SFD, BMD and key points on it.	20	2	
4	An I-section beam of 150 mm x 80 mm having flange thickness 6 mm and web thickness of 4 mm is subjected to shear force of 80 kN. Determine the maximum and minimum shear stress in the web and in the flange.	20	2	3,4

5	a) Calculate the maximum bending stress induced for beam (as shown in figure) having cross section 80mm deep and 35 mm wide. b) What is section modulus? How does it influence bending stress?		15	2	3,4
6	a) A cylindrical shell, 1200 mm in diameter, thickness of metal 12 mm and 2.8 m long, is subjected to internal pressure of 2.0 MPa. Calculate the change in diameter, length and volume of shell under pressure. Use thin cylinder theory. $E = 200 \text{ GPa}$, Poisson's ratio = 0.27. b) A circular shaft transmits 20 kW at 600 rpm. It is supported in bearings 4 meters apart and at 1 meters from one bearing it carries a rotor exerting a transverse load of 10 kN on the shaft. Determine a suitable diameter for the shaft taking into account both bending and torsional stresses if the maximum shear stress is not to exceed 32 MPa.		10	2	3,4
7	Find the slope and deflection at point C (8kN load). $E = 200 \text{ GPa}$, $I = 150 \times 10^6 \text{ mm}^4$		20	4	3



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END SEM/RE-EXAM EXAMINATION DEC/JAN 2024-25

Feb 2025

Program: Mechanical Engineering Working professional **Duration:** 03 Hrs.

Course Code: PC-BTM303

Maximum Points: 100

Course Name: Material and Manufacturing Science

Semester: III

Notes:

1. Question no 1 is compulsory
2. Attempt any four questions from the remaining six questions.
3. If necessary assume suitable data with justification
4. Draw neatly labeled sketches wherever required.

Q. No.	Questions	Points	CO	BL	Module No.
1A	Draw the Fe-C equilibrium diagram and accurately label the compositions, critical temperatures, and phases. Identify and write the equations for the three key invariant reactions observed in the Fe-C equilibrium diagram. Evaluate the amount of product phases for each of these reactions at equilibrium using the lever rule.	10	3	4,5	1
1B	A 325-mm-wide strip 33 mm thick is fed through a rolling mill with two powered rolls each of radius 250 mm. The work thickness is to be reduced to 30 mm in one pass at a roll speed of 50 rev/min. The work material has a flow curve defined by $K = 272 \text{ MPa}$ and $n = 0.14$, and the coefficient of friction between the rolls and the work is assumed to be 0.12. Determine if the friction is sufficient to permit the rolling operation to be accomplished. If so, calculate the roll force, torque, and horsepower.	10	2	3	7
2A	Explain the gas atomization process used in powder metallurgy. Analyze the key factors affecting the particle size and shape of the powders produced, and discuss their influence on the properties of the final product.	06	4	2	5
2B	A cylindrical workpiece is subjected to a cold upset forging operation. The starting piece is 90 mm in height and 52 mm in diameter. It is reduced in the operation to a height of 45mm. The work material has a flow curve defined by $K = 350 \text{ MPa}$ and $n = 0.17$. Assume a coefficient of friction of 0.1. Determine the force as the process begins, at intermediate heights of 68 mm, 52 mm, and at the final height of 45mm. (initial strain is 0.002)	06	1,2	3	7
2C	Derive an equation for the critical radius of a solid ball essential for solidification growth, supported by a labeled diagram. Analyze the	8	3	4	1



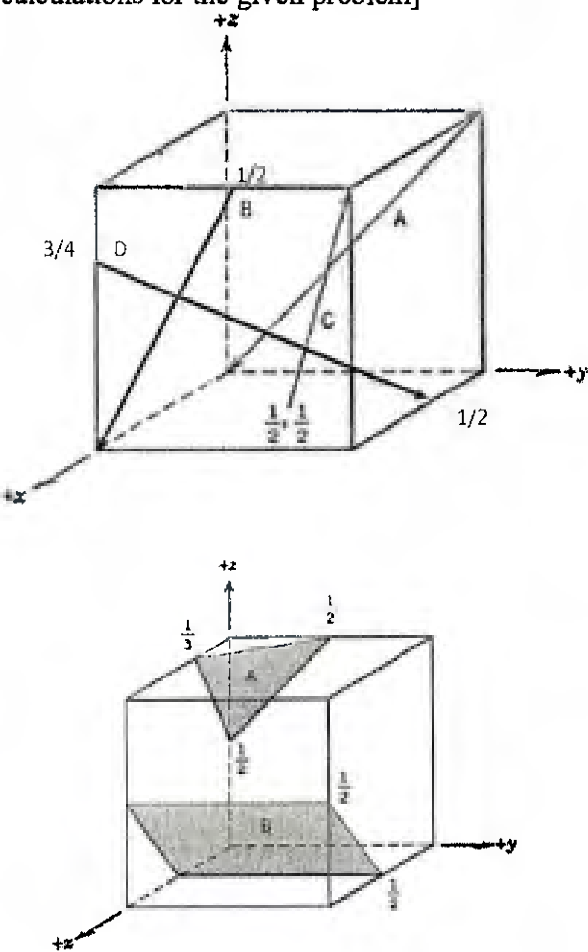
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	role of Gibbs free energy in the phase transformation from liquid to solid, and explain its significance during the nucleation process.				
3 A	Determine the Miller indices for the directions and the planes shown in the following unit cell:[Note: provide the stepwise calculations for the given problem] 	10(6 +4)	3	5	1
3B	What is stainless steel? Classify the different types of stainless steel and analyze the characteristics of austenitic stainless steel.	05	1	4	3
3C	Explain the austempering process in detail. Identify and describe the product formed during the austempering process. Illustrate your explanation with a labeled TTT diagram.	05	4,3	4	2
4A	Discuss each case of the heat treatment process of Fe-0.65% C eutectoid steel rapidly cooled from a preheated temperature of 860°C (>727°C) as follows [NOTE: Analyze the resulting microstructures, evaluate the properties of the final product, and justify the suitability of each process.] 1. Rapidly cool to 580° C and hold for 07 s, rapidly cool to 480 °C hold for 10³ s, quench to room temperature.	10	4	4	2



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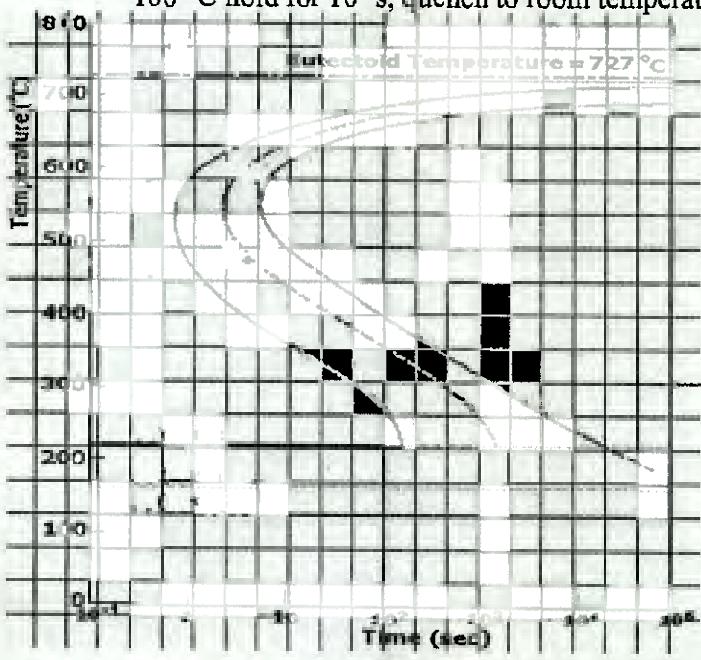
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	2. Rapidly cool to 380°C, hold for 10³ s and quench to room temperature; 3. Rapidly cool to 450 °C, hold for 10s, rapidly cool to 180 °C hold for 10⁴ s, quench to room temperature; 				
4B	The tool life equation for HSS tool is $VT^{0.14} f^{0.7} d^{0.4} = \text{Constant}$. The tool life (T) of 30 min is obtained using the following cutting conditions: $V = 45 \text{ m/min}$, $f = 0.35 \text{ mm}$, $d = 2.0 \text{ mm}$. If speed (V), feed (f) and depth of cut (d) are increased individually by 25%, calculate the tool life (in min).	05	4	3	6
4C	Explain the plasma spheroidization process in the context of powder metallurgy. Describe how it enhances the characteristics of powder particles and its significance in improving the properties of sintered components.	05	2	3	5
5A	Different alloy steel compositions are provided below. Analyze the given compositions, and based on the presence of the alloying elements, write the expected properties of each alloy steel. 1. C: 1.85%, Co: 1%, Mo: 0.3%, Cr: 1.5% 2. C: 0.15 to 1.2%, Mn: 1%, Si: 1%, Cr: 11.5 to 18% 3. C: below 0.08%, Mn: 2 to 10%, Si: 1 to 2%, Cr: 16 to 26%, Ni: 3.5 to 22%	06	4	4	03
5B	Define nanomaterials and elaborate on the top-down and bottom-up approaches used in their synthesis. Write any two applications of nanomaterials.	06	4	4	4



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END SEM/RE-EXAM EXAMINATION DEC/JAN 2024-25

5C	Apply your understanding of case hardening to explain its purpose and process. Analyze the following case hardening techniques by describing the elements added, their characterization, and applications: 1. Carbonitriding 2. Boronizing 3. Flame Hardening	08	3,4	4,5	2
6A	Classify composites based on the matrix material and explain the characteristics of each category. Provide a detailed explanation of metal matrix composites and carbon matrix composites, including their properties, applications, and operating temperature ranges.	08	4	4	4
6B	Apply your knowledge of material compositions to write the chemical composition of the following materials. Analyze their properties and suggest suitable engineering applications for each: 1. Naval brass 2. Cartridge Brass: 3. Nickel Gun Metal.	06	3,4	3	3
6C	Analyze a manufacturing scenario where a metal's mechanical properties need to be enhanced after forming. Apply your understanding to explain the roles of cold working, warm working, and hot working in metal forming	06	4	3	7
7A	Mild steel is being machined at a cutting speed of 190 m/min with a tool rake angle of 12° . The width of cut and uncut chip thickness are 2 mm and 0.2mm, respectively. If the average value of coefficient of friction between the tool and chip is 0.5 and the shear stress of the work material is 350N/mm ² . Determine: cutting and thrust components of machining force. Assume $2\phi + \lambda - \alpha = (\pi/2)$.	06	2,3	4	6
7B	Explain the importance of particle size and density measurements in the additive manufacturing process, focusing on their role in ensuring consistent material deposition and final part quality. Discuss how variations in particle size directly influence powder flowability and the density of the final product.	07	1,4	3	5
7C	The following data from an orthogonal cutting test is available Rake angle = 17° , Chip thickness ratio(cutting ratio) = 0.383, Uncut chip thickness = 0.8 mm, Width of cut= 4 mm, Yield stress of material in shear = 285 N/mm ² , Average coefficient of friction on the tool face = 0.75. Determine the normal and tangential forces on the tool face.	07	1,3	4,5	6



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End Semester/Re-examination 2024-25

Program: S.Y.B.Tech_WP (Mechanical) Sum III

Duration: 3 Hours

Course Code: ES-BTM301

Maximum Points: 100

Course Name: Linear Algebra and Vector Calculus

Semester: III

10/2/25

Note:

1. Attempt Any Five Questions
2. Answers to the sub questions should be grouped together

	Questions	Points	CO	BL	Module
1	a Test the consistency of the following system of linear equations and if possible, solve $\begin{aligned} 2x + y - z &= 0 \\ 2x + 5y + 7z &= 52 \\ x + y + z &= 9 \end{aligned}$	6	4	BL5	4
	b Find the sum and product of Eigen values of A^{-1}, where $A = \begin{bmatrix} 2 & 1 & -3 & 8 \\ 0 & 4 & -5 & 7 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & -3 \end{bmatrix}$	6	4	BL5	4
	c Find Fourier Series of $f(x) = \left[\frac{\pi - x}{2} \right]^2$, $x \in [0, 2\pi]$	8	1	BL3	1
2	a Find Eigen Values and Eigen Vectors of the following matrix $A = \begin{bmatrix} 1 & 2 \\ 4 & 3 \end{bmatrix}$	6	4	BL5	5
	b Find the unit normal vector to the surface $x^2y + 2xz = 4$ at $(2, -2, 3)$	6	3	BL2	3
	c Reduce the following matrix to normal form and hence find its rank.	8	4	BL3	4



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		$A = \begin{bmatrix} 4 & 2 & 8 & 1 \\ 5 & 1 & 7 & 2 \\ -1 & 4 & 7 & 4 \\ 2 & 8 & 3 & 8 \end{bmatrix}$				
3	a	Obtain Half Range Fourier Cosine Series of $f(x) = x(\pi - x)$, $x \in [0, \pi]$	6	3	BL4	3
	b	Find the Directional Derivative of $\phi = xy^2 + yz^3$ at $(1, -1, 1)$ in the direction of normal to the surface $x^2 + y^2 + z^2 = 9$ at $(1, 2, 2)$	6	1	BL5	2
	c	Verify Cayley Hamilton Theorem for the following matrix and find A^{-1} , if it exists $A = \begin{bmatrix} 0 & c & -b \\ -c & 0 & a \\ b & -a & 0 \end{bmatrix}$	8	4	BL5	5
4	a	Determine constants a, b and c if $A = \frac{1}{3} \begin{bmatrix} 1 & 2 & a \\ 2 & 1 & b \\ 2 & -2 & c \end{bmatrix}$ is orthogonal.	6	4	BL5	4
	b	Find the angle between the surfaces $x^2 + y^2 + z^2 = 6$ and $z = 4 - y^2 - xy$ at $(1, 1, 2)$	6	2	BL3	1
	c	Obtain Fourier Series expansion of $f(x) = 2 - \frac{x^2}{2}$, $x \in [0, 2]$	8	1	BL3	2
5	a	Find Fourier Series of $f(x) = x + x^2$, $x \in [-\pi, \pi]$	6	1	BL4	2
	b	Find constants a, b and c if $\vec{f} = (axy + bz^3)\hat{i} + (3x^2 - cz)\hat{j} + (3xz^2 - y)\hat{k}$ is irrotational	6	3	BL4	3
	c	Verify Stoke's Theorem for $\vec{f} = (x^2 + y^2)\hat{i} - 2xy\hat{j}$ taken around the rectangle bounded by the lines $x = -1, x = 1, y = 0, y = 3$	8	1	BL2 BL4	1



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6	a	Using Green's Theorem, Evaluate $\oint_C [(5x+7y)dx + (4x-5y)dy]$ where C is the circle $x^2 + y^2 = 25$	6	1	BL5	2	
	b	Find Fourier Series of $f(x) = x, x \in [-L, L]$	6	1	BL3	1	
	c	For the following matrix A , find two non-singular matrices P and Q such that PAQ is in the normal form. $A = \begin{bmatrix} 2 & 1 & 4 & 3 \\ 4 & 8 & 0 & 12 \\ 5 & 4 & 9 & 9 \end{bmatrix}$	8	4	BL3 BL5	4	
7	a	Evaluate $\int_C \bar{f} \cdot d\bar{r}$ where $\bar{f} = x^2\hat{i} + 2xy\hat{j}$ and C is the arc of the curve $y^2 = x$ from $(0,0)$ to $(1,1)$	5	3	BL2 BL3	3	
	b	Obtain Half Range Fourier Sine Series of $f(x) = \cos x, x \in [0, \pi]$	5	1	BL5	2	
	c	Find Eigen Values and Eigen Vectors of the following matrix $A = \begin{bmatrix} 2 & 1 & 1 \\ 2 & 3 & 2 \\ 3 & 3 & 4 \end{bmatrix}$	10	4	BL1 BL3	5	



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WORKING PROFESSIONALS END SEM / RE-EXAMINATION A.Y. 2024-25

Program: B.Tech. Mechanical

Course Code: PCC-BTM302

Course Name: Thermodynamics

Duration: 3 Hour

Maximum Points: 100

Semester: III

Notes:

- 1) Solve: Any FIVE Questions.
- 2) Answers must be **SPECIFIC** and in **LEGIBLE** handwriting.
- 3) Draw neat system diagram/s and process diagrams wherever necessary.
- 4) Use **Steam tables** and **Mollier Chart** provided by Examination section, if required.
- 5) Illustrate your answers with suitable examples as and where necessary.
- 6) Assume suitable data wherever necessary and state the same.

Q. No.	Question	Points	CO	BL	Modul
1.	a) Explain: the concept of thermodynamic work with an illustrative example. Derive: Expression for displacement work transfer in an isentropic process. Draw: neat system diagram and process diagram wherever necessary.	10	1	II, III, VI	1
	b) Explain: PMM1 and its converse. Draw: Neat sketches. A fluid, contained in a horizontal cylinder fitted with a frictionless leakproof piston, is continuously agitated by means of a stirrer passing through the cylinder. The cylinder diameter is 0.40 m. During the stirring process lasting 10 minutes, the piston slowly moves out by 0.485 m against the atmosphere. The net work done by the fluid, during the process is 2 kJ. The speed of the electric motor driving the stirrer is 840 rpm. Evaluate: i) Torque in the shaft and ii) output power of the motor. Draw: Neat system diagram.	10	1, 2	II, III, VI	1, 2
2.	a) Derive: General form of steady flow energy equation for a control volume. Draw: Neat system diagram. Using the general form of steady flow energy equation, Derive: Steady flow energy equation for nozzle. State: Assumptions made and Draw: neat system diagram.	10	1, 2	I, III, IV,	2
	b) Steam expands isentropically in a nozzle from 1 MPa, 250°C to 10 kPa. The mass flow rate of steam is 1 kg/s. Neglecting the K.E. of	10	1, 2	III, VI	2, 5



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	steam at inlet to the nozzle, Evaluate: i) Velocity of steam at exit from the nozzle, ii) the exit area of the nozzle. Draw: Neat T-s and h-s diagram for the process.				
3.	a) Explain: Kelvin-Planck statement and Clausius statement of second law of thermodynamics. Draw: Neat block diagrams for each statement. Illustrate: One practical example of a device / cycle which operates following each statement.	10	1, 2	II, III	3
	b) Explain: Principles of working of Refrigerator and heat pump. Draw: neat block diagram of each. Justify: $CoP_{HP} = CoP_R + 1$.	10	1, 2	I, VI	3, 7
4.	a) Explain: Working of an ideal Reheat cycle for steam power plant. Draw: Neat i) system diagram, ii) T-s and h-s diagrams and Derive: Expression for efficiency of the cycle.	10	2, 3	III, IV	5
	b) 1 kg of ice at -5°C is converted to superheated steam at 250°C . The pressure during this conversion process is constant at 1 atm. Identify and Explain: Stages/steps of this entire conversion process. Draw: T-s diagram for the entire process showing each stage of the entire process, without the saturated solid, liquid and vapor curves. Evaluate: i) Change in entropy for each stage of the conversion process Refer the following data: c_p of ice = 2.093 kJ/kg.K , latent heat of fusion of ice, $h_{sf} = 336.96 \text{ kJ/kg}$, c_p of water = 4.187 kJ/kg.K , latent heat of vaporization of water, $h_{fg} = 2257 \text{ kJ/kg}$, c_p of steam = 2.093 kJ/kg.K .	10	2, 3	II, VI	4, 5
5.	a) Explain: i) Subcooled liquid ii) Wet steam and dryness fraction iii) Superheated steam. Illustrate: Each state on a p-V and T-s diagram. Justify: For wet steam of unit mass with dryness fraction x , $v = v_f + x.v_{fg}$.	8	2, 3	II, III, VI	5
	b) A steam power plant works on an ideal Rankine cycle. Steam turbine receives the steam at 15 bar and 350°C and is exhausted to condenser at 0.06 bar. Evaluate: Thermal efficiency of the plant. Draw: Neat i) system diagram, ii) T-s and h-s diagram for the cycle.	12	4	I, V	5
6.	a) Explain: Working of an air standard Otto cycle for petrol engine. Draw: Neat p-V and T-s diagrams. Justify: Air standard efficiency	8	2, 3	II, III, V	6



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	of an Otto cycle is independent of temperature and pressure in the engine cycle with necessary derivation.				
	b) An engine is operating on the air standard Otto cycle. The conditions at the start of the compression are 27°C and 100 kPa. The heat added is 1840 kJ/kg. The compression ratio is 8. Determine: i) The temperature and pressure at each point in the cycle, ii) Thermal efficiency and iii) mean effective pressure.	12	4	VI	6
7.	Write short notes on ANY THREE of the following. Draw: Neat system and process diagrams wherever necessary.	20	1, 2	II	
	a) Joule's Experiment				2
	b) Thermodynamic systems and thermodynamic equilibrium				1
	c) Diesel and dual cycle				6
	d) Vapor Compression Refrigeration cycle				7
	e) Fuel cells				7