BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION MO/2023)

CLASS: B.Tech. SEMESTER : III
BRANCH: MECH SESSION : MO/2023

SUBJECT: PE213 MANUFACTURING PROCESSES

TIME: 02 Hours FULL MARKS: 25

INSTRUCTIONS:
1. The question paper contains 5 questions each of 5 marks and total 25 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates

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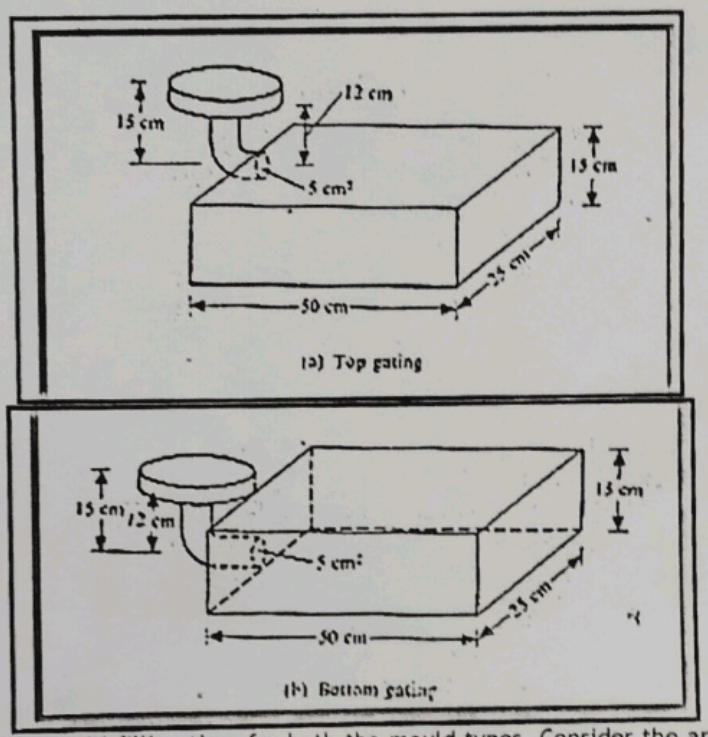
			CO	BL
Q.1(a)	Mention the limitations of sand casting process.	[2]	3	2
Q.1(b)	What are the allowances given to the pattern and why?	[3]	1	1

Q.2 [5] 4 3



Calculate the mould filling time for both the mould types. Consider the area of cross section of the gate is 5 cm^2.

Q.3(a)	Differentiate between orthogonal cutting and oblique cutting.	[2]	1	2
Q.3(b)	Explain the significance of providing rake angle and clearance angle on a tool.	[3]	1	2
Q.4	In orthogonal turning of a 50 mm diameter mild steel bar on a lathe machine, the following data were obtained: rake angle = 15°, cutting speed =100m/min, feed 0.2 mm/rev, cutting force =180 kg. Feed force=60 Kg. Calculate the chip thickness ratio, shear plane angle, coefficient of friction, cutting power, the chip flow velocity and shear force, if the chip thickness is 0.3 mm.	[5]	4	3
Q.5(a)	What are the differences between three jaw chuck and four jaw chuck?	[2]	1	2
Q.5(b)	How do you specify a lathe machine?	[3]	1	1

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BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION MO/2023)

CLASS: B.TECH. SEMESTER : III
BRANCH: MECHANICAL ENGINEERING SESSION : MO/2023

SUBJECT: ME203 FLUID MECHANICS & HYDRAULIC MACHINES

TIME: 02 Hours FULL MARKS: 25

INSTRUCTIONS:
1. The question paper contains 5 questions each of 5 marks and total 25 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates

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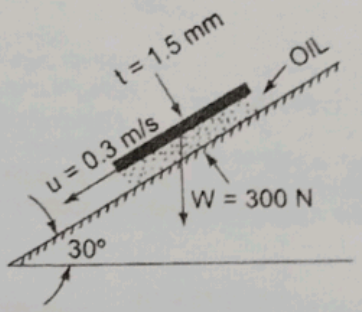
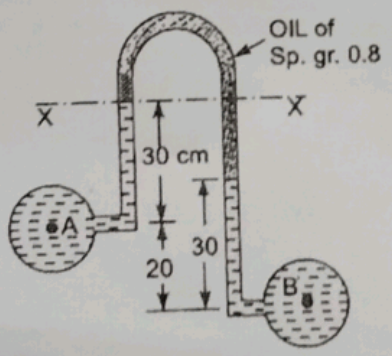
			CO	BL
Q.1(a)	Define the term continuum for fluids. What is its importance in fluid domain.	[2]	1	L
Q.1(b)	Determine the dynamic viscosity of an oil, which is used for lubrication between a square plate of size 0.8 m x 0.8 m and an inclined plane with angle of inclination 30 degrees as shown in Figure. The weight of the square plate is 300 N and it slides down the inclined plane with a uniform velocity of 0.3 m/s. Take the thickness of the oil film as 1.5 mm.	[3]	1	M



Q.2(a)	What is the difference between U-tube differential manometer and inverted U-tube differential manometer. Where they are used?	[2]	1	L
Q.2(b)	An inverted U-tube differential manometer is connected to two pipes A and B which convey water as shown in Figure. The fluid in manometer is oil of specific gravity 0.8. For the manometer readings, determine the gauge pressure difference between A and B.	[3]	1	M

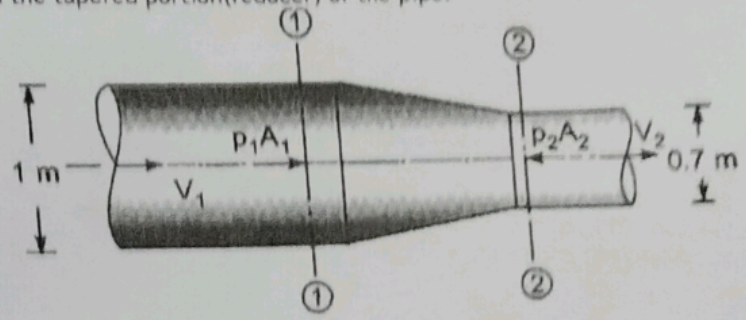


Q.3(a)	With a suitable sketch explain the term stream line in a fluid flow.	[2]	2	L
Q.3(b)	A fluid flow is given by $V = (x^2y)i + (y^2z)j - (2xyz + yz^2)k$. Analyze this flow for its continuity and rotationality at point(2,1,3).	[3]	2	M

PTO

Q.4(a) Distinguish between laminar flow and turbulent flow. [2] 2 L

Q.4(b) The diameter of a pipe gradually reduces from 1 m to 0.7 m as shown in Figure. [3] 2 M
The pressure intensity at the centerline of 1 m section is 7.848 kN/sq.m. and rate of flow of water through the pipe is 600 liters/second. Determine(i) the intensity of pressure at the centerline of 0.7 m section, (ii) the force exerted by the flowing fluid on the tapered portion(reducer) of the pipe.



Q.5(a) Distinguish between major and minor losses in pipes. [2] 3 L

Q.5(b) A crude oil of kinematic viscosity 0.4 x 10^-4 sq m./sec (0.4 multiplied by 10 to the power minus 4) is flowing through a pipe of diameter 300 mm at the rate of 0.3 m^3/sec. Determine the (i) head loss due to friction for a length of 50 m of the pipe, (ii) Reynolds number of the flow. Take coefficient of friction as 0.006. [3] 3 M

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BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION MO/2023)

CLASS: BTECH
BRANCH: MECHANICAL

SEMESTER : III
SESSION : MO/2023

SUBJECT: ME201 THERMODYNAMICS

TIME: 02 Hours

FULL MARKS: 25

INSTRUCTIONS:
1. The question paper contains 5 questions each of 5 marks and total 25 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. STEAM TABLE will be supplied to the candidates or will be allowed to use by the candidates

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			CO	BL
Q.1(a)	Explain work from thermodynamics point of view.	[2]	1	3
Q.1(b)	Explain the following: (i) Intensive and extensive properties (ii) free expansion process	[3]	1	3
Q.2	A 1m^3 rigid tank has air at 15 bar and ambient temperature 27°C connected by a valve to a piston cylinder. The piston of area 0.1 m^2 requires 2.5 bar below it to float. The valve is opened and the piston moves slowly 2m up and the valve is closed. During the process air temperature remains at 27°C. Evaluate the final pressure in the tank?	[5]	1	5
Q.3(a)	Determine the temperature of water at a state of P = 0.5MPa and h = 2890kJ/kg	[2]	1	5
Q.3(b)	Determine the amount of heat to be supplied to 2kg of water at 25°C to convert it to steam at 5 bar and 0.9 dry.	[3]	1	5
Q.4(a)	Explain First Law of thermodynamics for the cycle and the non-cyclic process.	[2]	2	3
Q.4(b)	For a polytropic process $pv^{\gamma} = constant$ Prove that $$\int_1^2 \delta Q = \left(\frac{\gamma - n}{\gamma - 1}\right) \times polytropic\ work\ done$$	[3]	2	
Q.5	The fluid parameters at the inlet of a steam nozzle are: Enthalpy=2850kJ/kg; velocity=50m/s; area=0.1m^2; and specific volume=0.18m^3/kg. At the discharge end the enthalpy is 2650kJ/kg and the specific volume is 0.49m^3/kg. At the exit of the nozzle evaluate (i) velocity of steam, (ii) mass flow rate of fluid, and (iii) the exit area of the nozzle. Assume nozzle is horizontal and there is negligible heat loss from it.	[5]	2	5

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BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION MO/2023)

CLASS: B.TECH. SEMESTER : III
BRANCH: MECH/CIVIL/CHEM/PIE/BIOTECH SESSION : MO/2023

SUBJECT: MA203 NUMERICAL METHODS

TIME: 02 Hours FULL MARKS: 25

INSTRUCTIONS:
1. The question paper contains 5 questions each of 5 marks and total 25 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates

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			CO	BL
Q.1(a)	Considering floating point arithmetic, perform the following arithmetic operations (as indicated) and express the obtained results in 4-digit mantissa standard (normalized) form with chopping: i. $0.5466 \times 10^3 + 0.6115 \times 10^3$ ii. $0.8324 \times 10^5 - 0.8307 \times 10^5$	[2]	1	2
Q.1(b)	The positive real root of the equation $f(x) = x^3 - 2x - 5 = 0$ lies in the interval $(2,3)$. Taking $a = 2$ and $b = 3$ as the initial approximations, execute two iterations of Regula-Falsi method to get two approximate values of the root. At each iteration step, all calculations should be accurately done up to four decimal places.	[3]	1	3
Q.2(a)	State the convergence condition for the fixed point (general) iteration method $x = \phi(x)$. Hence, use it to check whether the following rearrangement of the fixed point (general) iteration method: $x = x^3 - 0.1$ will ensure the convergence to the real root of the equation $f(x) = x^3 - x - 0.1$ in the interval $(1,2)$ or not.	[2]	1	1,2
Q.2(b)	Applying Newton-Raphson method, derive the following iterative formula to compute the cube root of any positive real number N: $x_{n+1} = \frac{1}{3}\left(2x_n + \frac{N}{x_n^2}\right),\ n = 0,1,2,\ldots.$ Hence, apply the above obtained iterative formula to find the cube root of $N = 17$ correct to three decimal places taking $x_0 = 2.5$ as the initial approximation.	[3]	1	2,3
Q.3(a)	Let the matrix $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$. If $a \neq 0$, the matrix A is to be factorized through LU decomposition where $L = \begin{bmatrix} 1 & 0 \\ l_{21} & 1 \end{bmatrix}$ and $U = \begin{bmatrix} u_{11} & u_{12} \\ 0 & u_{22} \end{bmatrix}$. Identify the values of l_{21}, u_{11}, u_{12}, and u_{22} in terms of $a, b.c$, and d.	[2]	2	3
Q.3(b)	Develop the solution of the following system of linear equations using Gauss elimination method: $x + 2y - 3z = -2; x + 5y + 3z = 10; x + 3y + 2z = 5$ Clearly, mention the operations applied at each step.	[3]	2	3

PTO

Q.4(a) [2] 2 3

The system of linear equations is given as: $\begin{bmatrix} 5 & 0 & -1 \\ 0 & 1 & 0 \\ 0 & -3 & 2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 2 \\ 2 \\ 4 \end{bmatrix}$.

Starting from an initial guess of $\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$, predict the result of the first iteration of Jacobi (Gauss-Jacobi) method.

Q.4(b) The following system of linear equations is given: [3] 2 3

$$5x_1 - x_2 = 9; -x_1 + 5x_2 - x_3 = 4; -x_2 + 5x_3 = -6$$

Starting with initial approximations $x_1 = x_2 = x_3 = 0$, execute two iterations of Gauss-Seidel method to obtain approximate solution of the given system.

Q.5(a) [2] 3 2

For the function $f(x) = \frac{1}{x^2}$, prove that the first divided difference $f[x_0, x_1]$ between the arguments (values of x) x_0 and x_1 is

$$f[x_0, x_1] = -\left(\frac{x_0 + x_1}{x_0^2 x_1^2}\right).$$

Q.5(b) Obtain the interpolating polynomial that fits into the following data using Lagrange formula: [3] 3 3

x	0	1	2
$f(x)$	2	1	12

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BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION SP2023)

CLASS: BTECH
BRANCH: MECHANICAL / PIE

SEMESTER : III
SESSION : MO/2023

SUBJECT: ME205 STRENGTH OF MATERIALS

TIME: 02 Hours

FULL MARKS: 25

INSTRUCTIONS:
1. The question paper contains 5 questions each of 5 marks and total 25 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates

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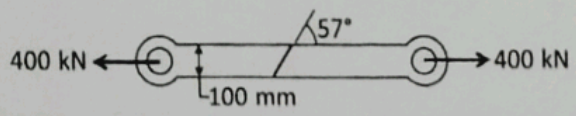
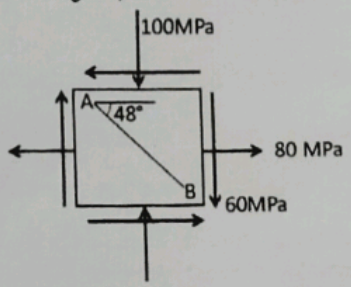
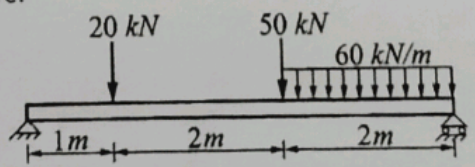
			CO	BL
Q.1	A steel bar with a butt-welded joint, as shown in figure, will be used to carry an axial tensile load of400 kN. If the normal and shear stresses on the plane of the butt weld must be limited to 70 MPa and 45 MPa, respectively, determine the minimum thickness t required for the bar.	[5]	1	2



Q.2	Derive the expressions for principal stresses and maximum shearing stress in plane stress condition described by $\sigma_x, \sigma_y,$ and τ_{xy}.	[5]	1	2
Q.3	For the stress element shown in figure, Find normal and shear stresses on plane AB.	[5]	1	3



Q.4	Explain shear forces and bending moments in beams with neat diagram. Also explain the sign convention with diagram.	[5]	2	2
Q.5	Find the support reactions and draw the shear force and bending moment diagrams for a beam as shown in figure.	[5]	2	3



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BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION MO/2023)

CLASS: B. TECH
BRANCH: MECHANICAL AND PIE

SEMESTER : III
SESSION : MO/2023

SUBJECT: PE214 METALLURGICAL AND MATERIALS ENGINEERING

TIME: 02 Hours

FULL MARKS: 25

INSTRUCTIONS:
1. The question paper contains 5 questions each of 5 marks and total 25 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates

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			CO	BL
Q.1(a)	I. A unit cell cannot have 100% atomic packing density - explain the statement with a simple diagram.	[1+1]	CO1	BL2
	II. Determine the total number of atoms per unit cell for body centered cubic structure with the help of a diagram			
Q.1(b)	A crystalline solid has a cubic unit cell with one atom per lattice point. If the lattice parameter, a = 4.0786 Å and atomic radius, r = 1.442 Å, determine whether the crystal structure is simple cubic, body centered cubic or face centered cubic.	[3]	CO1	BL3
Q.2(a)	I. Name the different types of defects in crystalline solids with respect to the dimension of the defect and state which is the most relevant for explaining deformation of crystalline solids.	[1+1]	CO1	BL1
	II. State the Hume Rothery's rules for formation of substitutional solid solutions			
Q.2(b)	I. Explain why ceramic solids are not suitable for processing by rolling or forging.	[1+2]	CO1	BL2
	II. Discuss the most important difference between a twin boundary and a grain boundary with a schematic microstructure.			
Q.3(a)	Temperature is a state function, but mechanical strain is not - justify this statement with proper logic.	[2]	CO2	BL3
Q.3(b)	Discuss the invariant transformations (describing the suitable reactions) that occur on cooling below the following isothermal temperatures in plain carbon steel referring to the iron-cementite phase diagram: (i) 1147 °C and (ii) 727 °C	[3]	CO2	BL2
Q.4(a)	Draw a schematic binary (A-B) phase diagram with labelling showing: I. partial solubility of B in A but no solubility of A in B and II. a eutectic transformation at an intermediate composition.	[2]	CO2	BL4
Q.4(b)	I. Compute the mass fractions of ferrite and cementite in pearlite. II. Draw the microstructure of pearlite with proper labelling.	[2+1]	CO2	BL3
Q.5(a)	What is strain hardening? Why does it arise?	[2]	CO2	BL2
Q.5(b)	Select the correct choice:	[1x3]	CO3	BL2

I. In isothermal transformation, the time to start the transformation is called _____ (nucleation/kinetic/formation/incubation) time, and the same at a higher temperature (above the nose or knee) at a higher temperature is _____ (lower/cannot be determined/higher/same) than that at a lower temperature.

II. The basic difference between Fick's First Law and Second Law are related to _____ (polymorphism/diffusion/osmosis/solidification) and for determining _____ (temperature range/composition of alloy/steady and non-steady state/activation barrier of diffusion).

III. The characterization technique appropriate for determining crystal structure of a phase in a crystalline solid is _____ (SEM/AFM/XRD/XRF) and the technique for determining micro-composition of a phase is _____ (TEM/XRD/SPM/EDS).

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