

**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI  
(END SEMESTER EXAMINATION)**

**CLASS: BTECH  
BRANCH: MECH/PIE**

**SEMESTER : VI  
SESSION : SP/2025**

**SUBJECT: PE337 MANUFACTURING SCIENCE**

**TIME: 3 Hours**

**FULL MARKS: 50**

**INSTRUCTIONS:**

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
  2. Attempt all questions.
  3. The missing data, if any, may be assumed suitably.
  4. Before attempting the question paper, be sure that you have got the correct question paper.
  5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
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Q.1(a)	I.	Define pattern allowances and classify the different types of allowances considered for pattern making using neat schematic diagrams.	[3+2]	CO1	BL1 BL2 BL3
	II.	Define cooling characteristics, freezing ratio, and modulus.			
Q.1(b)	I.	State the Chvorinov's Rule to determine the solidification time of a casting.	[1+4]	CO1	BL1 BL4
	II.	The total solidification times of three casting shapes are to be compared: (1) a sphere, (2) a cylinder, in which the $L/D$ ratio = 1.0, and (3) a cube. For all three geometries, the volume $V = 1000 \text{ cm}^3$ . The same casting alloy is used in the three cases. (a) Estimate the relative solidification times for each geometry. (b) Based on the results of part (a), which geometric element would make the best riser? (c) If the mould constant = $3.5 \text{ min/cm}^2$ in Chvorinov's Rule, compute the total solidification time for each casting.			
Q.2(a)	I.	Deduce the equation of average flow stress as $K\varepsilon^n/(n+1)$	[2+3]	CO2	BL4
	II.	A metal has a flow curve with parameters: $K = 800 \text{ MPa}$ and strain hardening exponent $n = 0.40$ . A tensile specimen of the metal with gage length = 100 mm is stretched to a length = 165 mm. Estimate (a) the flow stress at the new length and (b) the average flow stress that the metal has been subjected to during the deformation.			
Q.2(b)	I.	Explain the variation of extrusion pressure with ram displacement for direct and indirect extrusion processes.	[2]	CO2	BL3 BL4
	II.	A series of cold rolling operations are to be used to reduce the thickness of a plate from 50 mm down to 25 mm in a reversing two-high mill. Roll diameter = 700 mm and coefficient of friction between rolls and work = 0.15. The specification is that the draft is to be equal on each pass. Estimate: (a) minimum number of passes required, and (b) draft for each pass.			
Q.3(a)	I.	Define generatrix and directrix with the help of neat diagrams.	[2+3]	CO3	BL1 BL3
	II.	Develop expressions for optimum cutting speed and optimum tool life for maximum production.			
Q.3(b)	I.	"In most of the metal cutting processes chip thickness is always greater than the uncut chip thickness" - Explain the statement with proper justification and neat diagram.	[2+3]	CO3	BL3 BL4
	III.	Estimate the cutting force, feed force and normal force components when shaping a cast iron block with depth of cut 3 mm, feed 0.25 mm/stroke, normal rake angle as $10^\circ$ , principal cutting-edge angle as $25^\circ$ , $\mu$ as 0.5 and ultimate shear stress as $350 \text{ N/mm}^2$ . Use the Lee and Shaffer shear angle relationship.			

Q.4(a)	I.	Calculate the melting efficiency in the case of arc welding of steel with a potential of 25 V and current of 150 A. The travel speed is 6 mm/s and the cross-sectional area of the joint is 25 mm <sup>2</sup> . Heat required to melt steel may be taken as 10 J/mm <sup>3</sup> and the heat transfer efficiency as 0.80.	[3+2]	CO4	BL3 BL5
	II.	“Low ionization potential elements are essential for the maintenance of an AC arc” - Justify the statement with suitable reasoning.			
Q.4(b)	I.	The voltage-length characteristic of a dc arc is given by $V=15+4l$ where $l$ is the length of the arc in mm. During a welding operation, it is expected that the arc length will vary between 4 mm and 6 mm. It is desired that the welding current be limited to the range 475 A to 575 A. Assuming a linear power source characteristic, estimate the open circuit voltage and the short circuit current of the power source.	[3+2]	CO4	BL4 BL2
	II.	Discuss the important factors affecting the solid-state welding process.			
Q.5(a)	I.	Explain the distinct needs and characteristics of modern manufacturing processes.	[3+1 +1]	CO5	BL3 BL2 BL2
	II.	Discuss the effect of standoff distance in water jet machining.			
	III.	Describe the effect of abrasive size and concentration on the MRR in ultrasonic machining.			
Q.5(b)	I.	Explain the mechanism of material removal in electrochemical machining with the help of a neat diagram.	[5]	CO5	BL3 BL2
	II.	Discuss the advantages and limitations of laser beam machining process.			

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