Ref. No.: Ex/ME(M2)/PC/B/T/226/2024

B.E. MECHANICAL ENGINEERING SECOND YEAR SECOND SEMESTER EXAM 2024

SUBJECT: MANUFACTURING PROCESSES

Time: 3 Hours **Full Marks: 100**

Assume any relevant data, if necessary. Symbols in the Question Paper carry their usual meanings. Figures in the margin indicate full marks. All Parts of any one question must be answered together. Answer strictly to the point.

ANSWER ANY FOUR QUESTIONS

Q1. a) Distinguish between liquid shrinkage and solid shrinkage as related to castings. Explain how these are taken care of in designing sand castings. What is the relevance of the facing sand towards the casting quality? What are the specific advantages of using carbon dioxide in core making? Why a loose-piece pattern is used? [2+2+2+2+2]

b) A cast iron cylinder of 450 mm outside diameter, 75 mm inside diameter, and 150 mm long is to be obtained by sand casting. Find the dimensions of the wooden pattern considering the shrinkage allowance as 3% and the machining allowance as 5%. [8]

c) The Madras sand has been found to contain the following size grading.

Sieve No.	6	12	20	30	40	50	70	100	140	200	270	Pan
Retained percentage (%)	-	0.75	18.44	28.91	29.82	16.91	3.62	0.75	0.2	0.06	0.03	0.11
Multiplier	3	5	10	20	30	40	50	70	100	140	200	300

Calculate the grain fineness number. [7]

Q2. a) What are the functions served by the pouring basin in a sand casting? What are the various methods available to a casting designer to reduce the momentum of the molten metal? What are the essential conditions that are to be kept in mind while designing a riser? What are the methods available to a casting designer to increase the casting yield? Briefly explain the rationale of Caine's empirical rules for risering. [3+3+3+3+3]

b) Three metal pieces being cast have the same volume but different shapes; one is a sphere, one is a cube, and the other is a cylinder with its height equal to its diameter. Which piece will solidify fastest and which one the slowest? Explain on the basis of solidification times of each shape. [5]

c) Calculate the optimum pouring time for a casting whose mass is 100 kg and having an average section thickness of 25 mm. The materials of the casting are grey cast iron and steel. Take the fluidity of iron as 32 inches. [5]

Q3. a) What are the functions of flux in melting metals and alloys? Describe the operation of a cupola furnace for melting cast iron. [3+5]

b) Explain how shrinkage cavities are sometimes formed in a casting. State the causes and remedies of air/gas borne defects in casting. [3+6]

[Turn over

c) "Although sand casting is the most widely used process judging from the tonnages of castings produced, there are instances where one would choose die casting in preference to sand casting." – Discus the statement. Briefly enumerate the steps in sequence for producing castings from shell moulding. [3+5]

Q4. a) An annealed copper strip 225 mm wide and 25 mm thick is being rolled to a thickness of 20 mm in one pass. The roll radius is 300 mm, and the rolls rotate at 100 rpm. Calculate the roll force and the power required in this operation. the average true stress in the roll gap is 178 MPa. [5]

b) How do you compare forged components with cast components? What are the specific application of hydrostatic extrusion? Why lubrication is difficult in wire drawing? Why shear angle is provided in a shearing operation? How does side wall thickness of a drawn component vary? [3+3+3+3+3]

c) Determine the die and punch sizes for blanking a circular disc of 20 mm diameter from a C20 steel sheet whose thickness is 1.5 mm. Also calculate the punching and stripping force. [5]

Q5. a) Two steel sheets of 1.0 mm thickness are resistance welded in a lap joint with a current of 10000 A for 0.1 second. The effective resistance of the joint can be taken as 100 micro ohms. The joint can be considered as a cylinder of 5 mm diameter and 1.5 mm height. The density of the steel is 0.00786 g/mm^3 and the heat required for melting steel be taken as 10 J/mm^3. [5]

b) Why is the neutral flame extensively used in oxyacetylene welding? Why is the possibility of distortion very low in the submerged arc welding process? With a schematic diagram explain the working procedure of laser beam welding (LBM) process and mention the advantages and limitations of the welding process. [3+3+9]

c) A welding operation is performed with a voltage of 20 volts, a current of 200 A, and the cross-sectional area of the weld bead of 30 mm^2. Estimate the welding speed if the workpiece and electrode are made of aluminum, and titanium. Assume an efficiency of 75% and the specific energy required for aluminum and titanium is 2.9 J/mm^3 and 14.3 J/mm^3 respectively. [5]

Q6. a) With neat and explanatory diagram discuss about Machine forging operation. What should be the ideal length of the overhang portion to be upset? What is "pancaking"? [5+2+2]

b) What is meant by "cogging operation"? Stating about all the legends, deduce the coefficient of spread as per Tomlinson and Stringer. [2+8]

c) A solid cylindrical slug of 1020 steel is 150 mm in diameter and 100 mm high. The height is reduced to 50% by cold, open die forging operation. Assuming a coefficient of friction of 0.2 calculate the forgoing force needed at the end of stroke. True stress vs. True strain curve is given in Fig.1. [6]

Q7. a) What is deep drawing operation? What is the major difference of deep drawing with ordinary drawing? What is meant by 'hot draw bench'? [2+1+2]

b) Drawing a neat and labeled diagram explain the deep drawing process. What is conventional redraw and reverse redraw? Discuss with adequate figures. What is meant by ironing? [6+4+2]

c) How the press force is calculated in deep drawing operation? State the mathematical relations without proof. What is meant by flow stress ad average true stress? [5+3]

Q8. a) Explain how arc is established in between the electrodes in case of arc welding. Discuss in the light of electron theory. [5]

b) How a corrosion resistant electrode is specified as per ASTM? Give an example. [3]

c) What are the functions of coating materials in an electrode? Mention about some commonly used coating materials. [4+2]

d) Drawing neat diagram discuss about a welding process where chemical reaction is used as the heat source. [6]

e) How acetylene gas is preserved in gas cylinder? Why the use of copper is not permitted in the presence of acetylene? [4+1]

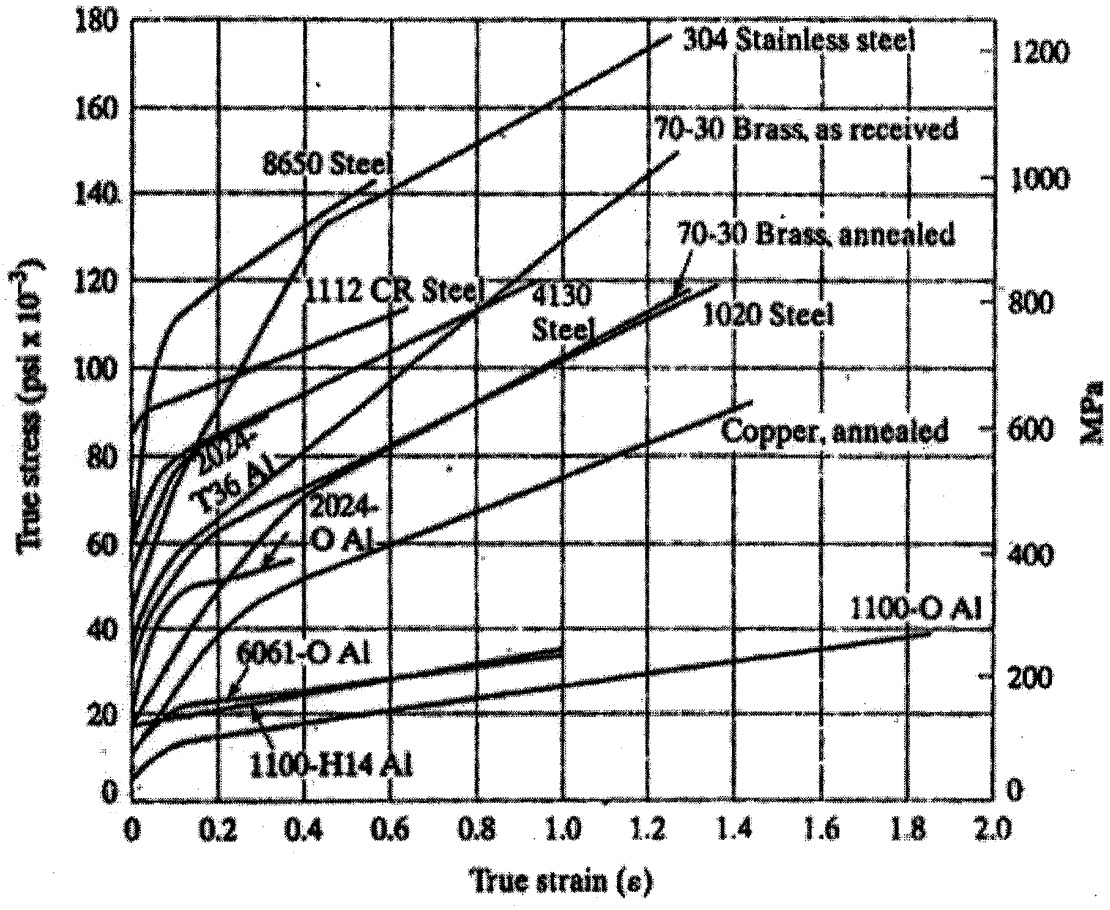

Fig.1. True stress -vs- True strain curve, in connection with question 6 (b).