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B.Tech.
(SEM VII) THEORY EXAMINATION 2022-23
MATHEMATICAL MODELING OF MANUFACTURING PROCESSES

Time: 3 Hours ***Total Marks: 100***

Note: Attempt all Sections. If you require any missing data, then choose suitably.

SECTION A

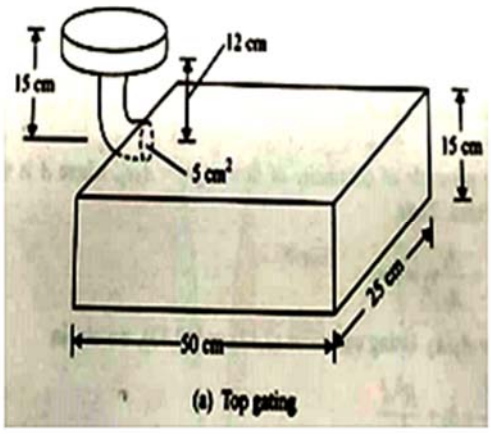
1. Attempt *all* questions in brief. **2*10 = 20**

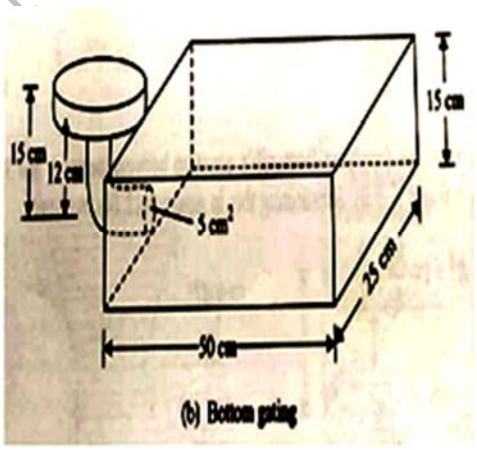
(a) How are physics-based models used in the manufacturing industry?
(b) Explain the statement: "Tool life is a random variable."
(c) What is strain hardening? How might it be used in manufacturing?
(d) Define Centre-line Feeding Resistance (CFR)?
(e) In what ways is a thermit weld similar to the production of a casting?
(f) What is the role of thermoplastic material in P/M injection moulding?
(g) Classify additive manufacturing processes.
(h) Why might chipless machining processes have greater importance in the future?
(i) What are microalloyed steels? Where are they used?
(j) Mention the factors on which the suitability of the casting operation for a given material depends.

SECTION B

2. Attempt any *three* of the following: **10*3 = 30**

(a) Explain the different methods that can be used to control the properties of engineering materials to make the materials suitable for a given application.
(b) Draw comparison chart to explain clearly the difference between orthogonal cutting and oblique cutting.
(c) Explain the various forming operations used in manufacturing processes.
(d) Two gating designs for a mould of 50 cm × 25 cm × 15 cm are shown in fig below. The cross-sectional area of the gate is 5 cm^2. Determine the filling time for both the designs.





(e) Explain with the help of a TTT diagram, how can we achieve different phases of plain carbon steel by changing only the rate of cooling.

SECTION C

3. Attempt any *one* part of the following: 10*1 = 10

(a) Briefly explain how heat treatment process affects the microstructure of metal and its alloy.

(b) Explain ceramic materials and processing procedures.

4. Attempt any *one* part of the following: 10 *1 = 10

(a) During an orthogonal machining operation on mild steel, the results obtained are

$t_1 = 0.25$ mm $t_2 = 0.75$ mm $w = 2.5$ mm,

$\alpha = 0^0$ $F_c = 950$ N $F_T = 475$ N.

(i) Determine the coefficient of friction between the tool and the chip.

(ii) Determine the ultimate shear stress of the work material.

(b) Explain the working of Abrasive Jet Machining with the help of a neat sketch. What are its advantages and limitations?

5. Attempt any *one* part of the following: 10*1 = 10

(a) What is fusion welding? Explain the important factors governing a fusion welding process.

(b) Explain the modes of metal transfer in arc welding clearly showing the types of metal transfer.

6. Attempt any *one* part of the following: 10*1 = 10

(a) What is the principle of powder metallurgy? Explain in detail the basic steps involved in the manufacture of product by powder metallurgy technique.

(b) Bring out the advantages of additive manufacturing technique. Mention some of its applications.

7. Attempt any *one* part of the following: 10*1 = 10

(a) Explain in detail the role of mathematical modeling in problem solving.

(b) Briefly show how materials are plastically deformed and how residual stresses are removed if it being stored during plastic deformation.