

ASME-24BC-MENG-I
MECHANICAL ENGINEERING (PAPER-I)

Time Allowed: 3 Hours

[Maximum Marks: 100]

QUESTION PAPER SPECIFIC INSTRUCTIONS

Please read the following instructions carefully before attempting questions.

1. There are EIGHT questions printed in English.
 2. Candidate has to attempt FIVE questions in all.
 3. Question No.1 is compulsory. Out of the remaining SEVEN questions, FOUR are to be attempted.
 4. All questions carry equal marks. The number of marks carried by a question / part are indicated against it.
 5. Write answers in legible handwriting.
 6. Wherever any assumptions are made for answering a question, they must be clearly indicated.
 7. Diagrams / Figures, wherever required, shall be drawn neatly. Unless otherwise mentioned, symbols and notations carry their usual standard meanings.
 8. Attempts of questions shall be counted in sequential order. Unless struck off, attempt of a question shall be counted even if attempted partly. Any page or portion of the page left blank in answer book must be clearly struck off.
 9. Re-evaluation / Re-checking of answer book of the candidate is not allowed.
 10. Use of calculators is allowed.
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1. (a) Explain the purpose and function of the following components in a casting gating system: 05
 - i. Pouring Basin
 - ii. Sprue
 - iii. Runner
 - iv. Gate
 - v. Provide a diagram to illustrate these components.
- (b) Explain the working principle of a differential in an automobile? 05
- (c) What are the different EOQ (Economic Order Quantity) models used in inventory control? 05
- (d) Explain the following machining processes: 05
 - i. Boring
 - ii. Counter boring
 - iii. Counter sinking
 - iv. Honing
 - v. Lapping
- 2 (a) Describe the various types of welding processes. Briefly explain the TIG (Tungsten Inert Gas) and MIG (Metal Inert Gas) welding techniques? 07
- (b) Explain the different types of pins used in jigs and fixtures, including their functions and applications? 07
- (c) In a Hartnell governor, the mass of each ball is 4 kg. The maximum and minimum centrifugal forces on the balls are 1800N and 100N at a radius of 25cm and 20cm, respectively. The lengths of vertical and horizontal arms of the bell-crank levers are the same. What is the spring stiffness? 06
3. (a) Explain the principles, applications, and advantages of the following machining processes: 08
 - i. Electrochemical Machining (ECM)
 - ii. Laser Beam Machining (LBM)

Include diagrams to illustrate each process.
- (b) A thin cylinder 75 mm internal diameter, 250 mm long with walls 2.5 mm thick is subjected to an internal pressure of 8 MN/m². Determine the change 12

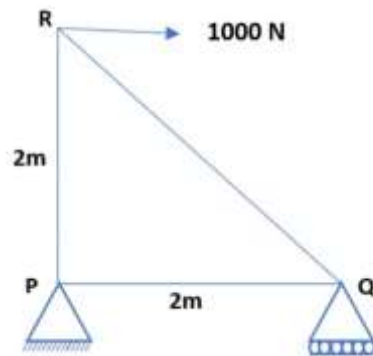
in internal diameter and the change in length. If, in addition to the internal pressure, the cylinder is subjected to a torque of 200 N m, find the magnitude and nature of the principal stresses set up in the cylinder. Take $E = 200 \text{ GN/m}^2$ and Poisson's ratio = 0.3.

4. (a) Explain the different types of chip formation in cutting operations— continuous chips, discontinuous chips, continuous chips with built-up edge, and segmented chips. Discuss the effects of depth of cut and cutting speed in chip formation 10
- (b) Draw Free Body Diagram for the following: 10
- i. Simply supported beam with point load at the mid span and the uniformly distributed load throughout the length of the beam.
 - ii. Cantilever beam with a uniformly varying load throughout the length of the beam along with a uniformly distributed load throughout the length of the beam.
 - iii. Two beams of same length are connected by a pivot. The left side beam is loaded by two point loads (at any lengths). The right side beam is loaded by a uniformly distributed load from the pivot to the mid span of itself, and rest of the portion of the right side beam is loaded by uniformly varying load.
 - iv. A sphere of certain weight placed on a V groove. (The angles of the sides of the groove may be assumed)
5. (a) Describe the various angles used in cutting tools: 08
- i. Rake angle
 - ii. End relief angle
 - iii. Side rake angle
 - iv. Side relief angle
 - v. End cutting edge angle
 - vi. Side cutting edge angle.

Explain their roles in machining and how they influence tool performance?

- (b) What are different types of riveted joints? What are the different failures based upon which a riveted joint is designed? Support your answer with mathematical expressions. 12

6. (a) For a given truss, determine the support reactions and force in all members of the given truss. 10



- (b) The stresses acting on a component are $\sigma_x = 120$ MPa, $\sigma_y = 80$ MPa and $\tau = 60$ MPa. Considering factor of safety as 1.5, determine the yield strength using Tresca and the Von Mises yield criteria 10
7. (a) Describe the various types of casting defects, including their causes and effects on the final product? 10
- (b) Explain the following in brief 10
- Single Degree of Freedom (SDOF) system and its key characteristics.
 - Natural frequency of an SDOF system, and its importance.
 - Difference between damped and undamped free vibration in an SDOF system.
 - Logarithmic decrement in the context of an SDOF system's free vibration.
8. (a) What is Work Study? How does it enhance the productivity of any industry? 08
Discuss the procedure adopted in carrying out Work Study.
- (b) What is a Transportation problem/model and its types? What are the different methods used to solve Transportation problems? Explain any one method. 08
- (c) An orthogonal cutting operation is being carried out under the following conditions: cutting speed = 2m/s, depth of cut = 0.4mm, chip thickness = 0.5mm. Determine the chip velocity? 04
