

GENERAL ENGINEERING SCIENCE

Paper—IV

(SECTION-II)

(Subjective)

Time Allowed : 2 Hours]

[Maximum Marks : 100

Note : (1) Attempt **any five** questions.

- (2) The figures in the margin indicate full marks for the questions.
 - (3) All parts of a question must be answered together.
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1. (a) List the different theories of elastic failure. Illustrate that the potential failure points lie outside the envelope when different theories of failure are plotted in terms of normal stresses in $x-y$ plane. 10
- (b) A ductile material is subjected to a simple tension test and shows yield point stress as 360 MN/m^2 . A specimen of the same material is subjected to a two-dimensional normal state of stress of tensile stress as 180 MN/m^2 and compressive stress as 60 MN/m^2 . Determine the factor of safety according to—
 - (i) maximum shear stress theory;
 - (ii) maximum shear strain energy theory.10

2. (a) Define the following mechanical properties and their importances in engineering design : 10
 - (i) Yield strength
 - (ii) Ultimate strength
 - (iii) Ductility
 - (iv) Hardness
 - (v) Resilience

- (b) In the tapered circular shaft of modulus of rigidity G as shown in Fig 1, the diameter is changing linearly from d_A to d_B over the length L :

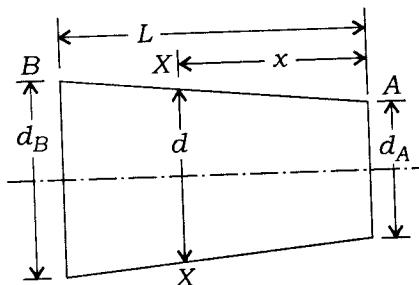


Fig. 1

Evaluate the total angle of twist, when it is subjected to a torque T . 10

3. (a) Compare between PERT and CPM. What are 'expected time' and 'standard deviation' of an activity? 10

- (b) Consider the network as shown in Fig. 2 with expected time of completion of each activity (t_E) (in days) is shown on arrows :

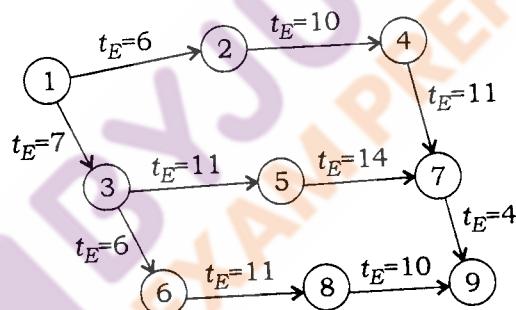


Fig. 2

Calculate the 'earliest expected time' of the network for the completion of work. 10

4. (a) What are the main factors of the following construction equipments? List at least two features of each : 10

- (i) Tractor
- (ii) Dozer
- (iii) Power shovel
- (iv) Dragline
- (v) Hoe

- (b) In construction activities, what is the importance of safety? Explain safety in terms of the following : 10
- (i) Humanitarian concern
 - (ii) Economic reason
 - (iii) Laws and regulations
 - (iv) Organization image
- 5.** (a) Apply Bernoulli's equation to a typical venturi meter and identify different heads. 10
- (b) A pitot tube is inserted in a pipe of 30 cm diameter. The static pressure of the tube is 10 cm of mercury vacuum. The stagnation pressure at the centre of the pipe recorded by the pitot tube is $1\cdot0 \text{ N/cm}^2$. Calculate the rate of the flow of water through the pipe, if the mean velocity of flow is 0.85 time the central velocity. Assume the coefficient of friction of the tube to be 0.98. 10
- 6.** (a) (i) What is the chemical composition of typical cement?
(ii) What are the functions of various ingredients of cement?
(iii) What is hydration of cement? Explain with the help of typical chemical reactions. 10
- (b) (i) What are the different types of cast iron and their applications?
(ii) Distinguish among mild steel, high-carbon steel and alloy steel in terms of carbon content and major properties.
(iii) What do you understand by heat treatment of steel in terms of hardening, tempering, annealing and normalizing? 10
- 7.** (a) Define proof stress, toughness and hardness of engineering materials. 10
- (b) A block is tested for shear stress. The shear stress in $x-y$ plane is fixed to 1000 MPa. The strain matrix corresponding to applied stresses is
- $$[\text{strain}] = \begin{bmatrix} 0.002 & 0.005 & 0.003 \\ 0.005 & 0.006 & 0.000 \\ 0.003 & 0.000 & 0.000 \end{bmatrix}$$
- Calculate the shear modulus of the block. 10

8. Draw the shear force and bending moment diagrams for a simply supported beam carrying a load whose intensity varies uniformly from zero at each end to W per unit run at mid span as shown in Fig. 3 : 20

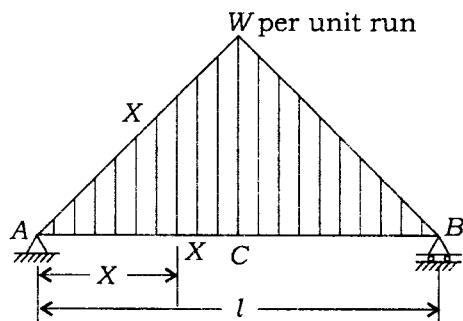


Fig. 3

9. (a) What are the causes and the consequences of 'air pollution'? 10
 (b) What are the major steps in 'industrial water purification'? 10
10. A pipe carries a stream of a liquid with mass flow rate of 5 kg/s. Because of poor insulation the liquid temperature increased from 250 K at the pipe inlet to 500 K at the exit. Neglecting pressure losses, calculate heat transfer to the liquid and rate of entropy increase of the liquid. Specific heat of the liquid is 2.85 kJ/kg K. 20

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