



ANSWER ANY FIVE (05) QUESTIONS. ALL QUESTIONS CARRY EQUAL MARKS.

QUESTION 01:

- (a) Explain the meaning of the instantaneous center of rotation
- (b)

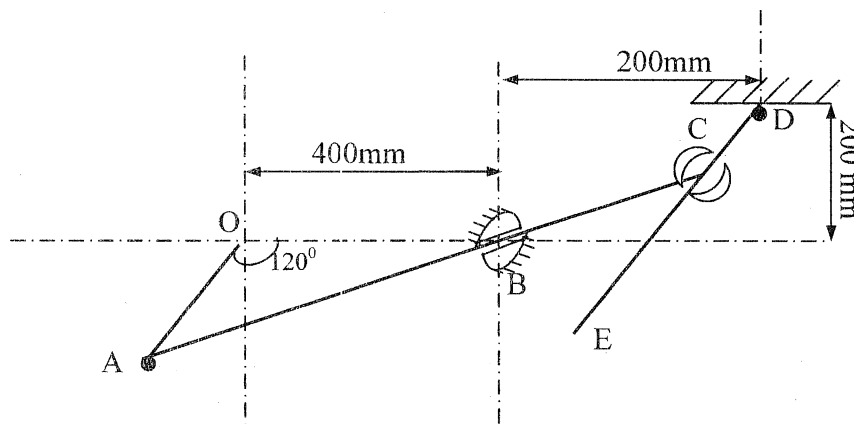


Fig.Q1

A crank OA which is 125 mm long, shown in Fig.Q1 rotates clockwise at 80 rev/min. Rod AC 600 mm long slides in a swiveling pin at B . The end C slides on a swinging link of DE . When the angle BOA is 120° , find the angular velocity of DE .

QUESTION 02:

A reinforced concrete beam is 240 mm wide and 450 mm deep to the center of the reinforcing steel rods. The rods are of total cross-sectional area $1.2 \times 10^{-3} \text{ m}^2$. The maximum allowable stresses in the steel and concrete are 150 MN/m^2 and 8 MN/m^2 respectively. The modular ratio (steel: concrete) is 16. Determine the moment of resistance of the beam.

QUESTION 03:

Two wooden planks 200 mm x 50 mm each connected to form a T-section of a beam as shown in FigQ3. If a moment of 6.4 kNm is applied around the horizontal neutral axis, inducing tension below the neutral axis, find the bending stresses at the extreme fibres of the cross section.

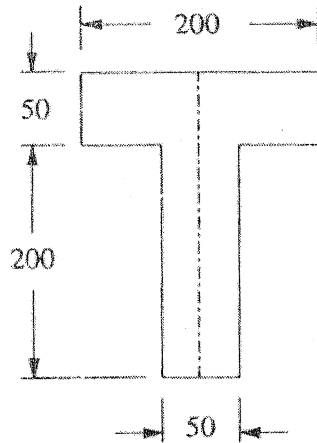


Fig.Q3

QUESTION 04:

- (a) Explain the conditions to be satisfied for dynamic and static balancing.
- (b) A system of four masses A, B, C and D attached to a rotating shaft is required to be completely balanced. They have following parameters.

	A	B	C	D
Mass (kg)	-	30	50	40
Radius (mm)	180	240	120	150

The planes containing masses B and C are 300 mm apart. The angle between planes containing B and C is 90° . B and C make angles of 210° and 120° respectively with D in the same sense. Find:

- (ii) The magnitude and the angular position of mass A; and
(iii) The position of planes A and D.

QUESTION 05:

- (a) A copper tube with external diameter 40 mm and thickness 6mm fits over a steel rod 25 mm diameter. The tube is secured to the rod by 2 pins each 10 mm diameter one at each end fitted transversely. If the temperature after the assembly is raised by 50⁰ C, calculate the shear stress in the pins.
- (b)

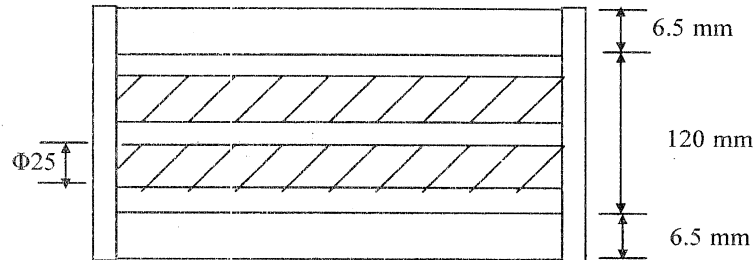


Fig.Q5

A copper tube of mean diameter 120 mm and 6.5 mm thick as shown in Fig.Q5 has its open ends sealed by two rigid plates connected by two steel bolts of each 25mm diameter, initially tensioned to 20 kN at a temperature of 30⁰ C, thus forming a pressure vessel. Determine the stresses in the copper and steel at the freezing point, and the temperature at which the vessels would cease to be pressure tight.

$$E_{\text{copper}} = 100 \text{ GPa}$$
$$\alpha_{\text{copper}} = 2 \times 10^{-5} / ^{\circ}\text{C}$$

$$E_{\text{steel}} = 200 \text{ GPa}$$
$$\alpha_{\text{steel}} = 1.2 \times 10^{-5} / ^{\circ}\text{C}$$

QUESTION 06:

A single plate clutch, effective on both sides, is required to transmit 25 kW at 3,000 rpm. Determine the outer and inner radii of frictional surfaces if the coefficient of friction is 0.25, with the ratio of radii is 1.25 and the maximum pressure not exceeding 0.1 N/mm². Also determine the axial thrust to be provided by springs. Assume the theory of uniform wear.

QUESTION 07:

- a) Derive an expression for the path of contact (L) in terms of addendum circle radius (R), pitch circle radius (r) and pressure angle (ϕ).
- b) A pinion having 18 teeth engages with an internal gear having 72 teeth. If both gears have involute profiled teeth with 20⁰ pressure angle, module of 4 mm and the addendum on pinion and gears are 8.5 mm and 3.5 mm respectively, find the length of the path of contact.

QUESTION 08:

Draw the shear force (S.F.) and bending moment (B.M.) diagrams for the beam loaded as shown in Fig.Q8. Determine:

- (a) the position and magnitude of the maximum B.M, and
- (b) the position of any point of contraflexure.

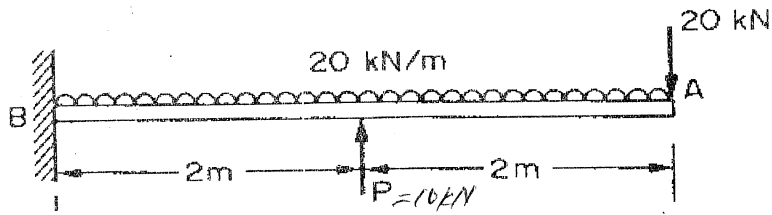


Fig.Q8

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