

B.Tech. (M) / III

J

Paper EME-305— DYNAMICS OF MACHINES

Time : 3 hours

Maximum Marks : 70

*(Write your Roll No. on the top immediately
on receipt of this question paper.)*

Attempt any five questions.

Assume missing data, if any.

Use of non-scientific calculator allowed.

1 (a) Define the following terms:

(i) Co-efficient of Fluctuation of Energy

(ii) Co-efficient of Fluctuation of speed

(2X2 = 4)

(b) The turning moment diagram for a multi – cylinder engine has been drawn to a scale of 1 mm = 650 Nm vertically and 1 mm = 6° horizontally. The areas above and below the mean torque line are : – 30, + 382, - 260, +310, -306, + 248, - 380, + 265 and – 229 mm² when taken in order from one end. The engine is running at a mean speed of 900 r. p. m. The total fluctuation of speed is not to exceed $\pm 1.8\%$ of the mean speed. If radius of flywheel is 1.05 m, find the mass of flywheel. The density of the rim material may be assumed as 7000 kg/m³. (10)

2 (a) What do you mean by partial balancing of primary forces, explain. (4)

(b) A shaft is rotating at a uniform angular speed. Four masses m_1 , m_2 , m_3 and m_4 of magnitudes 300 kg, 450 kg, 360 kg, and 390 kg, respectively are attached rigidly to the shaft. The masses are rotating in the same plane. The corresponding radii of rotation are 200 mm, 150 mm, 250 mm, and 300 mm respectively. Angles made by these masses with horizontal are 0°, 45°, 120°, and 255° respectively. Find :

(i) The magnitude of the balancing mass and

(ii) The position of the balancing mass if its radius of rotation is 250 mm. (10)

3. (a) Differentiate between a governor and flywheel? (4)

(b) The length of the upper lower arms of a Porter governor are 200 mm and 250 mm respectively. Both the arms are attached to axis of rotation. The central load is 150 N, weight of each ball is 20 N the friction of the sleeve together with the resistance of

the operating gear is equivalent 30 N at the sleeve. If the limiting inclinations of upper arms to the vertical are 30° and 40° , determine range of speed of governor. (10)

4. (a) Derive expression of gyroscopic couple (4)

(b) A car is of total mass 200 kg. It has heel base equal to 2.5 m and track width = 1.5 m. The centre of gravity lies at 500 mm above ground level and 1.5 m from the rear axle. The effective diameter of each wheel is 800 mm and moment of inertia of each wheel is 1.0 kgm^2 . The rear axle ratio is 4. The equivalent mass of engine rotating parts is 140 kg with radius of gyration 150 mm. The spin axis of the rotating engine parts is perpendicular to the spin axis of wheels. The engine parts are rotating in clockwise direction when viewed from the front. Determine the reaction at each wheel if car takes a right turn of 100 m radius at 25 m/s speed. (10)

5. (a) Define free vibration and classify it. (4)

(b) A vertical shaft of 25 mm diameter and one meter long has its upper end fixed at top and other end carries a disc of 5000 N. Take modulus of elasticity of material of shaft as $2 \times 10^5 \text{ N/mm}^2$. Neglect the weight of the shaft, determine the frequency of longitudinal vibrations and transverse vibrations. (10)

6. (a) What do you mean by period of vibrations, cycle, frequency and resonance as applied to vibratory motions? (1 + 1 + 1 + 1 = 4)

(b) A simply supported shaft of length 0.8 m carries a mass of 600 N placed .25 m from one end. If $E = 200 \times 10^9 \text{ N/m}^2$ and diameter of shaft is 50 mm, then find the natural frequency of transverse vibration. (10)

7. (a) Define the terms : damping factor, co-efficient of damping, critical co-efficient of damping and damped vibration. (1 + 1 + 1 + 1 = 4)

(b) A shaft of length 1.25 m is 75 mm in diameter for the first 275 mm of its length, 125 mm in diameter for the next 500 mm length 87.5 mm in diameter for the next 375 mm length and 175 mm in diameter for the remaining 100 mm of its length. The shaft carries two rotors at two ends. The mass moment of inertia of the first rotor is 75 kg m^2 where as of the second rotor is 50 kg m^2 . Find the frequency of natural Torsional vibrations of the system. The modulus of rigidity of shaft material may be taken as 80 GN/m^2 . (10)

8. Write short notes on any two of the following with the help of neat sketch:
- (i) Explain the terms spin and precession. How do these differ from each other?
 - (ii) Describe the fluctuation of speed of flywheel in 4 stroke I. C. Engine.
 - (iii) Partial balancing of single cylinder reciprocating engine.
 - (iv) Derive an expression for the height of Watt governor. (2x7 =14)