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Question Paper Code : P 1416

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2009.

Fifth Semester

(Regulation 2004)

Mechanical Engineering

ME 1301 — DYNAMICS OF MACHINERY

(Common to Fourth Semester, Mechatronics Engineering)

(Common to B.E. (Part-Time) – Fourth Semester, Mechanical Engineering Regulation 2005)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Define the significance of inertia force analysis.

2. Define D'Alemberts principle.

3. Differentiate : dynamic and static balancing.

4. Complete balancing of reciprocating mass in a single cylinder is not possible. Justify.

5. Define the term 'logarithmic decrement'.

6. Define damping factor.

7. Define transmissibility.

8. What is the need for vibration isolation?

9. Define hunting of the governor.

10. How does fly wheel differ from governor?

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PART B — (5 × 16 = 80 marks)

11. (a) The turning moment diagram for a multi cylinder engine has been drawn to a scale of 1mm = 325Nm vertically and 1mm = 3° horizontally. The areas above and below the mean torque line are –26, +378, –256, +306, –302, +244, –380, +261 and –225 mm^2 the engine is running at a mean speed of 600 rpm. The total fluctuation of speed is not to exceed ± 1.8% of the mean speed. If the radius of flywheel is 0.7 m, find the mass of the flywheel.

Or

(b) The dimensions of a four-link mechanism are AB = 500mm, BC = 660mm, CD = 560mm, and AD = 1000mm the link AB has an angular velocity of 10.5rad/s counter-clockwise and an angular retardation of 26rad/s^2 at the instant when it makes an angle of 60° with AD, the fixed link. The mass of the links BC and CD is 4.2 kg/m length. The link AB has a mass of 3.54 kg, the center of which lies at 200mm from A and a moment of inertia of 88,500 kgmm^2 neglecting the gravity and friction effects, determine the instantaneous value of the drive torque required to be applied on AB to over come the inertia forces.

12. (a) 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, 390 kg respectively are attached rigidly to the shaft. The masses are rotating in the same plane. The corresponding radii of rotation are 200mm, 150mm, 250mm and 300mm, respectively. The angles made by these masses with horizontal are 0°, 45°, 120°, and 255° respectively. If the system is to be balanced by adding two balancing mass. Find

(i) The magnitude of these balancing masses and

(ii) The position of the balancing mass if its radius of rotation is 200mm

Or

(b) (i) Derive the expressions for the following : (2 × 4 = 8)

(1) Variation in tractive force and

(2) Swaying couple.

(ii) The following data relate to a single cylinder vertical reciprocating engine; mass of reciprocating parts = 40kg, mass of revolving parts = 30kg at 180mm radius, speed =150rpm, stroke 350mm. If 60% of the reciprocating parts and all the revolving parts are to be balanced, determine (8)

(1) the balance mass required at a radius of 320 mm

(2) the unbalanced force when the crank has turned 45° from the top dead center.

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13. (a) A shaft is simply supported at its ends and is of 40mm in diameter and 2.5m in length. The shaft carries three point loads of masses 30kg, 70kg, and 45kg, at 0.5m, 1m, 1.7m respectively from the left support. The weight of the shaft per meter length is given as 73.575N. The young's modulus for the material of the shaft is 200GN/m^2. Find the critical speed of the shaft.

Or

(b) A machine weighs 18 kg and is supported on spring and dashpots. The total stiffness of the springs is 12N/mm and damping coefficient is 0.2 N/mm/s. The system is imparted to the mass. Determine

(i) The displacement and velocity of mass as a function of time

(ii) The displacement and velocity after 0.4s.

14. (a) A machine supported symmetrically on four springs has a mass of 80 kg. The mass of the reciprocating parts is 2.2 kg which move through a vertical stroke of 100 mm with simple harmonic motion. Neglecting damping, determine the combined stiffness of the springs so that the force transmitted to the foundation is 1/20th of the impressed force. The machine crankshaft rotates at 800 rpm.

If under actual working condition, the damping reduces the amplitudes of successive vibration by 30%, find

(i) the force transmitted to the foundation at 800rpm

(ii) the force transmitted to the foundation at resonance, and

(iii) the amplitude of the vibration at resonance.

Or

(b) A harmonic exciting force of 25N is acting on a machine part, which is having mass of 2 kg and is vibrating in a viscous medium. The exciting force causes resonant amplitude of 12.5mm with a period of 0.20 seconds. Determine the damping coefficient. If the system is excited by a harmonic force of frequency 4Hz, find the increase in amplitude of forced vibration when damper is removed.

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15. (a) A porter governor has all four arms 300mm long. The upper arms are pivoted on the axis of rotation and lower arms are attached to the sleeve at distance of 3.5 mm from the axis. The mass of each ball is 7 kg and the mass on the sleeve is 54 kg. If the extreme radii of rotation of the balls are 200mm and 250 mm, find the value of minimum speed.

Or

(b) The turbine rotator of a ship has a mass of 2200 kg and rotates at 1800 rpm clockwise when viewed from the Left the radius of gyration of the rotor is 320 mm find the gyroscopic couple and its effect when

(i) The ship turns right at radii of 250 m with a speed of 25 km/h

(ii) The ship pitches with bow rising at an angular velocity of 0.08 rad/s

(iii) The ship rolls at an angular velocity of 0.1 rad/s.

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