Question Paper Code : 11528

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2012.

Fifth Semester

Mechanical Engineering

ME 2302/ME 52/ME 1301/10122 ME 503 — DYNAMICS OF MACHINERY

(Regulation 2008)

(Common to PTME 2302 – Dynamics of Machinery for B.E. (Part-Time) Fourth Semester Mechanical Engineering Regulation 2009)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define 'piston effort' and 'crank effort'.

2. What is the function of a flywheel? How does it differ from that of a governor?

3. Differentiate: static and dynamic balancing.

4. Define hammer blow.

5. What is difference between damping and viscous damping?

6. What is meant by whirling speed of the shaft?

7. Define isolation factor.

8. Write down the expression for amplitude of forced vibration.

9. Define hunting of a governor.

10. What is the effect of gyroscopic couple on an automobile taking a turn?

11. (a) Deduce an expression for the inertia force in the reciprocating parts, neglecting the weight of the connecting rod. (16)

Or

(b) The turning moment curve for an engine is represented by the equation, $T = (20{,}000 + 9500 \sin 2\theta - 5700 \cos 2\theta)$ N-m, where θ is the angle moved by the crank from inner dead centre. If the resisting torque is constant, find

(i) Power developed by the engine,

(ii) Moment of inertia of flywheel in kg-m^2, if the total fluctuation of speed is not the exceed 1% of mean speed which is 180 rpm, and

(iii) Angular acceleration of the flywheel when the crank has turned through 45° from inner dead centre. (16)

12. (a) A, B, C and D are four masses carried by a rotating shaft at radii 100, 125, 200 and 150 mm respectively. The planes in which the masses revolve are spaced 600 mm apart and the mass of B, C and D are 10 kg, 5 kg and 4kg respectively.

Find the required mass A and the relative angular setting of the four masses so that the shaft shall be in complete balance. (16)

Or

(b) A four crank engine has the two outer cranks set at 120° to each other, and their reciprocating masses are each 400 kg. The distance between the planes of rotation of adjacent cranks are 450 mm, 750 mm and 600 mm. If the engine is to be in complete primary balance, find the reciprocating mass and relative angular position for each of the inner cranks.

If the length of each crank is 300 mm, the length of each connecting rod is 1.2 m and the speed of rotation is 240 rpm. What is the maximum secondary unbalanced force? (16)

13. (a) The mass of a single degree damped vibrating system is 7.5 kg and makes 24 free oscillations in 14 seconds when disturbed from its equilibrium position. The amplitude of vibration reduces to 0.25 of its initial value after five oscillations. Determine

(i) Stiffness of the spring,

(ii) Logarithmic decrement and

(iii) Damping factor. (16)

Or

(b) (i) Derive an expression for the frequency of free torsional vibrations for a shaft fixed at one end and carrying a load on the free end. (8)

(ii) What is meant by torsionally equivalent length of a shaft as referred to a stepped shaft? Derive the expression for the equivalent length of a shaft which has several steps. (8)

14. (a) A vibratory body of mass 150 kg supported on springs of total stiffness 1050 kN/m has a rotating unbalance force of 525 N at a speed of 6000 rpm. If the damping factor is 0.3, determine

(i) The amplitude caused by the unbalance and its phase angle

(ii) The transmissibility, and

(iii) The actual force transmitted and its phase angle. (16)

Or

(b) What do you understand by transmissibility? Describe the method of finding the transmissibility ratio from unbalanced machine supported with foundation. (16)

15. (a) The radius of rotation of the balls of a Hartnell governor is 80 mm at the minimum speed of 300 rpm. Neglecting gravity effect, determine the speed after the sleeve has lifted by 60 mm. Also determine the initial compression of the spring, the governor effort and the power. The particulars of the governor are given below :

Length of the ball arm = 150 mm, length of sleeve arm = 100 mm, mass of each ball = 4 kg, and stiffness of the spring = 25 N/mm. (16)

Or

(b) A ship is propelled by a turbine rotor which has a mass of 5 tonnes and a speed of 2100 rpm. The rotor has a radius of gyration of 0.5 m and rotates in a clockwise direction when viewed from the stern. Find the gyroscopic effect in the following conditions :

(i) The ship sails at a speed of 30 km/hr and steers to the left in a curve having 60 m radius.

(ii) The ship pitches 6° above and 6° below the horizontal position. The bow is descending with its maximum velocity. The motion due to pitching is simple harmonic and the periodic time is 20 seconds.

(iii) The ship rolls and at a certain instant it has an angular velocity of 0.03 rad/s clockwise when viewed from stern.

Determine also the maximum angular acceleration during pitching. Explain how the direction of motion due to gyroscopic effect is determined in each case. (16)
