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Question Paper Code : 91652

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2014.

Fifth Semester

Mechanical Engineering

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

(Regulation 2008/2010)

(Common to PTME 2302/10122 ME 503 — Dynamics of Machinery for B.E. (Part-Time) Fourth Semester Mechanical Engineering – Regulation 2009/2010)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. What is the purpose of the flywheel used in an engine?

2. Draw the turning moment diagram of a single cylinder double acting steam engine.

3. How the different masses rotating in different planes are balanced?

4. Define Swaying couple.

5. What are the causes and effects of vibrations?

6. Define the term "dynamic magnifier".

7. What do you meant by transmissibility?

8. Define the term "logarithmic decrement" as applied to damped vibrations.

9. What are the effects of the gyroscopic couple on a two wheeled vehicle when taking a turn?

10. Define sensitiveness of governors.

PART B — (5 × 16 = 80 marks)

11. (a) The equation of the turning moment curve of a three crank engine is $(5000 + 1500 \sin 3\theta)$ N–m where θ is the crank and in radians. The moment of inertia of the flywheel is 1000 $kg - m^2$ and the mean speed is 300 rpm. Calculate :

(i) Power of the engine, and (8)

(ii) The maximum fluctuation of the speed of the flywheel in percentage when

(1) The resisting torque is constant ,and (4)

(2) The resisting torque is $(5000 + 600 \sin \theta)$ N–m. (4)

Or

(b) A certain machine requires a torque of $(5000 + 500 \sin \theta)$ N–m to drive it, where θ is the angle of rotation of shaft measured from certain datum. The machine is directly coupled to an engine which produces a torque of $(5000 + 600 \sin 2\theta)$ N-m. The flywheel and the other rotating parts attached to the engine have a mass of 500kg at a radius of gyration of 0.4 m. If the mean speed is 150 r.p.m., find :

(i) the fluctuation of energy, (6)

(ii) the total percentage fluctuation of speed, and (5)

(iii) the maximum and minimum angular acceleration of the flywheel and the corresponding shaft position. (5)

12. (a) A shaft carries four masses in parallel planes A, B, C and D in this order along its length. The masses at B and C are 18 kg and 12.5 kg respectively. And each has an eccentricity of 60 mm. The masses at A and D have an Eccentricity of 80 mm. The angle between the masses at B and C is 100° and that between the masses at B and A is 190°, both being measured in the same direction. The axial distance between the planes A and B is 100 mm and that between B and C is 200 mm. If the shaft is in complete dynamic balance, determine: (i) The magnitude of the masses at A and D; (ii) The distance between the planes A and D; and (iii) The angular position of the mass at D.

Or

(b) A five cylinder in-line engine running at 750 r.p.m. has successive cranks 144° apart, the distance between the cylinder centre lines being 375 mm. The piston stroke is 225 mm and the ratio of the connecting rod to the crank is 4. Examine the engine for balance of primary and secondary forces and couples. Find the maximum values of these and the position of the central crank at which these maximum values occur. The reciprocating mass for each cylinder is 15 kg.

13. (a) A vertical steel shaft 15 mm diameter is held in along bearings 1 m apart and carries at its middle a disc of mass 15 kg. The eccentricity of the centre of gravity of the disc from the centre of the rotor is 0.30 mm. The modulus of elasticity for the shaft material is 200 GN/m^2 and the permissible stress is 70 MN/m^2. Determine (i) The critical speed of the shaft and (ii) The range of speed over which it is unsafe to run the shaft. Neglect the mass of the shaft.

Or

(b) The vertical shaft of 5 mm diameter is 200 mm long and is supported in long bearings at its ends. The disc of mass 50 kg is attached to the center of the shaft. Neglecting any increase in stiffness due to the attachment of the disc to the shaft. Find the critical speed of rotation and the maximum bending stress when the shaft is rotating at 75% of the critical speed. The centre of the disc is 0.25 mm from the geometric axis of the shaft. $E = 200 GN/m^2$.

14. (a) A mass of 10 kg is suspended from one end of a helical spring, the other end being fixed, the stiffness of a spring is 10 N/mm. The viscous damping causes the amplitude to decrease to one-tenth of the initial value in four complete oscillations. If a periodic force of a 150 cos50 tN is applied at the mass in the vertical direction, find the amplitude of the forced vibrations. What is its value of resonance?

Or

(b) A machine part of mass 2 kg vibrates in a viscous medium. Determine the damping coefficient when a harmonic exciting force of 35 N results in resonant-amplitude of 12.5 mm with a period of 0.2 sec. If the system is excited by a harmonic force of frequency 4Hz, what will be the percentage increase in the amplitude of vibration when damper is removed as compared with that with damping.

15. (a) Explain the effect of the gyroscopic couple on the reaction of the four wheels of a vehicle negotiating a curve.

Or

(b) In an engine governor of the porter type, the upper and lower arms are 200 mm and 250 mm respectively and pivoted on the axis of rotation. The mass of the central load is 15 kg, the mass of each ball is 2 kg and friction of the sleeve together with the resistance of the operating gear is equal to a load of 24 N at the sleeve. If the limiting Inclinations of the upper arms to the vertical are 30° and 40°, Find; taking friction into account, range of speed of the governor.
