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Question Paper Code : X60849

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2020.

Fifth Semester

Mechanical Engineering

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

(Regulations 2008/2010)

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

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 unbalanced shaking force and shaking couple.

4. What do you understand by balancing of revolving masses?

5. Write the vibration characteristics.

6. Differentiate coulomb damping and viscous damping.

7. What is the need of measuring vibration?

8. Differentiate critical speed and whirling speed of shaft.

9. Define sensitiveness of a governor.

10. List some of the terms related to motion of ships using gyroscopic principle.

PART B — (5 × 16 = 80 marks)

11. (a) Refer Fig. 11(a). Determine the couple on crank 2 to be applied for equilibrium of the system, when a force of 500 N acts on the connecting rod at point C as shown. Also determine the resultant of forces exerted on the frame of the engine.

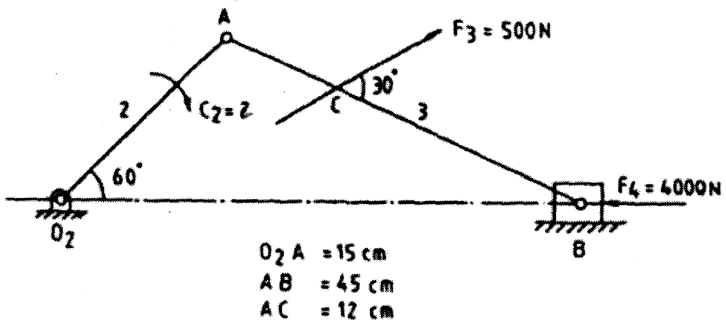


Fig. 11 (a)

Or

(b) The length of crank and connecting rod of a horizontal reciprocating engine are 100 mm and 500 mm respectively. The crank is rotating at 400 rpm. When the crank has turned 30° from the inner dead centre, find analytically (i) acceleration of the piston (ii) velocity of the piston (iii) angular velocity of the connecting rod and (iv) angular acceleration of the connecting rod. (4+4+4+4)

12. (a) A mass of 110 kg is fixed to a rotating shaft so that distance of its mass centre from the axis of rotation is 228 mm. Find balancing masses in following two conditions :

(i) Two masses – one on left of disturbing mass at a distance of 100 mm at radius 400 mm, and other on right at a distance of 200 mm at radius of 150 mm. (8)

(ii) Two masses placed on right of the disturbing mass respectively at distance of 100 and 200 mm and radii of 400 and 200 mm. The masses are placed in the same axial plane. (8)

Or

(b) The cylinders of twin V-engine are set at 60° angle with both pistons connected to a single crank through their respective connecting rods. Each connecting rod is 500 mm long and the crank radius is 100 mm. The total rotating mass is equivalent to 1.5 kg at the crank radius and the reciprocating mass is 1.8 kg per piston. A balance mass is also fitted opposite to the crank equivalent to 2 kg at a radius of 140 mm. Determine the maximum and minimum values of the primary and secondary forces due to inertia of the reciprocating and the rotating masses if the engine speed is 700 rpm. (16)

13. (a) (i) A reciprocating IC engine is coupled to a centrifugal pump through a pair of gears. The shaft from the flywheel of the engine to the gear wheel has a 50 mm diameter and is 825 mm long. The shaft from the pinion to the pump has 30 mm diameter and is 265 mm long. The pump speed is four times the engine speed. Moments of inertia of the flywheel, gear wheel, pinion and pump impellor are 1,000 kg.m^2, 14 kg.m^2, 5 kg.m^2 and 18 kg.m^2 respectively. Find the natural frequency of the torsional oscillations of the system. G = 80 GN/m^2. (12)

(ii) A steel wire 2 mm diameter is held between chucks 1 m apart. The wire weight 0.241 N/m. The flexural stiffness is 0.157 Nm^2. Calculate the first and second mode frequencies. (4)

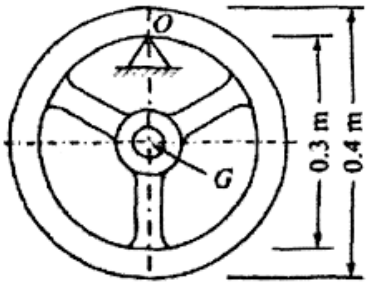
Or

(b) A machine weights 20 kg and is supported on springs and dashpots. The total stiffness of the springs is 12 N/mm and the damping is 0.2 N/mm/s. The system is initially at rest and a velocity of 125 mm/s is imparted to the mass. Determine the

(i) Displacement and velocity of mass as a function of time. (8)

(ii) Displacement and velocity after 0.5s. (8)

14. (a) A flywheel having a mass of 35 kg was allowed to swing as pendulum about a knife-edge at the inner side of the rim, as shown in Fig. 14 (a). If the measured time period of oscillation was 1.25 second, determine the moment of inertia of the flywheel about its geometric axis.



Flywheel as pendulum.

Fig. 14(a)

Or

(b) The disc of a torsional pendulum has a moment of inertia of 0.068 kg-m^2 and is immersed in a viscous fluid. The brass shaft (G = 40 GN/m^2) attached to it is of 10 mm diameter and 380 mm length, When the pendulum is vibrating the amplitudes on the same side of the rest position for successive cycles are 5°, 3° and 1.8°. Determine

(i) the logarithmic decrement, (4)

(ii) the damping torque at unit velocity. (6)

(iii) the periodic time of vibration. What would be the frequency of vibrations if the disc were removed from the viscous fluid? (6)

15. (a) (i) Explain the function of a proell governor with the help of a neat sketch. Derive the relationship among the various forces acting on the link. (12)

(ii) What are centrifugal governors? How do they differ from inertia governors? (4)

Or

(b) (i) The turbine rotor of a ship has mass of 2.2 tonnes and rotates at 1800 rpm clockwise when viewed from the aft. The radius of gyration of the rotor is 320 rpm. Determine gyroscopic Couple and its effect when

(1) The ship turns right at a radius of 250 m with a speed of 25 km/h.

(2) The ship pitches with the bow rising at an angular velocity of 0.8 rad/s.

(3) The ship rolls at an angular velocity of 0.1 rad/s. (12)

(ii) What is the effect of gyroscopic couple on the stability of a two wheel vehicle taking a turn? (4)

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