Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 23850

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2018.

Fifth Semester

Mechanical Engineering

ME 2302 — DYNAMICS OF MACHINERY

(Regulations 2008)

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

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State the principle of virtual work.

2. Define inertia and inertia force.

3. Differentiate unbalanced shaking force and shaking couple.

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

5. Why transient solution is not considered in the response of forced damped vibrating system?

6. If a damper exerts a force of 30 kN at a speed of 2 m/sec, movement, determine the damping coefficient.

7. Define step input and harmonic forcing function.

8. Define transmissibility.

9. The governor control system belongs to which type?

10. List some of the terms used in connection with the motion of naval ships.

PART B — (5 × 16 = 80 marks)

11. (a) A vertical petrol engine 150 mm diameter and 200 mm stroke has a connecting rod 350 mm long. The mass of the piston is 1.6 kg and engine speed is 1800 rpm. On the expansion stroke with crank angle 30° from top dead centre, the gas pressure is 750 kN/m². Determine the net thrust on the piston. (16)

Or

(b) The turning moment diagram for multi cylinder engine has been drawn to a vertical scale of 1 mm = 650 Nm and a horizontal scale of 1 mm = 4.5°. The areas above and below the mean torque line are –28, + 380, –260, +310, –300, +242, –380, +265 and –229 mm², the fluctuation of speed is limited to ± 1.8% of the mean speed which is 400 rpm. Density of rim material is 700 kg/m³ and width of the rim is 4.5 times its thickness. The hoop stress in the rim material is limited to 6 N/mm² Neglecting the effect of the boss and arms, determine diameter and cross section of fly wheel rim. (16)

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 and radius 400 mm, and other on right at a distance of 200 mm and 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

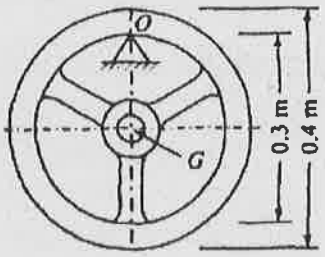
(b) The cylinders of twin V-engine are set at 60° angle with both pistons connected to a single crank through their respective connecting rods, Each connecting rod is 500 mm long and the crank radius is 100 mm. The total rotating mass is equivalent to 1.5 kg at the crank radius and the reciprocating 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) A rotor has mass of 12 kg and is mounted midway on a 21 mm diameter horizontal shaft supported at the ends by two bearings. The bearings are 1 m apart. The shaft rotates at 2400 rpm. If the center of mass of the rotor is 0.111 mm above from the geometric centre of the rotor due to a certain manufacturing defects, find the amplitude of the steady state vibration and the dynamic force transmitted to the bearing. Take $E = 200\ GN/m^2$. (16)

Or

(b) A shaft carries two masses. The mass A is 300 kg with radius of gyration of 0.75 m and the mass B is 500 kg with radius of gyration of 0.9 m. The shaft is a stepped shaft having; 100 mm diameter for 300 mm length, 150 mm diameter for 160 mm length, 120 mm diameter for 125 mm length and 90 mm diameter for 400 mm length. Determine the frequency of the natural torsional vibration. If it is desired to have node at the mid section of shaft of 120 mm diameter by changing the diameter of the section having 90 mm diameter, what will be the new diameter. Take $U = 84\ GN/m^2$. (16)

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,

(ii) the damping torque at unit velocity

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

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. (8)

(ii) What are centrifugal governors? How do they differ from inertia governors? (8)

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. (8)

(ii) What is the effect of gyroscopic couple on the stability of a two wheel vehicle taking a turn? (8)
