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Question Paper Code : 80847

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2021.

Fourth/Fifth Semester

Mechanical Engineering

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

(Regulations 2008/2010)

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

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. The lengths of crank and connecting rod of vertical reciprocating engine are 300 mm and 1.5 m respectively. If the crank rotates at 200 rpm. Find the velocity of piston at $\theta = 40°$.

2. Why the weight of flywheel for single cylinder engine is heavier than that of same powered multi cylinder engine?

3. Define hammer blow in locomotives.

4. What are the conditions required for complete balancing of reciprocating parts?

5. Write the vibration characteristics.

6. Differentiate coulomb damping and viscous damping.

7. Define isolation factor.

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

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) The following data relate to a four-bar link mechanism Fig. 11 (a)

$\omega_2 = 20$ rad/s (cw), $\alpha_2 = 160$ rad/s^2 (cw), OA = 240 mm, OG_2 = 100 mm, AB = 250 mm, AG_3 = 125 mm, BC = 250 mm, CG_4 = 130 mm, OC = 500 mm, $\angle AOC = 60°$. The masses and moment of inertia of the various members are

Link	Mass, m	MMI, kg m^2
2	21.7 kg	0.01782
3	10.66 kg	0.01105
4	24.47 kg	0.0277

Determine :

(i) The inertia force of the moving members

(ii) Torque which must be applied to link 2. (16)

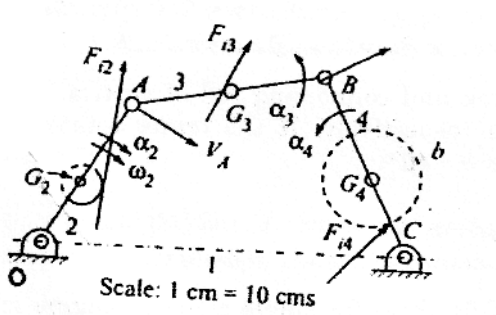


Figure 11 (a)

Or

(b) A single cylinder four-stroke petrol engine develops 18 kW power at a mean speed of 350 rpm. The work done during suction and exhaust strokes can be neglected. The work done by the gases during explosion stroke is three times the work done on the gases during the compression strokes and they can be represented by the triangles. Determine the mass of the flywheel to prevent a fluctuation of speed greater than 2% from the mean speed. The flywheel diameter may be taken as 2 m. (16)

12. (a) *A, B, C* and *D* are four masses carried by a rotating shaft at radii 100, 126, 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 incomplete 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) (i) A machine weighs 18 kg and is Supported on springs and dashpots. The total stiffness of the springs is 12 N/mm and damping is 0.2 N/mm/s the system is initially at rest and a velocity of 120 mm/s is imparted to the mass. Determine :

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

(2) The displacement and Velocity after 0.4 s. (12)

(ii) Describe the types of vibrations with simple sketch. (4)

Or

(b) A torsional system is shown in fig. 13 (b) find the frequencies of torsional vibrations and the positions of the nodes also find the amplitudes of vibrations $G = 84 \times 10^9$ N/m^2. (16)

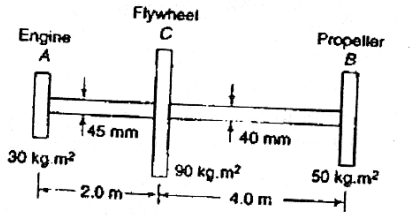
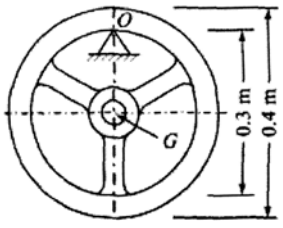


Fig 13 (b)

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 amplitude 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 vibration if the disc were removed from the viscous fluid?

15. (a) In a spring loaded governor, the controlling force curve is a straight line. The balls are 400 mm apart, when the controlling force is 1500 N and 240 mm when it is 800 N. The mass of each ball is 10 kg. Determine the speed at which the governor runs, when the balls are 300 mm apart. By how much should the initial tension be increased to make the governor isochronous? Also find the isochronous speed. (16)

Or

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

(i) the ship turns right at a radius of 250 m with a speed of 25 km/hr

(ii) the ship pitches with the bow rising at an angular velocity of 0.8 rad/sec

(iii) the ship rolls at an angular velocity of 0.1 rad/sec. (16)

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