Model Question Paper

Subject Title: MECHANICS OF MACHINES - II
Subject Code: 10ME201

Time: 3 hours
Maximum Marks: 100

Answer ALL questions

PART – A (10 x 1 = 10 MARKS)

1. Write down the condition of equilibrium for three force members.
2. Degrees of freedom of a structure is ________.
3. Higher is the fluctuation of energy in a cycle ________ is the size of the flywheel.
4. Define the term coefficient of fluctuation of speed.
5. What is meant by hammer blow?
6. Give an example of rotary balancing.
7. What is the effect of damping on the amplitude over every cycle of vibration?
8. What is the damping factor value for resonant condition?
9. What is node?
10. What is the condition to have two nodes for a shaft carrying three rotors.

PART – B (5 x 3 = 15 MARKS)

11. Explain two and three force members and their equilibrium conditions.
12. Draw the turning moment diagram of a single cylinder 4-stroke engine and indicate salient points of the diagram.
13. What is meant by primary unbalanced force and secondary unbalanced force?
14. Explain the term damping factor.
15. What is meant by torsionally equivalent shaft of a stepped shaft?

PART – C (5 x 15 = 75 MARKS)

16. The four-bar linkage has crank 2 driven by torque M_{12}; an external load P=200 N at an angle of 220° on link 4. For the particular position of the linkage shown, find all the constraint forces and their reactions necessary for equilibrium.

| R_{O_4O_2} = 20cm | R_{A_2O_2} = 15cm |
| R_{B_4O_4} = 30cm | R_{B_A} = 46cm |
| R_{Q_O_4} = 12.5cm |

(OR)

17. Derive an expression using Approximate Analytical Method for velocity and acceleration of the Piston of a reciprocating engine.
18. The turning moment diagram for a multi-cylinder engine has been drawn to a scale of 1mm=600N\cdot m vertically and 1mm=300mm horizontally. The intercepted areas between the output torque curve and the mean resistance line, taken in order from one end, are as follows: +57, -129, +97, -145, +90, -77 and +107 mm², when the engine is running at a speed of 600 r.p.m. If the total fluctuation of speed is not to exceed ± 1.5% of the mean, find the necessary mass of the flywheel of radius 0.5m.

(OR)

19. A certain machine requires a torque of \((4000+500 \sin \theta)\) N\cdot m to drive it, where \(\theta\) is the angle of rotation of shaft measured from certain datum. The machine is directly coupled to an engine which produces a torque of \((4000+600 \sin 2\theta)\) N\cdot m. The flywheel and the other rotating parts attached to the engine have a mass of 500 kg at a radius of gyration of 0.4m. If the mean speed is 150 r.p.m., find (a) The fluctuation of energy (b) the total percentage fluctuation of speed and (c) the maximum and minimum angular acceleration of the flywheel and the corresponding shaft position.

20. A shaft carries four masses A, B, C and D of magnitude 200 kg, 300 kg, 400 kg and 200 kg respectively and revolving at radii 80 mm, 70 mm, 60 mm, and 80 mm in planes measured from A at 300 mm, 400 mm and 700 mm. The angles between the cranks measured anticlockwise are A to B 45⁰, B to C 70⁰ and C to D 120⁰. The balancing masses are to be placed in planes X and Y. The distance between the planes A and X is 100 mm, between X and Y is 400 mm and between Y and D is 200 mm. If the balancing masses revolve at a radius of 100mm, find their magnitude and angular position.

(OR)

21. Explain and derive a relation for partial balancing of unbalanced primary force in a reciprocating engine.

22. The 9-kg body is moved 0.2 m to the right of the equilibrium position and released from rest at time \(t=0\). Determine the displacement at time \(t= 2\) s. The viscous damping coefficient \(c\) is 22.5 N.s/m, and the spring stiffness \(k\) is 36N/m.

(OR)

23. A shaft 50 mm diameter and 3 meters long is simply supported at the ends and carries three loads of 1000 N, 1500 N and 750 N at 1 m, 2 m and 2.5 m from the left support. The Young’s modulus for shaft material is 200 GN/m². Find the frequency of transverse vibration.

24. A steel shaft 1.5 m long is 95 mm in diameter for the first 0.6 m of its length, 60 mm in diameter for the next 0.5 m of the length and 50 mm in diameter for the remaining 0.4 m its length. The shaft carries two flywheels at two ends, the first having a mass of 900kg and 0.85m radius of gyration located at the 95mm diameter end and the second having a mass of 700 kg and 0.55m radius of gyration located at the other end. Determine the location of the node and the natural frequency of free torsional vibration of the system. The modulus of rigidity of shaft material may be taken as 80GN/m².

(OR)

25. A motor drives a centrifugal pump through gearing, the pump speed being one-third that of the motor. The shaft from the motor to the pinion is 60 mm diameter and 300 mm long. The moment of inertia of the motor is 400 kg\cdot m². The impeller shaft is 100 mm diameter and 600mm long. The moment of inertia of the impeller is 1500 kg\cdot m². Neglecting inertia of the gears and the shaft, determine the frequency of torsional vibration of the system. The modulus of rigidity of the shaft material is 80GN/m².