Reg. No. ________

Karunya University

(Declared as Deemed to be University under Sec.3 of the UGC Act, 1956)

Model Question Paper

Subject Title:	**MECHANICS OF MACHINES – II**	**Time : 3 hours**
Subject Code:	**10ME201**	**Maximum Marks: 100**

Answer ALL questions

PART – A (10 x 1 = 10 MARKS)

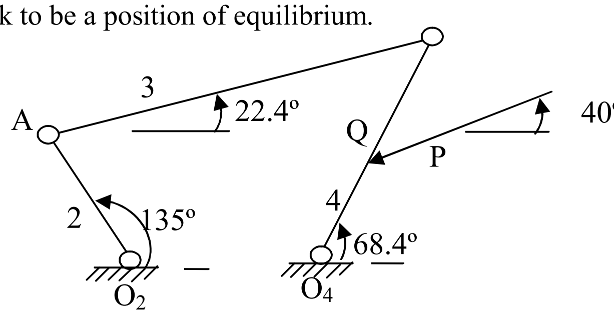
1. State two devices in which presence of friction is used for advantage.
2. State D'Alembert's principle.
3. Define the coefficient of fluctuation of energy of a flywheel.
4. What is the use of flywheel in a machine?
5. Express mathematically primary and secondary unbalanced forces in a reciprocating mass system?
6. Give an example of balancing in more than one plane
7. What is the condition for a critically damped system?
8. What is the condition for whirling speed of a shaft?
9. What is node in a torsional vibration system ?
10. A shaft having three rotors will have a maximum number of nodes: (a) one node (b) two nodes (c) three nodes (d) four nodes

PART – B (5 x 3 = 15 MARKS)

11. State Newton's laws of motion.
12. Draw the turning moment diagram for a four stroke cycle IC engines and indicate the salient features and state their meanings.
13. Using simple sketches show the position of cylinders, connecting rods and piston of in-line, V and radial engines.
14. Explain the magnification factor versus the frequency ratio for various damping ratio through a graphical plot.
15. What is an equivalent shaft? Derive the relation between lengths and diameters of a stepped shaft and an equivalent shaft.

PART – C (5 x 15 = 75 MARKS)

16. The four-bar linkage has crank 2 driven by torque $\mathbf{M}_{12}$; an external load P=120 N at an angle of 220º on link 4. For the particular position of the linkage shown find all the constraint forces and their reactions necessary for this link to be a position of equilibrium.



R_{O4O2}=20cm
R_{AO2}=15cm
R_{BO4}=30cm
R_{BA}=46cm
R_{QO4}=12.5cm

(OR)

17. The crank and connecting rod of a steam engine are 0.3m and 1.5m in length. The crank rotates at 180r.p.m. clockwise. Determine the velocity and acceleration of the piston when the crank is at 40 degrees from the inner dead centre position. Also determine the position of the crank for zero acceleration of the piston.

18. The turning moment diagram for a multi-cylinder engine has been drawn to a scale 1mm=600N-m vertically and 1mm = 3º horizontally. The intercepted areas between the output torque curve and the mean resistance line, taken in order from one end, are as follows: +62, -134, +102, -150, +95, -82 and +107 mm^2 , when the engine is running at a speed of 600r.p.m. If the total fluctuation of speed is not to exceed ± 2% of the mean, find the necessary mass of the flywheel of radius 0.5m.

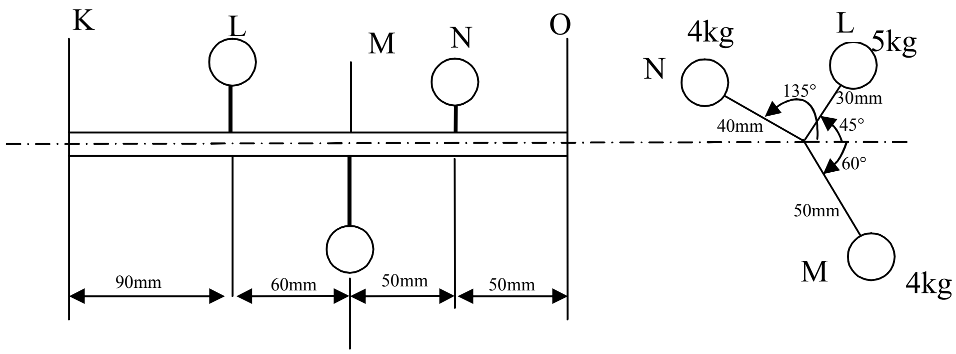
(OR)

19. A certain machine requires a torque of (5000+400sinθ) 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+500sin2θ) N-m. The flywheel and the other rotating parts attached to the engine has a mass of 500kg at a radius of gyration of 0.4m. If the mean speed is150r.p.m., find: 1. the fluctuation of energy, 2. the total percentage of fluctuation of speed, and 3. The maximum and minimum angular acceleration of the flywheel and the corresponding shaft position.

20. Five masses A, B, C ,D and E are attached to a shaft and revolve in the same plane. The masses are 10 kg, 12 kg, 15kg, 12kg and 10kg respectively and their radii of rotations are 40mm, 50mm, 60mm, 50mm and 40mm. The angular position of the masses B, C, D and E are 60°, 135° ,195° and 270° from the mass A. Find the magnitude and position of the balancing mass at a radius of 80mm.

(OR)

21. The diagram below shows masses on three rotors in planes L, M and N. Determine the masses to be added on the rotors in planes K and O at radius 60mm which will produce static and dynamic balance.



22. The 5-kg body is moved 0.15m to the right of the equilibrium position and released from rest at time t=0. Determine its displacement at time t = 1s. The viscous damping coefficient c is 15 N.s/m and the spring stiffness k is 20N/m.

(OR)

23. A shaft 1.6m long supported in flexible bearings at the ends carries two wheels each of 60kg mass. One wheel is situated at the centre of the shaft and the other at a distance of 400mm from the centre towards left. The shaft is hollow of external diameter 80mm and internal diameter 40mm. The density of the shaft material is 7800kg/m^3 and its modulus of elasticity is 200GN/m^2. Find the lowest whirling speed of the shaft, taking into account the mass of the shaft.

24. A steel shaft 1.25m long is 75mm in diameter for the first 0.5m of its length, 50mm in diameter for the next 0.5 m of the length and 37.5mm in diameter for the remaining 0.25m of its length. The shaft carries two flywheels at two ends, the first having a mass of 750kg and 0.707m radius of gyration located at the 75mm diameter end and the second having a mass of 500kg and 0.50m 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 is 80GN/m^2.

(OR)

25. A motor drives a centrifugal pump through gearing, the pump speed being one-fourth that of the motor. The shaft from the motor to the pinion is 50mm diameter and 250mm long. The moment of inertia of the motor is 250 kg-m^2. The impeller shaft is 75mm diameter and 500mm long. The moment of inertia of the impeller is 1000kg-m^2. 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/m^2.