Model Question Paper (CBCS) with effect from 2015-16

15ME52

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Fifth Semester B.E. Degree (CBCS) Examination

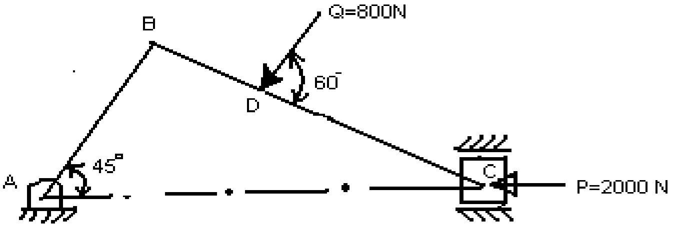
Dynamics of Machinery

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

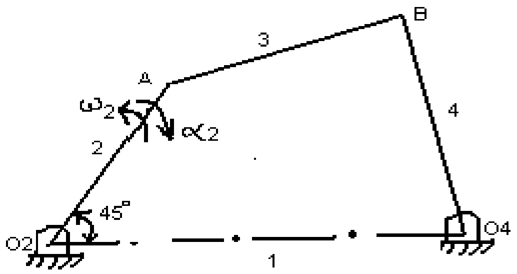
MODULE – I

1 **a** Determine the various forces on the links and couple T2 in the fig (16Marks)
AB = 300 mm , BC = 600 mm , BD=200 mm



OR

2 **a** A four bar mechanism is shown in fig. The center of gravity of each link is at its midpoint. Length of links O_2O_4 = 500mm, O_2A = 250 mm, O_4B = 300 mm, AB = 300 mm. Mass of links O_2A = 1.52 kg, AB = 3.06 kg, O_4B = 5.09 kg. Mass moment of inertia of links O_2A = 0.012 kg-m², AB = 0.012 kg-m², O_4B = 0.012 kg-m². Find the inertia forces on each link. (16Marks)



MODULE – II

3 **a** Explain analytical method of balancing of several masses in same plane (04 Marks)

b A Shaft running in bearings carries masses 20, 30, 40 Kg in planes A, B and C with C.G from the Axis of the shaft 30 mm, 20 mm and 15 mm respectively. The Distances of planes B and C from A are 1000 mm and 2000 mm to the right of A. The relative angular positions of the unbalanced masses are such that they are in static balance. To obtain complete dynamic balance suitable masses are introduced in planes D and E with C.G 100 mm from the axis. D is 500 mm to the left of A and E is 500 mm to right of C. Determine the position and magnitude of the balancing masses. (12 Marks)

OR

4 **a** With usual notations, Explain primary and secondary unbalanced forces of reciprocating masses (04 Marks)

b A 5 masses Cylinder inline engine running at 500 rpm has successive cranks at 144^0 apart. The distance between the cylinder centre line is 300 mm. Piston stroke=240 mm. Length of CR = 480 mm. Examine the engine for balance of primary and secondary forces and couples. Find the maximum value of these and position of central crank at which these maximum values occur. The reciprocating mass for balance each cylinder is 150 N. (12 Marks)

Important Note: 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written e.g, 38+2 = 40, will be treated as malpractice.

MODULE – III

5 **a** Derive expression for Governor Effort for K=1 (04 Marks)

b A porter governor has equal arms each 300mm long & pivoted on the axis of rotation. Each ball has a mass of 5 kg & the mass of the sleeve is 15 kg. The radius of rotation of the ball is 200 mm when the governor begins to lift & 250 mm when the governor is at maximum speed. Find the range of speed (12 Marks)

a. When the friction at the sleeve is neglected
b. When the friction at the sleeve is equivalent to 30 N

OR

6 **a** With neat sketches, explain the effect of gyroscopic couple on steering, pitching and rolling of ship. (06 Marks)

b A rear engine automobile is travelling along a track of 100 m radius. Each of the four wheels has a moment of inertia of 2 kgm2 and an effective diameter of 0.6 m. The rotating parts of the engine have a moment of inertia of 1.25 kgm2. The engine axis is parallel to the rear axle and the crank shaft rotates in the same direction as the wheels. The gear ratio of engine to back axle is 3:1. The automobile mass is 1500 kg and its centre of gravity is 0.5 m above the road level. The width of the track of the vehicle is 1.5 m. Determine the limiting speed of the vehicle around the curve for all the wheels to maintain contact with the road surface. (10 Marks)

MODULE – IV

7 **a** Add the fallowing motions analytically (06 Marks)

$X1 = 3 \sin(\omega t + 30^0)$ $X2 = 4 \cos(\omega t + 10^0)$

b The motion of a particle is **$X = 5 \sin \omega t$** .Show the relative positions and magnitudes of the displacement, velocity and acceleration vectors at time t = 0 wheni) ω=0.5 rad/sec, ii) ω=1 rad/sec, iii) ω=2 rad/sec

(10 Marks)

OR

8 **a** Using Energy Method Derive differential equation for undamped free vibrations. (06 Marks)

b A block of mass 0.05 Kg is suspended from spring having stiffness of 25 N/m. The block is displaced downwards from its equilibrium position through a distance of 2 cm and released with an upward velocity of 3 cm/sec. Determine i) Natural Frequency ii) Period of oscillation iii) Maximum Velocity iv) Maximum Acceleration v) Phase angle. (10 Marks)

MODULE – V

9 **a** Explain the fallowing i)Critical Damping ii) Damping ratio iii) logarithmic decrement iv) Damped natural Frequency (08 Marks)

b A mass of 7.5 Kg hangs from a spring and makes damped oscillations. The time for 60 oscillations is 35 secs and the ratio of seventh displacement is found to be 2.5. Find i) Stiffness of spring ii) Damping Resistance iii) If the oscillations were critically damped what is the damping resistance. (08 Marks)

OR

10 **a** Explain the fallowing i) Viscous Damping ii) Coulomb Damping iii) Structural Damping (06 Marks)

b A vibrating body is supported by six isolators each having stiffness 32000 N/m and 6 dash pots each have 400 N-s/m. The vibrating body is to be isolated by a rotating device having an amplitude of 0.06 mm at 600 rpm. Take m=30 Kg. Determine the amplitude of vibration of the body and dynamic load on each isolator. (10 Marks)