CBCS SCHEME

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15ME52

Fifth Semester B.E. Degree Examination, Jan./Feb.2021
Dynamics of Machinery

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 A 4 bar mechanism under the action of two external forces is shown in Fig. Q1. Determine the torque to be applied on the link AB for static equilibrium. The dimensions of the links are AB = 50 mm, BC = 66 mm, CD = 55 mm, CE = 25 mm, CF = 30 mm ∠BAD = 60° and AD = 100 mm, CF = 30 mm, CE = 25 mm. **(16 Marks)**

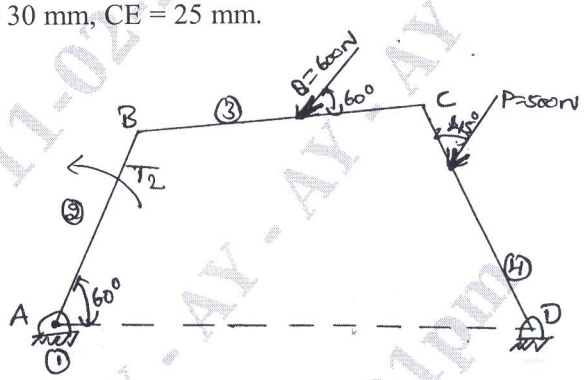

Fig. Q1

OR

2 The following data relate to a connecting rod of a reciprocating engine: Mass = 50 kg; Distance between bearing centres = 900 mm; Diameter of small end bearing = 70 mm; Diameter of big end bearing = 90 mm; Time of oscillation when the connecting rod is connected from small end is 1.9 seconds; Time of Oscillation when the connecting rod is connected from big end = 1.7 seconds. Determine (i) Radius of gyration of the rod is connected about an axis through centre of mass perpendicular to the plane of oscillation.
(ii) Moment of Inertia of the rod about the same axis. (iii) Dynamically equivalent system of connecting rod comprising two masses one at small end bearing centre. **(16 Marks)**

Module-2

3 a. Explain static and dynamic balancing of rotating masses. **(04 Marks)**
b. Four masses of magnitude 5, 6, M and 8 kg revolve in planes A, B, C and D respectively. The planes B, C, D are placed at a distance 0.3 m, 1.2 m and 2.0 m respectively from A. The masses are at same radii of 0.3 m. Find the magnitude of M and relative angular position of all masses for compute balance. **(12 Marks)**

OR

4 A four crank engine has two outer cranks set at 120° to each other and their reciprocating masses are each 400 kg. The distance between 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 the relative angular position for each of the inner cranks. If the length of crank is 300 mm, length of connecting rod is 1.2 m and speed of rotation is 240 rpm. Find the maximum secondary unbalanced force. **(16 Marks)**

Module-3

5 a. Explain the following: (i) Isochronous governors (ii) Hunting (iii) Sensitiveness of governors. **(06 Marks)**

b. In a spring controlled governor, the curve of controlling force is straight line. When balls are 400 mm apart, the controlling force is 1200 N and when 200 mm apart the controlling force is 450 N. At what speed will the governor run when the balls are 250 mm apart? What initial tension on the spring would be required for isochronisms and what would then be the speed? The mass of each ball is 9 kg. **(10 Marks)**

OR

6 a. Explain with neat sketch the Gyroscopic effect of an Aeroplane. **(08 Marks)**

b. A four wheeled trolley car has a total mass of 3000 kg. Each axle with its two wheels and gears has a total MI of 32 kg m^2. Each wheel is of 450 mm radius. The centre distance between two wheels is 1.4 m. Each Axle is driven by a motor with speed ratio of 1 : 3. Each motor along with its gear has a M.I. 16 kgm^2 and rotates in the opposite direction to that of axle. The center of mass of the car is 1 m above the rails. Calculate the limiting speed of the car when it has to travel around a curve of 250 m radius without leaving the rails. **(08 Marks)**

Module-4

7 a. Add the following two S.H.M and check it graphically,

$$x_1 = 4\sin\left[wt + \frac{\pi}{3}\right],\ x_2 = -6\cos\left[wt + \frac{2\pi}{3}\right].$$ **(08 Marks)**

b. Determine the natural frequency of the simple pendulum, (i) Neglecting mass of rod (ii) Considering the mass of rod. **(08 Marks)**

OR

8 Determine the natural frequency of the system as shown in Fig. Q8 (a) and Fig. Q8 (b). **(16 Marks)**

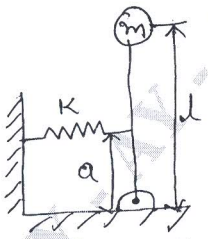

Fig. Q8 (a)

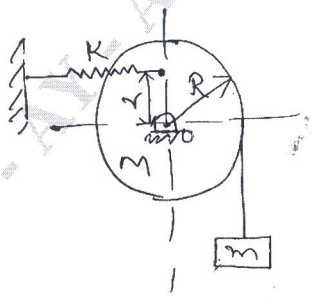

Fig. Q8 (b)

Module-5

9 a. Derive a governing differential equation of damped free vibration (viscous damping). **(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 first to 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 transmissibility ratio and explain different cases with curve. **(06 Marks)**

b. Determine the critical speed when an automobile trailer is traveling over a road with the road surface varies sinusoidally with a wave length of 15 meters and amplitude of 0.075 m. The springs of automobile are compressed 0.125 m under its own weight. Also determine the amplitude of vibration at 50 km/hr. **(10 Marks)**

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