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15ME52

Fifth Semester B.E. Degree Examination, Aug./Sept. 2020 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. State the conditions for static equilibrium of a body subjected to a system of, (i) two forces (ii) Three forces. (04 Marks)
- b. For the static equilibrium of the quick return mechanism shown in Fig. Q1 (b). Find the required input torque T_2 for a force of 3500 N on the slider. Angle of EB with the vertical is 70° . The impending motion of the slider is to the left. (12 Marks)

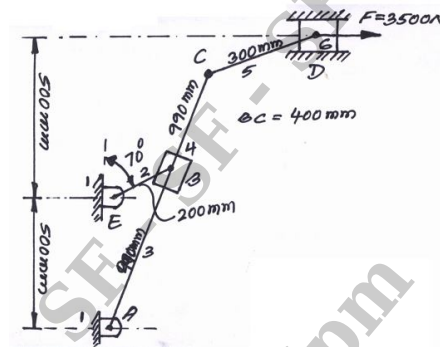


Fig. Q1 (b)

OR

- 2 a. What do you mean by inertia force and inertia torque? (04 Marks)
- b. A four bar mechanism shown in Fig. Q2 (b) has the following length of various links $O_2O_4 = 800$ mm, $O_2B = 330$ mm, $BC = 500$ mm, $O_4C = 400$ mm, $O_2G_2 = 200$ mm, $BG_3 = 250$ mm, $O_4G_4 = 200$ mm. The masses of links are $m_2 = 2.2$ kg, $m_3 = 2.5$ kg, $m_4 = 2$ kg. The moment of inertia of links about their C.G are $I_2 = 0.05$ kg-m², $I_3 = 0.07$ kg-m². The crank O_2B rotates at 100 rad/s². Neglecting gravity effects, determine the forces in the joints and the input torque. (12 Marks)

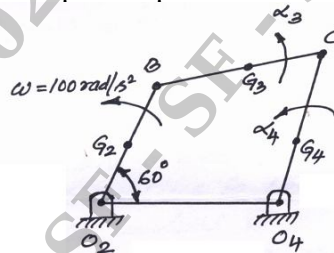


Fig. Q2 (b)

Module-2

- 3 a. What do you mean by static balancing and dynamic balancing? (04 Marks)
- b. A rotating shaft carries 4 masses A, B, C and D at radii 100, 125, 200 & 150 mm respectively. The planes in which the masses revolve are spaced 600 mm apart and the masses B, C and D having 10, 5 and 4 kg respectively. Find the required mass A and relative angular positions of 4 masses to keep the shaft in balance. (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 eg. 42+8 = 50, will be treated as malpractice.

OR

- 4 The cranks and connecting rods of a 4-cylinder in line engine running at 1800 rpm are 60 mm and 240 mm. Each respectively and the cylinder are spaced 150 mm apart. If the cylinders are numbered 1 to 4 in sequence from one end, the cranks appear at intervals of 90° in an End view in the order 1 – 4 – 2 – 3. The reciprocating mass corresponding to each cylinder is 1.5 kg. Determine
- Unbalanced primary and secondary force.
 - Unbalanced primary and secondary couples with reference to control plane of the engine.
- (16 Marks)**

Module-3

- 5 a. Define the following: (i) Sensitiveness (ii) Hunting (iii) Isochronism
(iv) Effort of governor (v) Stability of governor
(vi) Power of governor. **(06 Marks)**
- b. A loaded governor of the porter type has equal arms and links each 300 mm long. The weights of each ball is 20 N and the central weight is 120 N. When the ball radius is 150 mm, the valve is fully open and when the radius is 180 mm, the valve is closed. Find the maximum speed and the range of speed. If the maximum speed is to be increased 25% by an addition of weight to the central load, find its valve. **(10 Marks)**

OR

- 6 a. Derive an expression for the gyroscopic couple $C = I\omega\omega_p$ from first principle. **(06 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 M.I. of 32 kg-m^2 . Each wheel is of 450 mm radius. The centric distance between two wheel 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 of 16 kg-m^2 and rotates in the opposite direction to that of axle. The centre of mass of the car is 1 m above the rails. Calculate the limiting speed of the car when it has to travel around curve of 250 m radius without the wheels leaving the rails. **(10 Marks)**

Module-4

- 7 a. Define vibration. Give the classification of vibration. **(05 Marks)**
- b. Add the following harmonic motions and check the solution graphically
 $x_1 = 2 \cos(\omega t + 0.5)$, $x_2 = 5 \sin(\omega t + 1.0)$. **(11 Marks)**

OR

- 8 a. Determine the natural frequency of the spring mass system considering mass of the spring. **(08 Marks)**
- b. Find the natural frequency of the system as shown in Fig. Q8 (b). Solve by energy method. **(08 Marks)**

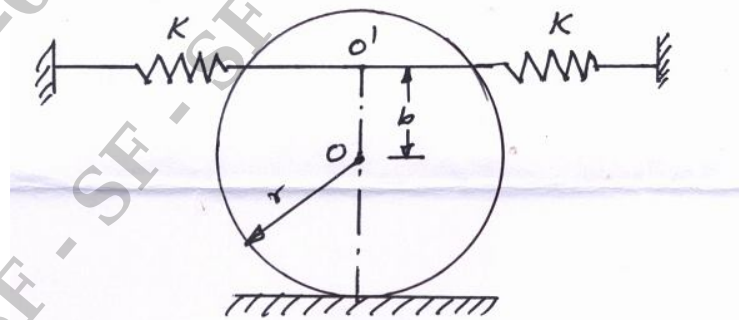


Fig. Q8 (b)

**Module-5**

- 9 a. Define damping. Explain different types of damping with neat sketches. (10 Marks)
- b. Show that the ratio of successive amplitudes of mass in a under damped, viscously damped spring mass system is given by $\frac{x_0}{x_1} = e^{\delta}$ where $\delta = \frac{2\pi\xi}{\sqrt{1-\xi^2}}$. (06 Marks)

OR

- 10 a. Write a note on vibration isolation and transmissibility. Explain the influence of frequency ratio on transmissibility. (08 Marks)
- b. A weight of 60 N suspended by a spring of stiffness 1.2 kN/m is forced to vibrate by a harmonic force of 10 N. Assuming viscous damping of 0.086 kN-s/m. Determine
- The resonant frequency.
 - Amplitude at resonance.
 - Phase angle at resonance.
 - Frequency corresponding to peak amplitude.
 - Peak amplitude.
- (08 Marks)

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