CBCS SCHEME

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15ME52

Fifth Semester B.E. Degree Examination, Feb./Mar. 2022
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. Define the following:
(i) Rigid body (ii) Inertia force
(iii) Mass moment of inertia (iv) Free body diagram **(04 Marks)**

b. Find the torque required to be applied to the link AB of the mechanism shown in Fig.Q1(b) to maintain static equilibrium. Given dimensions are AB = 550 mm, BC = 700 mm, CD = 650 mm, DE = 500 mm and AD = 300 mm.

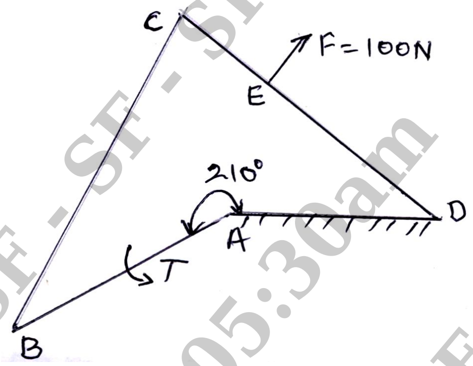

Fig.Q1(b) **(12 Marks)**

OR

2 a. Show the equation to locate the position of equivalent masses in dynamically equivalent system. **(06 Marks)**

b. The following data relate to horizontal reciprocating engine; mass of reciprocating parts = 100 kg, mass of connecting rod = 80 kg, stroke length = 200 mm, length of connecting rod between centres = 400 mm, radius of gyration of connecting rod about an axis through C.G. = 120 mm, distance of C.G from big end centres = 160 mm and engine speed = 900 rpm clockwise. Determine the inertia torque on crankshaft when crank has turned 40° from IDC analytically. **(10 Marks)**

Module-2

3 a. (i) What is balancing of rotors? Why it is required? **(02 Marks)**
(ii) Explain the static and dynamic analysis. **(04 Marks)**

b. A, B, C and D are four masses carried by rotating shaft at radii 100 mm, 125 mm, 200 mm and 150 mm respectively. The planes in which the masses revolve are spaced 600 mm apart and the masses of B, C and D are 10 kg, 5 kg and 4 kg respectively. Find the mass 'A' and the relative angular settings of the four masses, so that the shaft shall be in complete balance. **(10 Marks)**

OR

4 a. Explain primary and secondary unbalanced forces of reciprocating masses. **(04 Marks)**

b. A 5 cylinders in-line engine running at 500 rpm, has successive cranks at 144° apart. The distance between the cylinder centre is 300 mm, piston stroke = 240 mm and length of connecting rod = 480 mm. Examine the engine for balance of primary and secondary forces and couples. The reciprocating mass for each cylinder is 50N. Check the values of primary and secondary forces and couples graphically. **(12 Marks)**

Module-3

5 a. Define the following :

(i) Sensitiveness (ii) Isochronous governor
(iii) Stability (iv) Hunting **(04 Marks)**

b. A porter governor has all four arms 300 mm long. The upper arms are pivoted on axis of rotation and lower arms are attached to the Sleeves at a distance 35 mm from the axis. The mass of each ball is 7 kg and the load on sleeve is 540 N. Determine the equilibrium speed for two extreme radii of 200 mm and 260 mm of rotation of governor balls. **(12 Marks)**

OR

6 a. Explain with suitable sketches the Gyroscopic effect on steering of a ship. **(06 Marks)**

b. The turbine rotor of a ship has a mass of 2.2 tonnes and rotates at 1800 rpm clockwise when viewed from the aft. The radius of gyration of the rotor is 230 mm. Determine the gyroscopic couple and its effect, when:

(i) ship turns right at a radius of 250 m with a speed of 25 km/hr
(ii) ship pitches with the bow rising at an angular velocity of 0.8 rad/sec
(iii) ships rolls at an angular velocity of 0.1 rad/sec. **(10 Marks)**

Module-4

7 a. Add the following harmonic motions analytically, $x_1 = 4\cos(\omega t + 10^o)$ and $x_2 = 6\sin(\omega t + 60^o)$. Also check the solution graphically. **(10 Marks)**

b. Derive the equation for equivalent stiffness of spring combinations. **(06 Marks)**

OR

8 a. Determine the effect of the mass of the spring on the natural frequency of the system. **(08 Marks)**

b. Find the natural frequency of the system shown in Fig.Q8(b).

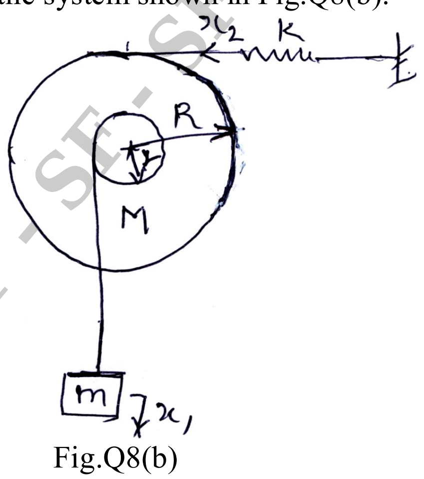

Fig.Q8(b) **(08 Marks)**

Module-5

9 a. Derive the expression for displacement for underdamped and overdamped vibrating system. **(08 Marks)**

b. The torsional pendulum with a disc of moment of inertia J = 0.05 kg-m^2 immersed in a viscous fluid. During vibration of pendulum, the observed amplitudes on the same side of the neutral axis for successive cycles are found to decay 50% of the initial value. Determine:
(i) Logarithmic decrement
(ii) Damping torque per unit velocity
(iii) The periodic time of vibration
(iv) The frequency when the disc is removed from the fluid.
Assume G = 4.5 × 10^{10} N/m^2 for the material of shaft, diameter of the shaft = 0.1 m and length = 0.5 m. **(08 Marks)**

OR

10 a. Derive the magnification factor for damped vibrating system with Harmonic force. **(08 Marks)**

b. The vibrating system is displayed for vibrational characteristics. The total mass of the system is 25 kg. At speed of 1000 rpm, the system and eccentric mass have a phase difference of 90° and the corresponding amplitude is 1.5 cm. The eccentric unbalanced mass of 1 kg has a radius of rotation 4 cm. Determine:
(i) The natural frequency of system
(ii) The damping factor
(iii) The amplitude at 1500 rpm
(iv) The phase angle at 1500 rpm **(08 Marks)**

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