CBCS SCHEME

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18ME53

Fifth Semester B.E. Degree Examination, Dec.2023/Jan.2024
Dynamics of Machines

Time: 3 hrs. Max. Marks: 100

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 :
(i) Two forces (ii) Three forces **(06 Marks)**

b. A four bar mechanism shown in Fig.Q1(b) has crank 2 driven by an input torque T_2 ; an external load P = 50 N acting at point E on link 3. For the position shown in figure, find the magnitude and direction of torque T_2 for the linkage to be in static equilibrium.

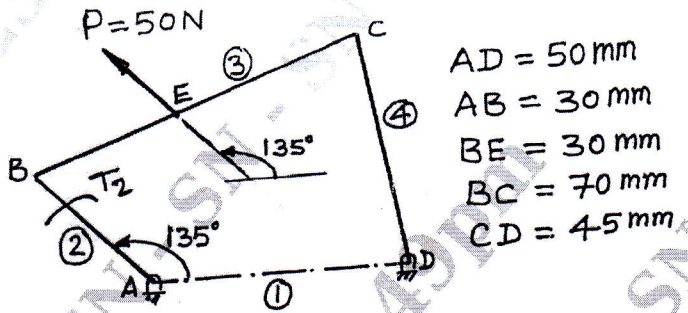

Fig.Q1(b) **(14 Marks)**

OR

2 a. State and explain D'Alembert's principle. **(05 Marks)**

b. When the crank is 50° from the inner dead centre on the down stroke, the effective steam pressure on the piston of a vertical steam engine is 2.5 bar. The diameter of the cylinder = 0.80 m, stroke of the piston = 0.5 m and length of the connecting rod = 1 meter. Determine the torque on the crank shaft, if the engine rotates at 350 rpm and the inertia of reciprocating parts 250 kg. **(15 Marks)**

Module-2

3 a. Explain static and dynamic balancing of rotating masses. **(06 Marks)**

b. Four masses A, B, C and D carried on a rotating shaft are at radii 100 mm, 140 mm, 210 mm and 160 mm respectively. The planes in which the masses revolve are spaced 600 mm apart and the masses of B, C and D are 16 kg, 10 kg, and 8 kg respectively. Find the required mass A and the relative angular positions of the four masses for the complete balancing of the shaft. **(14 Marks)**

OR

4 In a three cylinder engine, cranks are spaced at an equal angular interval of 120°. Length of connecting rod is 550 mm and the stroke length is 280 mm. The distance between centre line axis of the cylinders is 400 mm. Mass of reciprocating parts of each cylinder is 60 kg and the speed of the engine is 600 rpm. Find the primary and secondary unbalanced forces and couples acting on the reciprocating parts. **(20 Marks)**

Module-3

5 a. Define: (i) Height of governor (ii) Sensitivity of a governor (iii) Effort of a governor **(06 Marks)**

b. The upper arms of a porter governor are pivoted on the axis of rotation, their lengths being 300 mm. The lower arms are 270 mm long and are pivoted on the sleeve at a distance of 30 mm from the axis. Mass of each ball is 6 kg and sleeve mass is 50 kg. Determine the equilibrium speed for a radius of rotation of 170 mm and also the effort and power for one percent change of speed. **(14 Marks)**

OR

6 a. With usual notations, derive an expression for magnitude of Gyroscopic couple. **(08 Marks)**

b. The moment of inertia of an aeroplane air screw is 20 kg-m^2 and its speed of rotation is 1250 rpm clockwise as viewed from the nose. The speed of flight is 200 km/hour. Calculate the gyroscopic couple and discuss the direction and effect of gyroscopic couple on the aeroplane when it takes left turn on a 150 m path radius. **(12 Marks)**

Module-4

7 a. Briefly discuss/explain the following: (i) Simple Harmonic Motion (ii) Degrees of freedom (iii) Logarithmic decrement **(06 Marks)**

b. The mass 'm' is hanging from a chord attached to the circular homogeneous disc of mass 'M' and radius 'R' as shown in Fig.Q7(b). The disc is restrained from rotating by a spring attached at radius 'r' from the centre of the disc. If the mass is displaced downwards from the rest position, determine the frequency of oscillations. Take spring stiffness as 'k'. Use energy method.

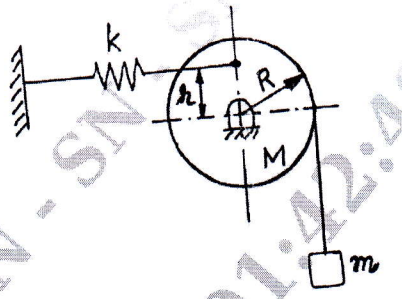

Fig.Q7(b) **(14 Marks)**

OR

8 a. Define: (i) Damping factor (ii) Damping ratio (iii) Critically damped system. **(06 Marks)**

b. In a single degree damped vibrating system, a suspended mass of 8 kg makes 30 oscillations in 18 seconds. The amplitude decreases to 0.25 of the initial value after 5 oscillations. Determine: (i) The stiffness of the spring (ii) Logarithmic decrement (iii) Damping factor (iv) The damping coefficient **(14 Marks)**

Module-5

9 a. Write a brief note on vibration isolation. **(05 Marks)**

b. A machine of total mass 17 kg is mounted on springs having stiffness k = 11000 N/cm. A piston within the machine has a mass of 2 kg which was reciprocating machine with stroke of 75 mm and speed 6000 rpm. Assuming the motion to be Simple Harmonic Motion. Determine: (i) Amplitude of machine (ii) Transmissibility (iii) Force transmitted to the ground or foundation. Take damping factor $\xi = 0.2$. **(15 Marks)**

OR

10 a. Define transmissibility. **(05 Marks)**

b. A shaft of 50 mm diameter and 3m long is supported at the ends and carries three weights of 1000 N, 1500 N and 750 N at 1m, 2m and 2.5 m from the left support, respectively. Take E = 200 GPa and find the frequency of transverse vibration of the shaft. **(15 Marks)**