CBCS SCHEME

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18ME53

Fifth Semester B.E. Degree Examination, June/July 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 system of (i) Two forces (ii) Three forces. **(06 Marks)**

b. In the Slider Crank mechanism the crank and connecting rod lengths are 80mm and 240mm respectively. When the crank has turned by 60° from IDC, a force of 2 kN acts on the piston towards crank shaft. Determine the torque on the crank for static equilibrium. **(14 Marks)**

OR

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

b. In a vertical petrol engine, the crank and connecting rod lengths are 60mm and 270mm respectively. The diameter of the piston is 100mm, mass of the reciprocating parts is 1.2kg and speed 1800 rpm. During the expansion stroke when the crank has turned 20° from top dead centre the gas pressure is 650 kN/m^2. Determine (i) Net driving force on the piston (ii) Force on the connecting rod (iii) Thrust on the cylinder walls (iv) Torque on the crank. **(15 Marks)**

Module-2

3 a. State the conditions for (i) Static balancing (ii) Dynamic balancing **(04 Marks)**

b. A rotating shaft carries four masses A, B, C and D having radii of mass centre 30mm, 38mm, 40mm and 35mm respectively, from the axis of rotation. The masses are 7.5kg, 5kg and 4 kg for A, C and D respectively. The axial distances between the planes of rotation of A and B is 400mm and between B and C is 500mm. The masses A and C are at right angles to each other. Find for complete balance,
i) The angles between the masses B and D from mass A
ii) The axial distance between the planes of rotation of C and D
iii) The magnitude of mass B **(16 Marks)**

OR

4 In a 4 cylinder inline engine running at 1800rpm, the crank and connecting rods are 60mm and 240mm respectively. The cylinders are spaced at 150mm apart. If the cylinders are numbered 1 to 4 in sequence from one end, the crank appears at intervals of 90° in end view in the order 1-4-2-3. The reciprocating mass in each cylinder is 1.5kg. Determine graphically
i) Unbalanced primary and secondary forces
ii) Unbalanced primary and secondary couples with reference to central plane of the engine. **(20 Marks)**

Module-3

5 a. Define the following terms with respect to governors:
i) Isochronism ii) Sensitiveness iii) Effort iv) Power **(08 Marks)**

b. Each arm of a porter governor is 200mm long and is pivoted on the axis of the governor, the radii of rotation of the balls at minimum and maximum speeds are 120mm and 160mm respectively. The mass of the sleeve is 24kg and mass of each ball is 4kg. Find sleeve lift and the range of speed of the governor if the friction at the sleeve is 18N. **(12 Marks)**

OR

6 a. With a neat sketch show the following :
i) Axis of spin ii) Axis of precession iii) Axis of couple iv) Plane of spin
v) Plane of precession vi) Plane of couple. **(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 stern. The radius of gyration of the rotor is 320mm. Determine the gyroscopic couple and its effect when the
(i) Ship turns right at a radius of 250mm with a speed of 25 kmph
(ii) Ship pitches with the bow rising at an angular velocity of 0.8 rad/s. **(14 Marks)**

Module-4

7 a. Derive the natural frequency of the spring mass system considering the mass of the spring into account using energy method. **(10 Marks)**

b. Find the natural frequencies of the system shown in Fig.Q7(b) by using Newton's method.

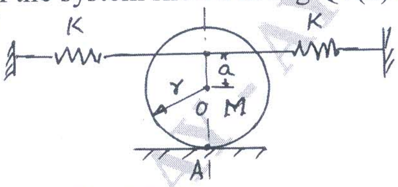

Fig.Q7(b) **(10 Marks)**

OR

8 a. Define logarithmic decrement and derive the equation for the same in terms of damping factor. **(10 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 the
(i) Stiffness of the spring (ii) Logarithmic decrement
(iii) Damping factor (iv) Damping coefficient **(10 Marks)**

Module-5

9 a. Derive an expression for the transmissibility ratio. **(10 Marks)**

b. A single cylinder vertical engine has a mass of 400kg and is mounted on a steel chassis frame. The static deflection owing to the weight of the chassis is 2.4mm. The reciprocating masses of the engine amounts to 18kg and the stroke of the engine is 160mm. A dashpot with a damping coefficient of 2 N/mm/s is also used to dampen the vibrations. In the steady state of the vibrations, determine
(i) the amplitude of the vibration if the driving shaft rotates at 500 rpm
(ii) the speed of the driving shaft when the resonance occurs. **(10 Marks)**

OR

10 a. Define the terms :
(i) Magnification factor (ii) Transmissibility ratio (iii) Vibrations isolation
(iv) Critical speed **(08 Marks)**

b. A rotor has a mass of 12 kg and is mounted midway on a 24mm diameter horizontal shaft supported at the ends by two bearings. The bearings are 1m apart. The shaft rotates at 2400rpm. If the centre of mass of the rotor is 0.11mm away from the geometric centre of the rotor due to certain manufacturing defect find (i) the steady state amplitude of vibration (ii) the dynamic force transmitted to the bearings. Take E = 200 GPa. **(12 Marks)**

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