CBCS SCHEME

USN | | | | | | | | | | 18ME53

Fifth Semester B.E. Degree Examination, Jan./Feb. 2023
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 four bar mechanism with the following dimensions is acted upon by a force 80N , 150° on the link DC. Determine the input torque on the link AB for the static equilibrium of the mechanism for the given configuration Fig. Q1. AB = 400mm , BC = 1000mm , CD = 750mm and DE = 350mm , AD = 500mm. **(20 Marks)**

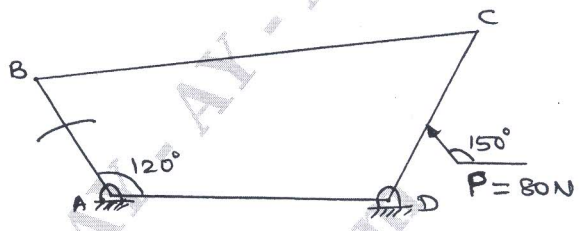

Fig. Q1

OR

2 a. State the condition of equilibrium of a body subjected to a system of
i) Two force ii) Three force iii) Two force and a torque. **(06 Marks)**

b. In a vertical engine, the length of connecting rod is 4.5 times the crank. The mass of reciprocating parts is 120kg and the crank length is 220mm. The engine runs at 250 rpm. The load on the piston due to steam pressure is 25 kN, when the crank has turned through an angle of 120° from the top dead centre. Determine i) Net effective driving force on the piston ii) Thrust on connecting rod iii) Thrust on the bearings iv) Turning moment on the crank shaft. **(14 Marks)**

Module-2

3 a. Explain Static and Dynamic balancing of rotating masses. **(04 Marks)**

b. Four masses A, B, C and D carried on a shaft at radii 100mm , 125mm , 200mm and 150mm respectively. The planes at which masses are rotating are placed 600mm apart. The mass B, C and D are 10kg , 5kg and 4kg respectively. Find the mass of A and relative angular position of the four masses so that the shaft will be in equilibrium. **(16 Marks)**

OR

4 The firing order in a six cylinder four stroke in line engine is 1 – 4 – 2 – 6 – 3 – 5. The piston stroke is 100mm and length of each connecting rod is 200mm. The pitch of the cylinder centre lines are 100mm , 100mm , 150mm , 100mm and 100mm respectively. The reciprocating mass per cylinder is 1kg and the engine runs at 3000 rpm. Determine the unbalanced primary and secondary forces and couples, if any. Take central plane of the engine as reference plane. **(20 Marks)**

Module-3

5 a. Derive the expression for speed of a Porter Governor with usual notations, taking friction into account. **(08 Marks)**

b. The upper arms of a Porter Governor has lengths 350mm and are pivoted on the axis of rotation. The lower arms have lengths 300mm and are attached to the sleeve at a distance of 40mm from the axis. Each ball has a mass of 4 kg and mass on the sleeve is 45kg. Determine the equilibrium speed for a radius of rotation of 200mm and find the effort and power of governor for 1% speed change. **(12 Marks)**

OR

6 a. Explain the effect of gyroscopic couple on an Aeroplane. **(06 Marks)**

b. The turbine rotor of a ship has a mass of 3500kg. It has a radius of gyration of 0.45m and a speed of 3000 rpm clockwise when looking from stress. Determine the gyroscopic couple and its effect upon the ship.

i) When the ship is steering to the left on a curve of 100m radius at a speed of 36km/hour.

ii) When the ship is pitching with SHM the bow falling with its maximum velocity. The period of pitching is 40 sec and the total angular displacement between the two extreme position of pitching is 12°. **(14 Marks)**

Module-4

7 a. Define the following with respect to vibration : i) Degrees of freedom ii) Amplitude iii) Resonance iv) Natural frequency v) Damping factor. **(10 Marks)**

b. Determine the natural frequency of the system shown in Fig. Q7(b) by Newton's and Energy method. **(10 Marks)**

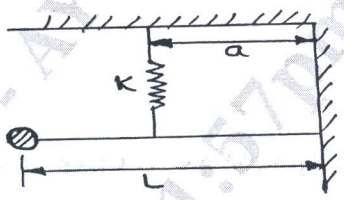

Fig. Q7(b)

OR

8 a. Set up the differential equation for a spring mass damper system and obtain complete solution for the critically damped condition. **(10 Marks)**

b. A vibrating system having a mass of 3kg, spring stiffness of 100 N/mm and damping coefficient of 3 N-S/m. Determine damping ratio, damped natural frequency , logarithmic decrement, ratio of two consecutive amplitudes and number of cycles after which the original amplitude is reduced to 20%. **(10 Marks)**

Module-5

9 a. Define "Transmissibility". Derive an expression for force transmissibility. **(10 Marks)**

b. A 35kg block is connected to a support through a spring of stiffness 1.4×10^6 N/m in parallel with dashpot of damping coefficient 1.8×10^3 N-S/m. The support is given a harmonic displacement of amplitude 10mm at a frequency of 35Hz. Compute the steady state amplitude of the absolute displacement of the block. **(10 Marks)**

OR

10 a. Derive an equation for steady state amplitude for forced vibration with rotating unbalance. **(10 Marks)**

b. A rotor has a mass of 12kg and is mounted midway on a 24mm diameter horizontal shaft supported simply at the ends by two bearings. The bearings are 1m apart. The shaft rotates at 2400 rpm. If the centre of mass of the rotor is 0.11mm away from the geometric centre of the rotor due to manufacturing defect, find i) the amplitude of the steady state vibration ii) the dynamic force transmitted to the bearing. Take E = 200 GPa. **(10 Marks)**

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