CBCS SCHEME

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18ME53

Fifth Semester B.E. Degree Examination, Jan./Feb. 2021
Dynamics of Machines

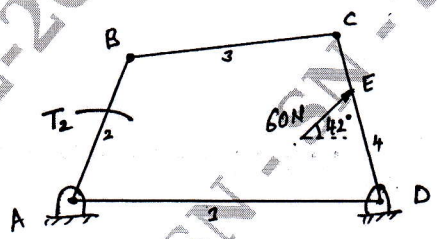
Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 For the static equilibrium of the four bar mechanism shown in Fig. Q1, determine the input torque T_2 on the link AB for a force of 60N acting on link CD. Dimensions are AB = 500mm, BC = 660 mm , CD = 560mm , Fixed link AD = 1000mm , DE = 373mm. **(20 Marks)**

Fig. Q1



OR

2 a. State the condition of equilibrium of a body subjected to a system of
i) two force ii) two forces 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 25kN, when the crank has turned through an angle of 120^0 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. **(06 Marks)**

b. A shaft carries four masses of magnitude 200kg, 300kg, 240kg and 260kg with corresponding radii of rotation are 0.2m, 0.15m, 0.25m and 0.3m respectively. The angles between the successive masses are 45^0, 75^0 and 135^0 respectively. Find the magnitude and position of the balance mass required at a radius of 0.2m. **(14 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 center 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. Define the following terms with respect to working of governors :
i) Sensitiveness ii) Isochronism iii) Stability iv) Controlling force. **(08 Marks)**

b. In a Hartnell governor, the extreme radii of rotation of the balls are 40mm and 60mm and corresponding speeds are 210 rpm and 230rpm. The mass of each ball is 3kg. The ball and sleeve arms are equal. Determine i) Spring loads at minimum and maximum speeds.
ii) Stiffness of the spring iii) Initial compression of the spring. **(12 Marks)**

OR

6 a. Derive an expression for Gyroscopic Couple C = I W W_p with usual notations. **(08 Marks)**

b. Each wheel of a motorcycle is of 600mm diameter and has a moment of inertial of 1.2 kg – m^2. The total mass of the motorcycle and the rider is 180kg and combined centre of mass is 580mm above the ground level when motor cycle is upright. The moment of inertia of the rotating parts of engine is 0.2kg – m^2. The engine speed is 5 times the speed of the wheels and is in the same sense. When the motorcycle takes a turn of 35m radius at a speed of 54km/h, determine the Gyroscopic couple, Centrifugal couple and Balancing couple in terms of angle of heel θ. Hence determine angle of heel necessary. **(12 Marks)**

Module-4

7 a. Derive the equation for natural frequency of the spring mass system considering the mass of the spring into account. **(10 Marks)**

b. Find the natural frequency of the system shown in Fig. Q7(b), using Newton's method. **(10 Marks)**

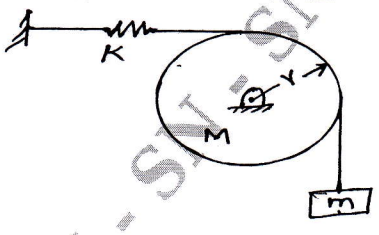


Fig. Q7(b)

OR

8 a. Define the following with respect to vibration : i) Natural frequency ii) Resonance iii) Damping factor iv) Logarithmic decrement. **(08 Marks)**

b. A vibrating system consists of a mass of 50kg, a spring with a stiffness of 30kN/m and a damper. The damping provided is only 20% of the critical value. Determine

i) Damping factor ii) Critical damping coefficient

iii) Natural frequency of damped vibration iv) Logarithmic decrement

v) Ratio of two consecutive amplitudes. **(12 Marks)**

Module-5

9 a. Derive an expression for magnification factor for a spring mass system with viscous damping subjected to harmonic force. **(10 Marks)**

b. A machine of mass 1000kg is acted upon by an external force 2450N at a frequency of 1500rpm. To reduce the effects of vibration, isolator of rubber having a static deflection of 2mm under the machine load and an estimated damping factor of 0.2 are used. Determine

i) Amplitude of vibration ii) Force transmitted to the foundation. **(10 Marks)**

OR

10 a. The support of a spring mass system is vibrating with an amplitude of 8mm and a frequency of 1100 cycles/min. If the mass is 0.8kg and the spring has a stiffness of 2000N/m, determine the amplitude of vibration of the mass. What is the amplitude of a damper with damping factor of 0.2 is introduced in the system? **(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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