CBCS SCHEME

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15ME52

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

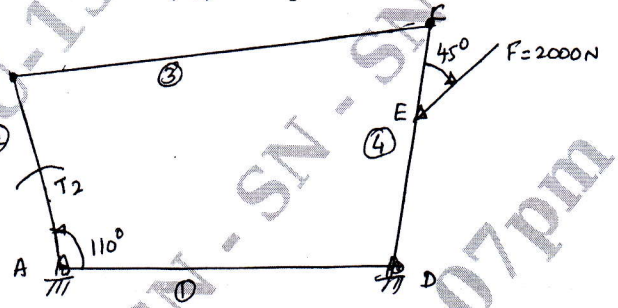
Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. State the conditions for link to be in static equilibrium:
(i) when 2 forces act
(ii) when three forces act
(iii) when two forces and torque act **(06 Marks)**

b. A four bar mechanism shown in Fig.Q1(b) is acted by a force F = 2000 N. Calculate the required torque on link AB(T_2) for equilibrium of the mechanism.



Given:
AD = 215 mm
AB = 200 mm
BC = 370 mm
DC = 350 mm
CE = 100 mm

Fig.Q1(b) **(10 Marks)**

OR

2 a. State and explain D Alembert's principle. **(04 Marks)**

b. Connecting rod of a gas engine has a mass of 70 kg and has radius of gyration of 36 cms about an axis through centre of gravity. Length of rod between centres is 100 cm and centre of gravity is 33 cms from crank pin centre. If crank length is 22.5 cms and revolves at a uniform speed of 270 rpm, determine the magnitude and direction of inertia force on the rod and corresponding torque on the crank shaft when the inclination to IDC is 30°. **(12 Marks)**

Module-2

3 a. Define static balancing and dynamic balancing. **(04 Marks)**

b. Four masses m_1 = 100 kg, m_2 = 175 kg, m_3 = 200 kg and m_4 = 125 kg are fixed to cranks of 200 mm radius and revolve in planes 1, 2, 3 and 4 respectively. Angular position of planes 2, 3 and 4 with respect to 1 are 75°, 135° and 240° taken in same sense. Distance of planes 2, 3 and 4 from 1 are 600 mm, 1800 mm and 2400 mm. Determine the magnitude and position of balance masses at radius 600 mm in planes L and M located in middle of 1 and 2 and in the middle of 3 and 4 respectively. **(12 Marks)**

OR

4 Firing order of 6 cylinder vertical 4 stroke in line engine is 1-4-2-6-3-5. Piston stroke is 100 mm, length of each connecting rod = 200 mm. Pitch distance between cylinder center lines are 100 mm, 100 mm, 150 mm, 100 mm and 100 mm. Determine out of balance primary and secondary forces and couples in this engine taking plane midway between cylinders 3 and 4 as reference plane. Reciprocating mass per cylinder is 2 kg and the engine runs at 1500 rpm. **(16 Marks)**

Module-3

5 a. Define: (i) Sensitivity (ii) Stability (iii) Isochronism **(06 Marks)**

b. A porter governor has all four arms 300 mm long. The upper arms are pivoted on the axis of rotation and lower arms are attached to the sleeve at distance of 35 mm from the axis. Mass of each ball is 7 kg and mass of sleeve is 54 kg. Determine the equilibrium speed when the radius of rotation of the balls is 225 mm.
What will be the range of speed for this position if frictional resistance to motion of sleeve is equal to force of 30 N at the sleeve? **(10 Marks)**

OR

6 a. Derive an equation for gyroscopic couple. **(08 Marks)**

b. An aeroplane makes a complete half circle of 40 m radius towards left when flying at 175 kmph. Mass of the engine along with propeller is 400 kg with radius of gyration 300 mm. Engine runs at 2500 rpm clockwise when viewed from the rear. Find the gyroscopic couple on the air craft what will be the affect if aeroplane takes right turn. **(08 Marks)**

Module-4

7 a. Define : (i) Periodic motion (ii) Time period (iii) Frequency (iv) Amplitude **(08 Marks)**

b. Add the following Harmonic motions analytically and check it graphically $x_1 = 3\sin(\omega t + 30^\circ)$, $x_2 = 4\cos(\omega t + 10^\circ)$. **(08 Marks)**

OR

8 a. Derive an expression for natural frequency of spring mass system considering the mass of the spring. **(08 Marks)**

b. Mass of uniform rod shown in Fig.Q8(b) is negligible compared to the mass attached to it. For small oscillation calculate natural frequency by (i) Newton's method (ii) Energy method

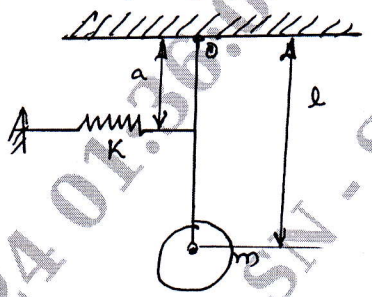


Fig.Q8(b) **(08 Marks)**

Module-5

9 a. Define logarithmic decrement. Derive an equation for logarithmic decrement. **(08 Marks)**

b. A spring mass damper system has a mass of 3 kg K = 100 N/m; c = 3 N-sec/m. Determine:
(i) Damping factor
(ii) Natural frequency of damped vibrations
(iii) Logarithmic decrement
(iv) Number of cycles after which original amplitude is below 20%. **(08 Marks)**

OR

10 a. Define magnification factor. Derive and expression for the same and discuss its variation with frequency ratio. **(08 Marks)**

b. Mass of 100 kg has been mounted on spring support having stiffness 19600 N/m and damping coefficient 100 N-Sec/m. Mass is acted by Harmonic force of 39 N at undamped natural frequency of the system. Determine:
(i) Amplitude of vibration of the mass
(ii) Phase difference between force and displacement
(iii) Force transmissibility ratio **(08 Marks)**