CBCS SCHEME

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18ME53

Fifth Semester B.E. Degree Examination, Dec.2024/Jan.2025
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. What are conditions for a body to be in equilibrium under the action of two forces, three forces and two forces and a torque? **(06 Marks)**

b. A slider crank mechanism with the following dimensions is acted upon by a Force F = 2 KN at B as shown in Fig. Q1 (b). OA = 100 mm, AB = 450 mm. Determine the input torque T on the link OA for the static equilibrium of the mechanism for the given configuration.

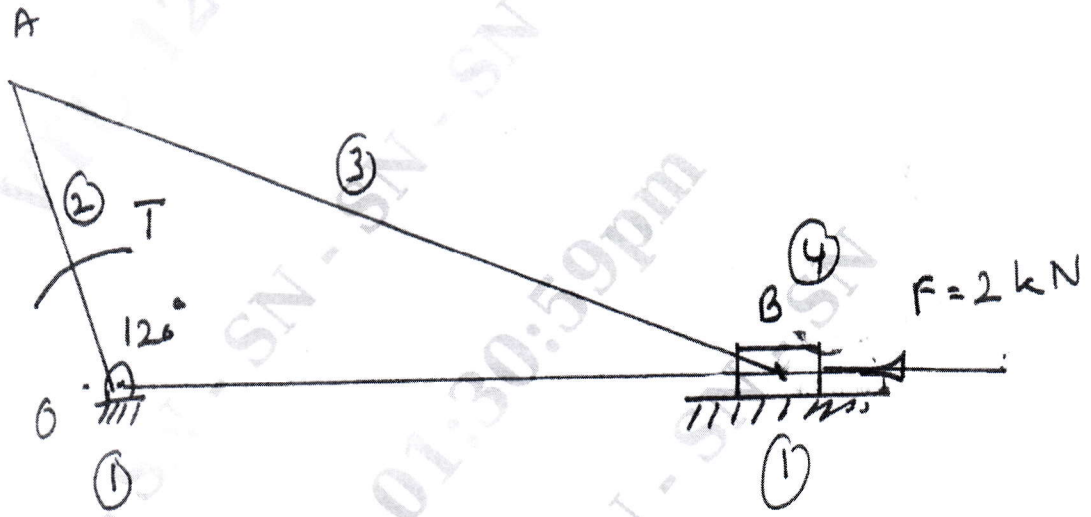

Fig. Q1 (b) **(14 Marks)**

OR

2 a. State and explain D'Alembert's principle. **(06 Marks)**

b. The Crank and connecting rod of a vertical petrol engine, running at 1800 rpm are 60 mm and 270 mm respectively. The diameter of the piston is 100 mm and the mass of the reciprocating part is 1.2 kg. During the expansion stroke when the crank has turned 20° from the top dead centre, the gas pressure is 650 KN/m^2. Determine the

(i) Net force on the piston
(ii) Net load on the gudgeon pin.
(iii) Thrust on the cylinder walls.
(iv) Speed at which the gudgeon pin load is reversed in direction. **(14 Marks)**

Module-2

3 a. What is meant by static and dynamic unbalance in machinery? Why balancing is necessary for rotors of high speed engines. **(06 Marks)**

b. Three masses of 8 kg, 12 kg and 15 kg are attached at radial distance of 80 mm, 100 mm and 60 mm respectively to a disc on a shaft are in complete balance. Determine the angular position of the masses of 12 kg and 15 kg relative to 8 kg mass. **(14 Marks)**

OR

4 a. What do you mean by primary unbalance in reciprocating engine? **(05 Marks)**

b. The following data relate to a single cylinder reciprocating engine :
Mass of reciprocating part = 40 kg
Mass of revolving part = 30 kg at crank radius
Speed = 150 rpm,
Stroke = 350 mm
If 60% of the reciprocating parts and all the revolving parts are to be balanced,
Determine the
(i) Balance mass required at a radius of 320 mm
(ii) Unbalanced force when the crank has turned 45° from the top deed centre. **(15 Marks)**

Module-3

5 a. Explain the terms sensitiveness, hunting and stability relating to governor. **(06 Marks)**

b. Each arm of a porter governor is 250 mm long. The upper and lower arms are pivoted to the links at 40 mm and 50 mm respectively from the axis of rotation. Each ball has a mass of 5 kg and the sleeve mass is 50 kg. The force of friction on the sleeve mechanism is 40 N. Determine the range of speed of the grievance for the extreme radii of 125 mm and 150 mm **(14 Marks)**

OR

6 a. Explain the gyroscopic effect of steering pitching and rolling of ship moving in sea. **(06 Marks)**

b. An aeroplane makes a complete quarter circle of 40 m radius towards left when flying at 175 km/hr. The mass of rotary engine and propeller is 400 kg with radius of gyration 300 mm. The engine runs at 2500 rpm clockwise when viewed from the rear. Find the gyroscopic couple on the aircraft. In what way is the effect changes when aeroplane turns towards right. **(14 Marks)**

Module-4

7 a. With a neat sketch, explain longitudinal vibration, transverse vibration, torsional vibration. **(10 Marks)**

7 b. Determine the equation of motion and natural frequency of the system shown in Fig. Q7 (b) using Newton's method. **(10 Marks)**

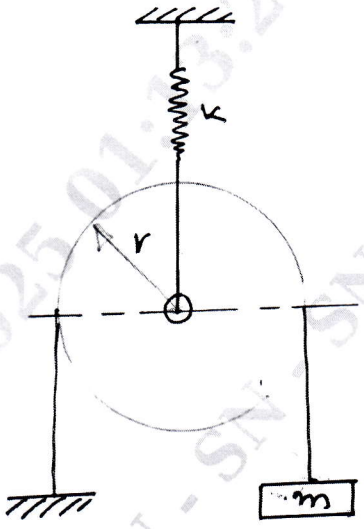

Fig.Q7 (b)

OR

8 a. Define Logarithmic decrement and derive the equation for same. **(10 Marks)**

b. A spring mass damper system has m = 3 kg K = 100 N/m, C = 3 N-S/m. Determine

(i) Damping factor
(ii) Natural frequency of damped vibration
(iii) Logarithmic decrement
(iv) The ratio of two successive amplitudes
(v) Number of cycles after which the original amplitude is below 20%. **(10 Marks)**

Module-5

9 a. Define : (i) Magnification factor (ii) Critical speed of the shaft
(iii) Vibration isolation (iv) Transmissibility ratio. **(10 Marks)**

b. A machine total mass 200 kg is supported on springs of total stiffness 1600 kN/m has unbalanced rotating element which results is a disturbing force 800 N at a speed of 3,000 rpm. Assuming $\xi = 0.2$. Determine

(i) Amplitude of motion due to unbalanced and its phase angle.
(ii) Transmissibility. **(10 Marks)**

OR

10 a. Obtain Natural frequency of free transverse vibration due to point load. **(10 Marks)**

b. A steel shaft simply supported in bearings 50 mm diameter and 1.5 m long carries a solid rotor of weight 1600 N at its centre, find its critical speed if E = 200 GN/m^2. **(10 Marks)**

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