CBCS SCHEME

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18AU52

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. With neat sketches, discuss the static equilibrium of the following :
i) Two force members
ii) Two force and a torque members
iii) Three force members
iv) Four force members **(08 Marks)**

b. A slider crank mechanism is as shown below. A force of 1000 N is applied to the piston when the crank is at 60° from the IDC. Calculate the driving torque T_2. Also calculate all forces [Refer Fig.Q1(b)]

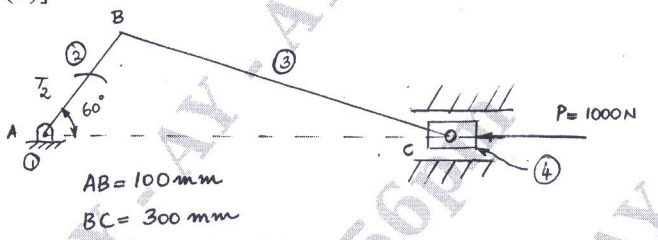

Fig.Q1(b) **(12 Marks)**

OR

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

b. The crank and the connecting rod of a vertical single cylinder gas engine running at 1800rpm are 60mm and 240mm respectively. The diameter of the piston is 80mm and the mass of the reciprocating parts is 1.2 kg. At a point during the power stroke when the piston has moved 20mm from the top dead centre position, the pressure on the piston is 800 kN/m^2. Find
i) Net force on the piston
ii) Thrust in the connecting rod
iii) Thrust on the sides of cylinder walls
iv) Engine speed at which the above values are zero. **(15 Marks)**

Module-2

3 a. What is meant by static balancing and dynamic balancing? **(06 Marks)**

b. Four masses M_1 = 100 kg; M_2 = 175 kg; M_3 = 200 kg and M_4 = 125 kg are fixed to the crank of 200mm radius and revolve in planes 1, 2, 3 and 4 respectively. The angular positions of the planes 2, 3 and 4 with respect to 1 are 75° , 135° and 240° taken in the same sense. Distances of the planes 2, 3 and 4 from 1 are 600mm, 1800mm and 2400mm. Determine the magnitude and position of the balancing masses at a radius of 600mm in planes 'L' and 'M' located in the middle of 1 and 2 in the middle of 3 and 4 respectively. **(14 Marks)**

OR

4 a. For partial primary balancing, derive an expression for the residual unbalanced face at a given instant. **(05 Marks)**

b. A 5 cylinder inline engine running at 500 rpm has successive cranks at 144° apart. The distance between the cylinder center line is 300mm. The piston stroke = 240mm, length of connecting rod = 480mm. Examine the engine for balance of primary and secondary forces and couples. Find the maximum values of these and the position of the central crank at which these maximum values occur. The reciprocating mass for each cylinder is 150N. **(15 Marks)**

Module-3

5 a. What are the distinct features which differentiate flywheels from governors? **(02 Marks)**

b. Define coefficient of fluctuation of speed and coefficient of fluctuation of energy. **(04 Marks)**

c. A three cylinder single acting engine bas its cranks set equally at 120° and it runs at 600 rpm. The torque crank angle diagram for each cycle is a triangle for the power stroke with a maximum torque of 90 N-m at 60° from the top dead centre of the corresponding crank. The torque on the return stroke is sensibly zero. Determine

i) Coefficient of fluctuation of speed

ii) Coefficient of fluctuation of energy. **(14 Marks)**

OR

6 a. Define the following with respect to governors:

i) Sensitiveness

ii) Governor Effect

iii) Governor Power

iv) Hunting

v) Stability

vi) Isochronous Governor. **(06 Marks)**

b. Explain the working principle of a simple centrifugal governor. **(04 Marks)**

c. A porter governor has all 4 arms 300mm long, the upper arms are pivoted on the axis of rotation and lower arms are attached to the sleeve at a distance 35mm from axis. The mass of each ball is 7Kg and the load on the sleeve is 540N. Determine the equilibrium speed for the two extreme radii of 200mm and 260mm of rotations. **(10 Marks)**

Module-4

7 a. Derive an expression for the total frictional torque of a conical pivot learning considering uniform wear and uniform pressure. **(10 Marks)**

b. In a thrust bearing, the external and the internal diameter of the contact surface are 300mm and 200mm respectively. The total axial load is 100 kN and the intensity of pressure is 250 kN /m^2. The speed of the shaft is 500 rpm and the coefficient of friction = 0.05. Calculate

i) Number of collars required

ii) Power lost due to friction, assuming uniform pressure theory. **(10 Marks)**

OR

8 a. With usual notation, derive the expression $\frac{T_1}{T_2} = e^{\mu\theta}$. **(10 Marks)**

b. Belt of 100mm width and 10mm thick is transmitting power at 1000 m/min. The net driving tension is 1.8 times the tension on the slack side. If the safe permissible stress is 2 MPa, calculate the maximum power that can be transmitted at this speed. Assume the density of leather as 1000 kg/m^3. Also calculate the absolute max. power that can be transmitted by this belt and the speed at which this can be transmitted and the percentage increase in the power. **(10 Marks)**

Module-5

9 a. Derive an expression for stability of a two wheeler negotiating a curve. **(08 Marks)**

b. Each wheel of a four wheeler, rear engine automobile has a moment of inertia of 2.4 kgm^2 and an effective diameter of 660 mm. The rotating parts of the engine has a moment of inertia of 1.2 kgm^2. The gear ratio of the engine to back axle is 3:1. The engine axis is parallel to the rear axle and the crank shaft rotates in the same sense as that of the road wheel. The mass of the vehicle is 2200 kg and the centre of mass is 550 mm above the road level. The track width of the vehicle is 1.5m. Determine the limiting speed of the vehicle around a curve with 80 m radius so that all the four wheels maintain contact with the road surface. **(12 Marks)**

OR

10 a. Derive an expression for the displacement, velocity and the acceleration of the follower when the roller is in contact with straight flank. **(10 Marks)**

b. Derive an expression for the displacement, velocity and the acceleration when the flat face of the follower has contact on the circular flank. **(10 Marks)**

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