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10ME54

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

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART - A

1 a. Explain principle of virtual work with necessary diagram. **(06 Marks)**

b. A four bar mechanism under the action of two external forces is shown in Fig. Q1(b). Determine the torque to be applied on the link AB for static equilibrium. The dimensions of the links are AB = 50mm , BC = 66mm , CD = 55mm , CE = 25mm , CF = 30mm , AD = 100mm , Angle BAD = 60^0 , P = 500N and Q = 600N. **(14 Marks)**

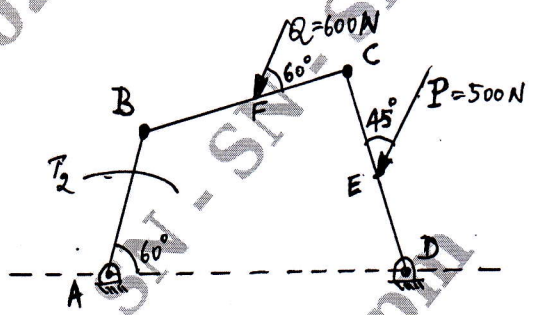

Fig.Q1(b)

2 a. Briefly discuss the following :
i) D' Alembert's principle ii) Dynamically equivalent system. **(06 Marks)**

b. A certain machine requires a torque of (5000 + 500 sin θ) N-m to drive it, where θ is the angle of rotation of shaft measured from certain datum. The machine is directly coupled to an engine which produces a torque of (5000 + 600 sin2θ) N-m. The fly wheel and the other rotating parts attached to the engine has a mass of 500kg at a radius of gyration of 0.4m. If the mean speed is 150 r.p.m, find i) The fluctuation of energy ii) The percentage fluctuation of speed iii) The maximum and minimum angular acceleration of the fly wheel and the corresponding shaft position. **(14 Marks)**

3 a. Derive an expression for frictional torque in a flat pivot bearing assuming uniform pressure and uniform wear. **(08 Marks)**

b. An open belt drive connects two pulleys 1200mm and 500mm diameters, on parallel shafts 4m apart. The maximum tension in the belt is 2000N. The coefficient of friction is 0.3. The driver pulley of diameter 1200mm runs at 200 rpm. Calculate
i) the power transmitted ii) torque on each of the two shafts. **(12 Marks)**

4 a. Define Static and Dynamic balancing. **(04 Marks)**

b. Four masses M_1 = 100 kg ; M_2 = 175kg ; M_3 = 200 kg and M_4 = 125kg are fixed to the crank of 200mm radius and revolve in planes 1, 2, 3 and 4 respectively. The angular position of the planes 2, 3, and 4 with respect to 1 are 75^0 , 135^0 and 240^0 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 radius 600mm in planes L and M located in the middle of 1 and 2 and in the middle of 3 and 4 respectively. **(16 Marks)**

PART - B

5 In an in – line six cylinder engine working on two stroke cycle, the cylinder center lines are spaced at 600mm. In the end view, the cranks are 60^0 apart and in the order 1-4-5-2-3-6. The stroke of each piston is 400mm and the connecting rod length is 1m. The mass of the reciprocating parts is 200kg per cylinder and that of rotating parts 100kg per crank. The engine rotates at 300 r.p.m. Examine the engine for the balance of primary and secondary forces and couples. Find the maximum unbalanced forces and couples. **(20 Marks)**

6 a. Derive an expression for the spring stiffness in case of Hartnell governor neglecting obliquity effect of arms. **(08 Marks)**

b. The arms of a porter governor are each 250mm long and pivoted on the governor axis. Mass of each ball is 5kg and the mass of central sleeve is 30kg. The radius of rotation of the balls is 15cm when the sleeve begins to rise and reaches a value of 20cm for maximum speed. Determine the speed range of the governor. If the friction of the sleeve is equivalent to 20N, determine how the speed range is modified. **(12 Marks)**

7 a. Analyse the stability of a two – wheel vehicle taking a turn and derive the necessary equations. **(08 Marks)**

b. An Aeroplane makes a complete half – circle of 40m radius towards left when flying at 175km/hr. The mass of the rotary engine and propeller is 400kg with radius of gyration 300mm. The engine runs at 2500 rpm clockwise when viewed from the rear. Find the gyroscopic couple on the aircraft. What will be the effect if the aeroplane twin towards right instead of left? **(12 Marks)**

8 A symmetrical tangent cam with a least radius of 25mm operates a roller follower of radius 10mm. The angle of ascent is 60^0 and total lift is 15mm. If the speed of the cam is 400 rpm, then calculate i) The main dimensions of the cam ii) the acceleration of the follower at

a. The beginning of the lift.
b. When the roller just touches the nose.
c. The apex of the circular nose.

Assume there is no dwell between ascent and distance. **(20 Marks)**

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