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10AE53

Fifth Semester B.E. Degree Examination, Aug./Sept.2020
Dynamics of Machines

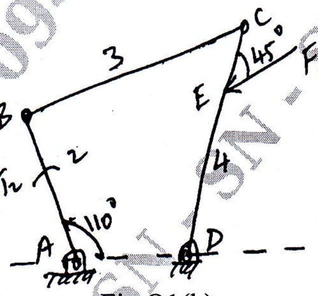
Time: 3 hrs. Max. Marks:100

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

PART – A

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. In a four bar mechanism shown in Fig.Q1(b), calculate the required value of T_2 and various forces on links for the equilibrium of the system. **(14 Marks)**



F = 2000N
AD = 215mm
AB = 200mm
BC = 370mm
DC = 350mm
CE = 100mm

Fig.Q1(b)

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

b. Prove that the maximum fluctuations of energy 'C' is given by C = 0.02 qE for a flywheel, where E = mean K.E. and q = Total percentage fluctuation of speed. **(05 Marks)**

c. A gas engine working on Otto cycle develops 22.08 kW at 300 rpm. The coefficient of fluctuation of energy is 1.85. The fly wheel mass is 1000 kg and its radius of gyration is 0.9m. What is the cyclic speed variation from the mean? **(10 Marks)**

3 a. Derive an expression for the ratio of belt-tension. **(08 Marks)**

b. An open belt-drive connects two pulleys 1.2 m and 0.6 m diameter, on parallel shafts 10 m apart. The mass of the belts is 1 kg/m length. The maximum tension in the belt is not to exceed 2000 N and the coefficient of friction is 0.25. The layer pulley, which is the driver, runs at 200 rpm. Due to belt slip on one of the pulleys, the speed of the driven pulley is 380 rpm. Calculation the torque on each of the two shafts, power transmitted, power lost in friction and the efficiency of the drive. **(12 Marks)**

4 a. Explain static and dynamic balance of a system of revolving masses with sketch. **(06 Marks)**

b. A shaft carries 4 rotating masses A, B, C, D in this order along the axis. The mass A may be assumed to be concentrated at 160 mm radius, B at 180 mm C at 200 mm and D at 120 mm radius. The masses B, C and D are 40 kg, 30 kg and 50 kg respectively. The planes containing B and C are 300 mm apart. The angular spacing of C and D are 90° and 210° respectively with respect ot B measured in same direction. If the shaft and masses are to be in complete dynamic balance, determine :

i) Mass and angular position of A
ii) Position of planes A and D. **(14 Marks)**

PART - B

5 a. Prove that the resultant unbalanced force is minimum when half of the reciprocating masses are balanced by rotating masses (i.e) when C = ½. **(06 Marks)**

b. The pistons of a 4 cylinder vertical inline engine reach their upper most position at 90° interval in order of their axial position. Pitch of cylinder = 0.35 m, crank radius = 0.12 m. Length of connecting rod = 0.42 m. The engine runs at 600 rpm. If the reciprocating parts of each engine has a mass of 2.5 kg. Find the unbalanced primary and secondary forces and couples. Take central plane of engine as reference plane. (Analytical method alone). **(14 Marks)**

6 A spring loaded governor of the Hartnell type has arms of equal length. The masses rotate in a circle of 120 mm diameter when the sleeve is in the mid position and the ball arms are vertical. The equilibrium speed for this position is 550 rpm, neglecting friction. The maximum sleeve movement is to be 25 mm and the maximum variation of speed taking in account the friction to be 6 per cent of the mid position speed. The mass of the sleeve is 5 kg and the friction may be considered equivalent to 35 N at the sleeve. The power of the governor must be sufficient to overcome the friction by two percent change of speed either way at mid-position. Determine, neglecting obliquity effect of arms;

i) The value of each rotating mass
ii) The spring stiffness in N/mm and
iii) The initial compression of spring. **(20 Marks)**

7 a. With usual notations and diagram, derive an expression for the gyroscopic couple, produced by a rotating disc. **(06 Marks)**

b. A four-wheeled trolley car has a total mass of 3500 kg. Each axle with its two wheels and gears has a total M.I. of 30 kg-m^2. Each wheel is of 450 mm radius. The centre distance between two wheels is 1.4 m. Each axle is driven by a motor with speed ratio of 1 : 3. Each motor along with its gear has a moment of inertia of 20 kg-m^2 and rotates in the opposite direction to that of axle. The center of mass of the car is 1 m above the rails. Calculate the limiting speed of the car when it has to travel around a curve of 250 m radius without the wheels leaving the rails. **(14 Marks)**

8 A tangent cam with straight working faces tangential to a base circle of 120 mm diameter has a roller follower of 48 mm diameter. The line of stroke of the roller follower passes through the axis of the cam. The nose circle radius of the cam is 12 mm and the angle between the tangential faces of the cam is 90°. If the speed of the cam is 180 rpm, determine the acceleration of the follower when

i) during the lift, the roller just leaves the straight flank.
ii) the roller is at the outer end of its lift, i.e., at the top of the nose. **(20 Marks)**

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