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10AE53

Fifth Semester B.E. Degree Examination, June/July 2017
Dynamics of Machinery

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Explain the equilibrium of the following systems: (i) Two force members (ii) Three force members (iii) Member with two forces and a torque. **(06 Marks)**

b. On the link 6 of the mechanism given in Fig. Q1 (b), a 100 N vertical force is acting. Calculate the amount of the torque required on the crank AB to keep the mechanism in static equilibrium, using the graphical approach. **(14 Marks)**

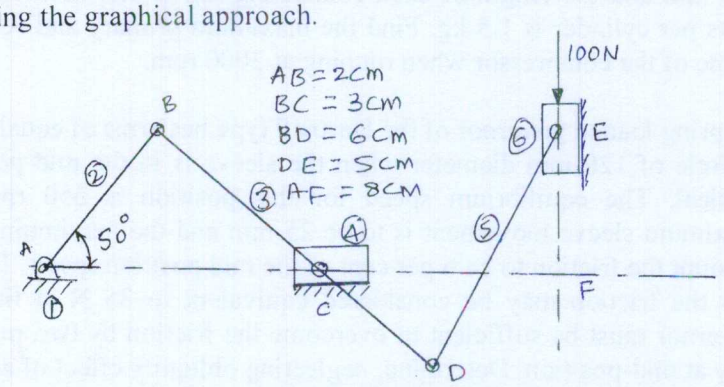

Fig. Q1 (b)

2 The turning moment diagram of a four stroke engine may be assumed for the sake of simplicity to be represented by four triangles in each stroke. The areas of these triangles are as follows:

Suction stroke = 5×10^{-5} m^2; Compression stroke = 21×10^{-5} m^2; Expansion stroke = 85×10^{-5} m^2; Exhaust stroke = 8×10^{-5} m^2

All the areas expecting expression stroke are negative. Each m^2 of area represents 14 MN-m of work.

Assuming the resisting torque to be constant, determine the moment of inertia of the flywheel to keep the speed between 98 rpm and 102 rpm. Also find the size of a rim-type flywheel based on the minimum material criterion, given that density of flywheel material is 8150 kg/m^3 ; the allowable tensile stress of the flywheel material is 7.5 MPa. The rim cross section is rectangular, one side being four times the length of the other. **(20 Marks)**

3 a. Establish an expression for ratio of tensions in flat belt drive. **(06 Marks)**

b. 2.5 kW of power is transmitted by an open belt drive. The linear velocity of the belt is 3 m/s. The angle of lap on the smaller pulley is 160°. The coefficient of friction is 0.28. Determine the effect on power transmission in the following cases: (i) Initial tension in the belt is increased by 8%. (ii) Initial tension in the belt is decreased by 8%. (iii) Angle of lap is increased by 8% by the use of an idler pulley, for the same speed and tension on the tight side. (iv) Coefficient of friction is increased by 8% by suitable dressing to the friction sample of the belt. **(14 Marks)**

4 a. What do you mean by static balancing and dynamic balancing? **(04 Marks)**

b. A shaft has three eccentrics, each 80 mm diameter and 20 mm thick, machined in one piece with the shaft. The central planes of the eccentric are 8 cm apart. The distance of the centres from the axis rotation are 12 mm, 18 mm and 12 mm and their angular positions are 120° apart. The density of metal is 7500 kg/m^3. Find the amount of out-of-balance force and couple at 660 rpm. If the shaft is balanced by adding two masses at a radius 75 mm and at distances of 100 mm from the central plane of the middle eccentric, find the amount of the masses and their angular positions. **(16 Marks)**

PART – B

5 a. Derive the equations for primary and secondary resultant forces of V engine when cylinders are placed at 90° apart. **(10 Marks)**

b. A 5 cylinder radial engine has its connecting rods coupled to a single crank. The stroke is 100 mm and the length of each connecting rod is 150 mm. The mass of the reciprocating parts per cylinder is 1.5 kg. Find the maximum primary and secondary forces acting on the frame of the compressor when running at 3000 rpm. **(10 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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