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10MA52

Fifth Semester B.E. Degree Examination, Dec.2016/Jan.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 An external torque of 100N-m is acting on the crank EF of the mechanism. Shown in Fig Q1 in CCW direction. Calculate the magnitude and direction of the external torque required on crank AB to keep the system in static equilibrium. **(20 Marks)**

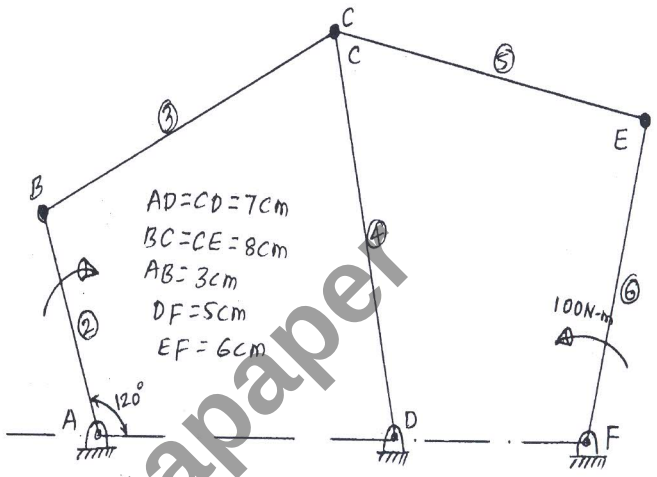

Fig Q1

2 a. Derive an expression of ratio of driving tensions for flat belt drive. **(06 Marks)**

b. An open belt drive connects two pulleys 1.2m and 0.5m diameter, on parallel shafts 4 metres apart. The mass of the belt is 0.9kg per metre length and the maximum tension is not to exceed 2000N. The coefficient of friction is 0.3. the 1.2m pulley, which is the driver, runs at 200 rpm. Due to belt slip on one of the pulleys, the velocity of the driven shaft is only 450rpm. Calculate the torque on each of the two shafts, the power transmitted, and power lost in friction. What is the efficiency of the drive? **(14 Marks)**

3 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 excepting expression stroke are negative. Each m^2 of area represents 14MN-m of work.

Assuming the resisting torque to be constant, determine the moment of inertia of the flywheel to keep the speed between 98rpm and 102rpm. Also find the size of 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 7.5MPa. The rim cross-section is rectangular; one side being four times the length of the other. **(20 Marks)**

4 a. Explain clearly the terms 'static balancing' and' dynamic balancing;. State the necessary conditions to achieve them. **(04 Marks)**

b. A shaft carries four masses in parallel planes A, B, C and D in this order along its length. The masses at B and C are 18kg and 12.5kg respectively, and each has an eccentricity of 60mm. The masses at A and D have an eccentricity of 80mm. the angle between the masses at B and C is 100° and that between the masses at B and A is 190°, both being measured in the same direction. The axial distance between the planes A and B is 100mm and that between B and C is 200mm. If the shaft is in complete dynamic balance, determine :

i) The magnitude of the masses at A and D
ii) The distance between planes A and D ; and
iii) The angular position of the mass at D. **(16 Marks)**

PART – B

5 A five cylinder in line engine running at 750rpm has successive cranks 144° apart, the distance between the cylinder centre lines being 375mm. the piston stroke is 225mm and the ratio of the connecting rod to the crank is 4. 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 15kg. **(20 Marks)**

6 a. Explain the term height of the governor. Derive an expression for the height in the case of a porter governor. **(08 Marks)**

b. In an engine governor of the porter type, the upper and lower arms are 200mm and250mm, respectively and pivoted on the axis of rotation. The mass of the central load is 15kg, the mass of each ball is 2kg and friction of the sleeve together with the resistance of the operating gear is equal to a load of 25N at the sleeve. If the limiting inclinations of the upper arms to the vertical are 30° and 40°, find taking friction into account, range of speed of the governor. **(12 Marks)**

7 a. Discuss the effect on ship due to gyroscopic effect with the vectorial representation for the following cases.

i) When propeller rotates in CCW direction when viewed from stern and taking right turn
ii) When propeller rotates in CW when viewed from stern and pitching up.
iii) When propeller rotates in CW when viewed form stern and rolls clockwise. **(08 Marks)**

b. A rear engine automobile is travelling along a track of 100metres mean radius. Each of the four road wheels has a moment of inertia of 2.5 kg-m^2 and an effective diameter of 0.6m. the rotating parts of the engine have a moment of inertia of 1.2 kg-m^2. The engine axis is parallel to the rear axle and the crank shaft rotates in the same sense as the road wheels. The ratio of engine speed to back axle is 3:1. The automobile has a mass of 1600kg and has its centre of gravity 0.5m above road level. The width of the track of the vehicle is 1.5m. Determine the limiting speed of the vehicle around the curve for all four wheels to maintain contact with the road surface. Assume that the road surface is not cambered and centre of gravity of automobile lies centrally with respect to the four wheels. **(12 Marks)**

8 A tangent cam with straight working faces tangential to a base circle of 120mm diameter has a roller follower of 48mmdiameter. The line of stroke of the roller follower passes through the axis of the cam. The nose circle radius of the cam is 12mm and the angle between the tangential faces of the cam is 90°. If the speed of the cam is 180rpm, 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 the nose. **(20 Marks)**

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