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10AE53

Fifth Semester B.E. Degree Examination, Dec.2013 / Jan. 2014
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. What is a free body diagram? List any two advantages of free body diagram. **(04 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 , $\angle BAD = 60^0$ and AD = 100mm. **(16 Marks)**

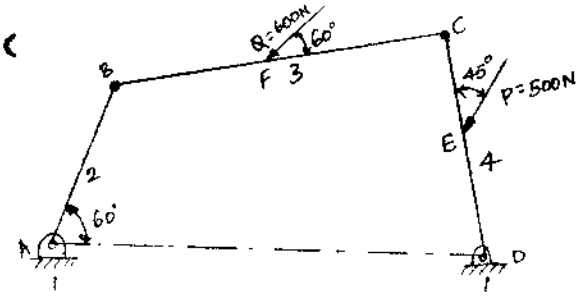

Fig. Q1(b)

2 a. What is co-efficient of fluctuation of speed? Obtain an expression for co-efficient of fluctuation of speed of fly wheels. **(06 Marks)**

b. The turning moment diagram of a four – stroke engine is assumed to be represented by four triangles, the areas of which from the line of zero pressure are : Section stroke = $440mm^2$, Compression stroke = $1600mm^2$, Expansion stroke = $7200mm^2$, Exhaust stroke = $660mm^2$. Each mm^2 of area represents 3N.m of energy. If the resisting torque is uniform, determine the mass of the rim of a fly wheel to keep the speed between 218 and 222 rpm, when the mean radius of the rim is to be 1.25m. **(14 Marks)**

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

b. A shaft rotating at 200rpm drives another shaft at 300rpm and transmits 6kW through a belt. The belt is 100mm wide and 10mm thick. The distance between the shafts is 3m. The smaller pulley is 0.5m in diameter. Calculate the stress in the belt, if it is i) an open belt drive and ii) a cross belt derive. Take $\mu = 0.3$. **(12 Marks)**

4 a. Explain how a single rotating mass in one plane is balanced. **(04 Marks)**

b. A shaft carriers 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 mass 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 100^0 and that between the masses at B and A is 190^0, 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 the planes A and D
iii) The angular position of the mass at D. **(16 Marks)**

PART - B

5 A 5 cylinder inline engine running at 500rpm has successive cranks at 144^0 apart. The distance between the cylinder centre line is 300mm. Piston stroke = 240mm, Length of connecting rod = 480mm. Examine the engine for balance of primary and secondary forces and couples. Find the maximum value of these and position of central crank at which these maximum values occur. The reciprocating mass for each cylinder is 150N. **(20 Marks)**

6 a. What is controlling force? Sketch a typical controlling force diagram for porter governor. **(04 Marks)**

b. In a Hartnell governor, the lengths of ball and sleeve arms of a bell crank lever are 120mm and 100mm respectively. The distance of the ful cross of the bell crank level from the governor axis is 140mm. Each governor ball has a mass of 4kg. The governor runs at a mean speed of 300rpm with the ball arms vertical and sleeve arms horizontal. For an increase of speed of 4 percent, the sleeve moves 10mm upwards. Neglecting friction find :
i) the minimum equilibrium speed if the total sleeve movement is limited to 20mm.
ii) the spring stiffness iii) the sensitiveness of the governor iv) The spring stiffness if the governor is to be isochronous at 300 rpm. **(16 Marks)**

7 a. With usual notations, 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 3000kg. Each axle with its two wheels and gears has a total moment of inertia of 32kg m^2. Each wheel is of 450mm radius. The centre distance between two wheels on an axle is 1.4m. Each axle is driven by a motor with a speed ratio of 1:3. Each motor along with its gear has a moment of inertia of 16kg.m^2 and rotates in the opposite direction to that of the axle. The centre of mass of the car is 1m above the rails. Calculate the limiting speed of the car when it has to travel around a curve of 250m radius without the wheels leaving the rails. **(14 Marks)**

8 a. Derive an expression for velocity and acceleration for a tangent cam with roller follower. When the roller is in contact with straight flank. **(08 Marks)**

b. A tangent cam with straight working faces tangential to a base circle of 120mm diameter has a roller follower of 48mm diameter. 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 90^0. 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 of the nose. **(12 Marks)**

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