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06ME53

Fifth Semester B.E. Degree Examination, June / July 2014
Dynamics of Machines

Time: 3 hrs. Max. Marks:100

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

PART – A

1 In Fig. Q1 known force P = 800 N and Q = 600 N are applied to links of four bar mechanism. What couple must be applied to link 2 for equilibrium?
O_2A = 50 mm, AB = 66 mm, O_4B = 55 mm, BC = 25 mm, BD = 30 mm, $A\hat{O}_2O_4 = 60°$ and O_2O_4 = 100 mm. **(20 Marks)**

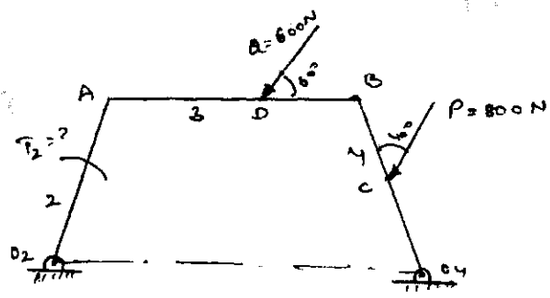

Fig. Q1

2 a. Explain D'Alembertz principle and why it is used. **(06 Marks)**
b. A punching press is required to punch 40 mm diameter holes in a plate of 15 mm thickness at the rate of 30 holes per minute. It requires 6 N-m of energy per mm^2 of sheared area. If the punching takes $\frac{1}{10}$ of second and the speed of the flywheel varies from 160 to 140 rpm, determine the mass of the flywheel having radius of gyration of 1 meter. **(14 Marks)**

3 a. Derive an expression for ratio of tensions in flat belt drive. **(05 Marks)**
b. A belt 100 mm wide and 10 mm thick is to transmit power at speed of 1000 m/min. The net driving tension is 1.8 times the tension on slack side. If the safe permissible stress is 2 MPa. Calculate the maximum power that can be transmitted at this speed. Assume the density of leather as 1000 kg/m^3. Also determine
(i) the absolute maximum power.
(ii) percentage increase in power. **(15 Marks)**

4 A rotating shaft carries four masses A, B, C, D of 10 kg, 15 kg, 18 kg and 20 kg at radii 50 mm, 60 mm, 60 mm and 80 mm respectively. The masses B, C and D revolve in planes 400 mm, 600 mm and 800 mm respectively measured from plane of mass A and are angularly located at 60°, 145° and 270° respectively measured anticlockwise from mass A and are viewing from mass A. The shaft dynamically balanced by two masses 60^{th} located at 50 mm radii and revolving in planes L and M placed midway between the masses A and B and midway between those of masses C & D respectively. Determine the magnitude of balance masses and their angular positions. **(20 Marks)**

PART – B

5 In a four cylinder in-line engine the cylinders are placed symmetrically along the longitudinal axis, with a centre distance of 2.4 m between the outside cylinder and 0.6 m between the inside cylinder. The cranks between the two inside cylinders are at 90° each other and mass of reciprocating parts of each of these is 225 kg. All the four cranks are 0.3 m radius. If the system is to be in complete primary balance, determine
i) Mass of reciprocating parts of each of outside cranks.
ii) Maximum secondary unbalanced force, if the engine is running at 180 rev/min and length of each connecting rod is 1.2 m. **(20 Marks)**

6 a. Define the following terms in connection with governors:
(i) Sensitiveness (ii) Isochromism (iii) Governor effort and (iv) Governor power. **(06 Marks)**

b. The mass of each ball of a Hartnell type governor is 1.4 kg. The length of ball arm of the bell-crank lever is 100 mm where as the lengths of arm towards sleeve is 50 mm. The distance of the fulcrum of bell-crank lever from the axis of rotation is 80 mm. The extreme radii of rotation of the balls are 75 mm and 112.5 mm. The maximum equilibrium speed is 6% greater than the minimum equilibrium speed which is 300 rev/min. Determine
(i) Stiffness the springs and
(ii) Equilibrium speed when the radius of rotation of the ball is 90 mm. **(14 Marks)**

7 a. Derive an expression to determine gyroscopic couple. **(05 Marks)**

b. The motor of a marine engine has a mass of 1000 kg and radius of gyration of 300 mm. The rotor rotates at 1550 rpm in clockwise direction when looking from the bow. Determine the gyroscopic couple and state the effect on the ship by means of vector diagrams in the following cases:
(i) Ship is steering at a speed of 40 kmph and takes left turn around a circular path of 200 m radius.
(ii) Ship is pitching and the bow is descending with its maximum velocity, the pitching is SHM, the periodic time being 30 secs and the total angular movement between extreme positions is 10 degrees. **(15 Marks)**

8 A symmetrical tangent cam has the following data:
Roller radius = 17.5 mm
Minimum radius of the cam = 30 mm
Maximum lift = 20 mm
Cam displacement during the outstroke = 75°
Cam shaft speed = 600 rpm
Find the acceleration of the follower at the beginning of the outstroke. Find also the nose radius, the distance between the cam and nose centre and the angle subtended by the straight flank at the centre. **(20 Marks)**

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