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10ME54

Fifth Semester B.E. Degree Examination, June/July 2018
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 are the conditions for a body to be in equilibrium under the action of (i) two forces (ii) three forces (iii) two forces and a torque? **(06 Marks)**

b. A four bar mechanism shown in Fig.Q1(b) is acted by a force F = 2000 N. Calculate the required torque on link AB(T_2) for equilibrium of the mechanism. Given AB = 200mm, BC = 370 mm, DC = 250 mm, AD = 215 mm, CE = 100 mm, ∠DAB = 110°, ∠CEF = 45°. **(14 Marks)**

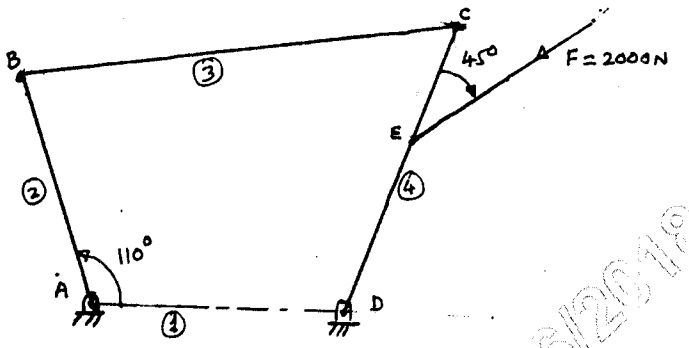

Fig.Q1(b)

2 a. Derive an expression for the size of flywheel. **(06 Marks)**

b. During one revolution of the crank of a multicylinder engines the areas above and below the mean turning moment line taken in order are +0.36, – 0.81, +0.75, – 0.64, +0.92, – 0.58 cm^2. Horizontal scale of diagram 1 cm = 45°, vertical scale 1 cm = 7200 Nm, speed of engine 150 rpm, total fluctuation of speed 2% of mean speed. Find
(i) Mass of flywheel (ii) Area of cross section of rim.
Neglect the effect of arms and boss. Take density of rim material as 7260 kg/m^3 and peripheral speed (mean) as 1000 m/min. **(14 Marks)**

3 a. Derive an expression for centrifugal tension in a belt passing around a pulley rim. **(06 Marks)**

b. A leather belt drive is required to transmit 10 kW from a motor running at 600 RPM. The belt is 12mm thick and has mass density of 0.001 gm/mm^3. Safe stress in the belt not to exceed 2.5 N/mm^2. Diameter of driving pulley is 250 mm whereas speed of the driven pulley is 220 RPM. Two shafts are 1.25 m apart. The coefficient of friction is 0.25. Determine the width of the belt. **(14 Marks)**

4 a. Explain the procedure for balancing several masses rotating in the same plane. **(06 Marks)**

b. A shaft carries four masses A, B, C and D of magnitude 200 kgs, 300 kgs, 400 kgs, and 200 kgs respectively revolving at radii 80 mm, 70 mm, 60 mm and 80 mm respectively. The distances of the planes in which masses B, C, D are revolving as measures from the plane of rotation of mass A is 300 mm, 400 mm and 700 mm. The angles between the cranks measured counter clockwise are A to B 5°, B to C 70° and C to D 120°. The balancing masses are to be placed in planes X and Y. The distance between planes A and X is 100 mm and that between planes X and Y is 400 mm. The distance between planes Y and D is 200 mm. If the balancing masses revolve at radius of 100 mm, determine their magnitude and angular positions. **(14 Marks)**

PART – B

5 a. Show that for a 90° engine the primary forces can be balanced by a single rotating balance mass. **(06 Marks)**

b. A four cylinder vertical engine has cranks 300 mm long. The planes of rotation of first, third and fourth cranks are 750mm, 1050mm and 1650 mm respectively from that of the second crank and their reciprocating masses are 150 kg, 400 kg and 250 kg respectively. Find the mass of reciprocating parts for the second cylinder and the relative angular position of the cranks in order that the engine may be in complete primary balance. **(14 Marks)**

6 a. Each arm of a porter governor is 300 mm long and pivoted on the axis of rotation. Each ball has a mass of 6 kg and the mass of the sleeve is 18 kg. Radius of rotation of the ball is 200mm when the governor begins to lift and 250 mm when the speed is maximum. Determine the maximum and minimum speed of the governor. **(10 Marks)**

b. In a spring loaded governor of Harmell type rotating masses are each 1.5 kg and rotate at radius of 120 mm when the equilibrium speed is 550 RPM. At this speed the arms of bell crank lever are 100 mm and 75 mm respectively are vertical and horizontal when the equilibrium speed is 575 RPM, the rotating masses are at maximum radius of 145 mm. Determine the rate of spring and compression of spring at 550 RPM. **(10 Marks)**

7 a. Describe the effect of gyroscopic couple on an aeroplane. **(06 Marks)**

b. A ship is propelled by a turbine rotor of mass 500 kg and has a speed of 2400 RPM. The rotor has a radius of gyration of 0.5 m and rotates in clockwise direction when viewed from stern. Find the gyroscopic effect when

(i) The ship pitches ± 5° from the horizontal position with a time period of 20 sec with SHM. Bow descending with max velocity.

(ii) Ship runs at speed of 15 knots (1 knot = 1.860 km/hr) and steers to the left in a curve of 60 m radius.

(iii) Ship rolls with angular velocity of 0.04 rad/sec clockwise when viewed from the stern. **(14 Marks)**

8 A symmetrical cam with convex flanks operating a flat faced follower has a base circle diameter of 75 mm and nose radius of 10 mm. The lift the follower is 20 mm. The cam is symmetrical and the total angle of action is 120°. Determine (i) Principal dimensions of the cam (ii) Acceleration of the follower at the beginning of lift, at the end of contact with circular flank, at the beginning of contact with the nose and at the apex of the nose. Speed of cam shaft is 600 RPM. **(20 Marks)**

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