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10ME54

Fifth Semester B.E. Degree Examination, Aug./Sept.2020

Dynamics of Machines

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. What is "principal of virtual work"? Explain. **(05 Marks)**

b. In a four bar mechanism shown in Fig.Q1(b), torque T_3 and T_4 have magnitudes of 3000 Nm and 2000 Nm respectively. Take AD = 800 mm, AB = 300 mm, BC = 700 mm and CD = 400 mm. For static equilibrium of mechanism, find the required input torque on the crank.

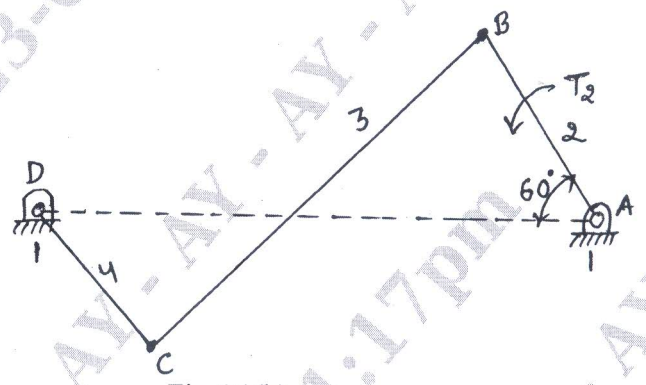

Fig.Q1(b) **(15 Marks)**

2 a. Explain D'Alembert's principle and why it is used. **(05 Marks)**

b. A single cylinder, four stroke I.C. engine develops 30 KW of power at 300 rpm. The T.M. diagram for the expansion and compression strokes may be taken as isosceles triangles on bases 0 to π and 3π to 4π radians respectively and the work done during compression is 25% of that of during expansion. Work done during suction and exhaust is neglected. Find the M.I. of flywheel to keep the speed fluctuation 1.5% on either side of mean speed. Sketch the T.M. diagram and mark on the diagram the points of maximum and minimum speed. **(15 Marks)**

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

b. A flat belt is required to transmit 35 KW from a pulley of 1.5m effective diameter running at 300 rpm. The angle of contact is spread over $\frac{11}{24}$ of the circumference and the coefficient of friction between the belt and the pulley surface is 0.3. Determine taking centrifugal force into account width of belt required, it is given that the belt thickness is 9.5 mm, density of material is 1.1 mg/m^3 and the permissible working stress is 2.5 MPa. **(12 Marks)**

4 a. Why is balancing of rotating parts necessary for high speed engines? **(04 Marks)**

b. Four masses of magnitude 5, 6, M and 8 kg revolve in planes A, B, C and D respectively. The planes B, C, D are placed at a distance 0.3m, 1.2m and 2.0m respectively from A. The masses are at same radii of 0.3m. Find the magnitude of M and relative angular position of all masses for complete balance. **(16 Marks)**

PART – B

5 a. What are in-line engines and state how are they balanced? **(05 Marks)**

b. In a 3 cylinder radial engine all the connecting rods acts on a single crank. The cylinder centre lines are set at 120°. Mass of reciprocating parts per cylinder = 2.5 kg. Crank length = 0.075 m, connecting rod length = 0.275 m and speed = 1800 rpm. Determine:

(i) Maximum unbalanced primary force and the balancing mass to be attached at 100 mm radius to give primary balance

(ii) Maximum unbalanced secondary force and the balancing mass to be attached at 100 mm radius to give secondary balance. **(15 Marks)**

6 a. Define the following:

(i) Controlling Ffrce (ii) Isochronous Governor

(iii) Stability (iv) Hunting **(04 Marks)**

b. In a Hartnell governor the length of ball and sleeve arm are 12 and 10 cm respectively. The distance at fulcrum of the bell crank lever from the governor axis is 14 cm. Mass at each governor ball is 4 kg. When the governor runs at the mean speed of 300 rpm, the ball arm is vertical and sleeve arm is horizontal. For an increase of speed of 4% the sleeve moves 10 mm upward. Neglecting friction find:

(i) Minimum equilibrium speed if total sleeve movement is 20 mm

(ii) Spring stiffness

(iii) Sensitiveness of governor

(iv) Spring stiffness if governor is to be isochronous at 300 rpm. **(16 Marks)**

7 a. Derive an expression for the gyroscopic couple. **(05 Marks)**

b. The rotor of the turbine of a ship has a mass of 2500 kg and rotates at a speed of 3200 rpm counter clockwise when viewed from stern. The rotor has radius of gyration of 0.4 m. Determine the gyroscopic couple and its effect when,

(i) The ship steers to the left in a curve of 80 m at a speed of 27,900 m/hr

(ii) The ship pitches 5° above and 5° below the normal position and the bow is descending with its maximum velocity. The pitching motion is simple harmonic with a periodic time of 40 seconds.

(iii) The ship rolls and at the instant the angular velocity is 0.04 rad/sec clockwise when viewed from stern. **(15 Marks)**

8 A flat ended valve tappet is operated by a symmetrical cam with circular arcs for flank and nose profiles. The total angle of action is 150°, base circle diameter 125 mm and the lift 25 mm. During the lift, the period of acceleration is half that of the deceleration. Speed of the cam shaft is 1250 rpm. The straight line path of the tappet passes through the cam axis. Find:

(i) Radii of the nose and the flank

(ii) Maximum acceleration and deceleration during the lift **(20 Marks)**

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