Fifth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Dynamics of Machines

Time: 3 hrs.   Max. Marks:100

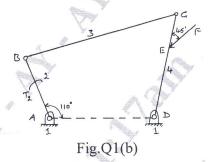**Note:** *1. Answer any FIVE full questions, selecting at least TWO questions from each part.*

2. Graphical solutions must be on drawing sheets only.

3. Missing data, if any, may be suitably assumed.

PART – A

1   a.   Explain Equilibrium with respect to two force and three force members.   **(06 Marks)**
    b.   A four bar mechanism shown in Fig.Q1(b). The dimensions of various links are AB = 200mm, BC = 370mm, CD = 350mm, AD = 215mm, CE = 100mm. Determine the required value of "T_2" and various forces on links for the equilibrium of the system.
                                                                                    (14 Marks)

Fig.Q1(b)

2   a.   Briefly discuss the following :
         i)   D' Alembert's Principle
         ii) Dynamically Equivalent system.   **(06 Marks)**
    b.   Explain the procedure with a neat sketch, for dynamic force analysis of slider – crank mechanism.   **(14 Marks)**

3   a.   Derive the expression to determine the size of flywheel.   **(06 Marks)**
    b.   A multicylinder engine is to run at a speed of 500 rpm. On drawing the turning moment diagram to a scale 1 mm = 250 Nm and 1 mm = 3°, the areas above and below the mean torque line in mm^2 are $+170$, -182, $+178$, -207 and -172. The speed is to be kept $\pm 1\%$ of the mean speed of the engine. The density of flywheel material is 7200 kg/m^3 and its hoop stress is 4.5 MPa. Determine the necessary mass of the flywheel. Also, calculate suitable dimensions of a rectangular flywheel rim, if the breadth is twice the width.
                                                                                    (14 Marks)

4   a.   Derive an expression for displacement, velocity and acceleration of the flat faced follower when in contact with nose.   **(08 Marks)**
    b.   A symmetrical arc cam using flat faced follower has the following particulars. Total lift = 25mm; least radius = 35 mm; Angle of lift = 90°, flank radius = 105mm and cam speed = 1200 rpm. Calculate: i) Principal dimensions of cam; ii) Acceleration of the follower at the beginning of lift, at the end of contact with flank, at the beginning of contact with nose and at the apex.   **(12 Marks)**

PART – B

5   A shaft carries four masses P, Q, R and S in parallel planes along its length. The masses at Q and R are 18 kg and 12.5 kg respectively and each has radius of rotation 60 mm. The masses at planes P and S have radii of rotation of 80 mm. The angle between masses at Q and P is 190°and that between the masses at Q and R is 100°, both being measured in same direction. The axial distance between the planes P and Q is 100 mm and between Q and R is 200 mm. For the complete dynamic balance, determine
i)   The magnitude of masses P and S.
ii) The distance between planes P and S.
iii) The angular position of mass at S plane.   **(20 Marks)**

6   The crank and connecting rods of a 4 cylinder in-line engine running at 1800 rpm are 60mm and 240mm each respectively and cylinder centre lines are 150mm apart. If the cylinder are numbered 1 to 4 in sequence from one end, the cranks appear at interval of 90° in an end view in order 1 – 4 – 2 – 3. The reciprocating mass corresponding to each cylinder is 1.5kg. Calculate: i) Unbalanced primary and secondary forces; ii) Unbalanced primary and secondary couples with reference to central plane of the engine.   **(20 Marks)**

7 a. Explain controlling force, sensitiveness and hunting of governor.   **(05 Marks)**
    b. All the arms of governor have equal length of 250mm each and pivoted on the axis of rotation. Each ball has a mass of 5kg and central load is 25kg. The radius of rotation of ball is 150mm when the governor begins to lift and 200mm when the governor is at maximum speed. Determine: i) The range of speed; ii) The effort and power of governor for 1% speed change, when the sleeve is highest position.   **(15 Marks)**

8 a. Derive an expression for stability of two wheeler negotiating a curve.   **(08 Marks)**
    b. A four wheeled motor car weighing 2 tonnes has height of C.G. of 0.6m above the ground surface. The mass of the engine and transmission parts are equivalent to 80kg with the radius of gyration 150mm and their axis is parallel to the axis of wheel of vehicle. The car negotiates a curve of 60m radius at 72 kmph with overall gear ratio 4:1. The radius of road wheel is 300 mm and moment of inertia is 3 kg-m^2. Assuming wheel track as 1.5m, determine reaction on each inner and outer wheels.   **(12 Marks)**

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