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Fifth Semester B.E. Degree Examination, Dec.2015/Jan.2016
Dynamics of Machines

Time: 3 hrs.

Max. Marks:100

- Note:** 1. Answer 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 and stated.

PART – A

- 1 For the static equilibrium of the mechanism shown in Fig. Q1, determine the required torque input T_2 . (20 Marks)

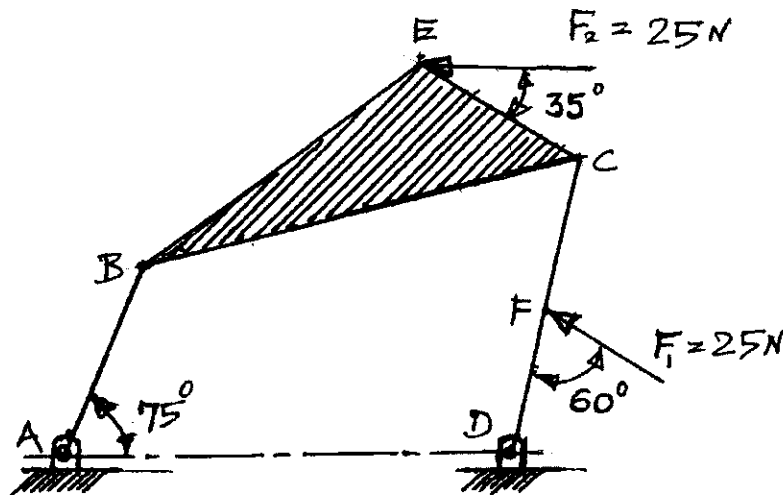


Fig. Q1

- 2 a. Explain dynamic equivalent masses. (05 Marks)
 b. The crank and connecting rod of a vertical petrol engine, running at 1800 rpm, are 60 mm and 270 mm respectively. The diameter of piston is 100 mm and the mass of reciprocating parts is 1.2 kg. During the expansion stroke, when the crank has turned 20° from inner dead centre, the pressure is 650 kN/m^2 . Determine (i) Net force on the piston (ii) Net load on the gudgeon pin (iii) Thrust on the cylinder walls (iv) Speed at which the gudgeon pin load is reversed in direction. (15 Marks)
- 3 a. Derive an expression for determining 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 $1 \text{ mm} = 250 \text{ Nm}$ and $1 \text{ mm} = 3^\circ$, 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 roller follower when in contact with straight flank. (08 Marks)
- b. A symmetrical circular arc cam operating a flat faced follower has the following particulars: Least radius of Cam = 30 mm; Lift = 20 mm; Angle of lift = 75°; Nose radius = 5 mm and Speed of cam = 600 rpm.
Determine (i) The principal dimensions of cam (ii) Acceleration at the beginning of lift, at the end of contact with circular flank, at the beginning of 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
- The magnitude of masses P and S.
 - The distance between planes P and S.
 - The angular position of mass at S plane. (20 Marks)
- 6 The firing order of a six cylinder vertical four stroke in-line engine is 1–4–2–6–3–5. The piston stroke is 100 mm and length of each connecting rod is 200 mm. The pitch distance between the cylinder centre lines are 100 mm, 100 mm, 150 mm, 100 mm and 100 mm respectively. The reciprocating mass per cylinder is 1 kg and the engine runs at 4000 rpm. Determine the unbalanced primary and secondary forces and couples on this engine, taking a plane midway between the cylinder 3 and 4 as reference plane. (20 Marks)
- 7 a. Each arm of a Porter governor is 250 mm long. The upper and lower arms are pivoted to links of 40 mm and 50 mm respectively from the axis of rotation. Each ball has a mass of 5 kg and the sleeve mass is 50 kg. The friction between sleeve and spindle mechanism is 40 N. Determine the range of speed of the governor for extreme radii of rotation 125 mm and 150 mm. (10 Marks)
- b. A Hartnell governor moves between 300 rpm and 320 rpm for a sleeve lift of 20 mm. The sleeve arms and the ball arms are 80 mm and 120 mm respectively. The levers are pivoted at 120 mm from the governor axis. The weight of the ball is 25 N. The ball arms are parallel to the governor axis at the lowest equilibrium speed. Determine the stiffness of spring. (10 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 0.6 m above the ground surface. The mass of engine and transmission parts are equivalent to 80 kg with radius of gyration 150 mm and their axis is parallel to the axis of wheel of vehicle. The car negotiates a curve of 60 m radius at 72 kmph with overall gear ratio 4 : 1. The radius of road wheel is 300 mm and moment of inertia is 3 kgm². Assuming wheel track as 1.5 m, determine reaction on each inner wheel and outer wheel. (12 Marks)

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