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10AU54

Fifth Semester B.E. Degree Examination, Dec.2014/Jan.2015

## 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 a. Explain with neat sketch the following:
- Equilibrium of two force member.
  - Equilibrium of three force member.
  - Equilibrium of a member with two forces and applied couple.
- (08 Marks)
- b. In a four bar mechanism shown in the Fig.Q1(b) torque  $T_3$  and  $T_4$  have magnitude of 3000 N-m and 2000 N-m respectively. The length of links AD = 800 mm, AB = 300 mm, BC = 700 mm and CD = 400 mm. For static equilibrium of the mechanism determine the required input torque on the link AB.

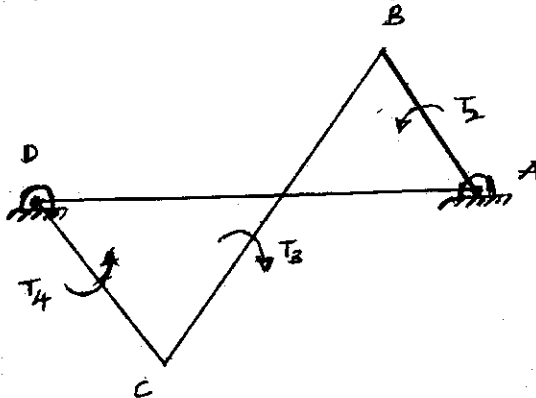


Fig.Q1(b)

(12 Marks)

- 2 a. Explain with neat sketch the equivalent dynamical system. (08 Marks)
- b. The crank pin radius of horizontal engine is 300 mm. The mass of the reciprocating parts is 250 kg. When the crank has turned  $60^\circ$  from IDC the difference between driving and back pressure is  $0.35 \text{ N/mm}^2$ . The connecting rod length is 1.2 m and cylinder bore is 0.5 m. If the engine runs at 250 rpm, calculate:
- Thrust on the side of cylinder walls.
  - Thrust on the connecting rod.
  - Tangential force on the crank pin and
  - Turning moment on the crank shaft.
- (12 Marks)
- 3 a. Derive an expression for maximum fluctuation of energy in a multi-cylinder engine. (08 Marks)
- b. A single cylinder, single acting four stroke gas engine develops 20 KW at 300 rpm. The work done by the gases during the expansion stroke is three times work done on the gases during the compression stroke, the work done during the suction and exhaust strokes being negligible. If the total fluctuation of speed is not to exceed  $\pm 2\%$  of the mean speed and the turning moment diagram during compression and expansion is assumed to be triangular in shape, determine the moment of inertia of the flywheel. (12 Marks)

- 4 In a symmetrical tangent cam operating a roller follower, the least radius of cam is 30 mm and roller radius is 17.5 mm. The angle of ascent is  $75^\circ$  and total lift is 17 mm. The speed of the cam shaft is 600 rpm. Calculate: i) The principal dimensions of cam, ii) Acceleration of the follower at the beginning of the lift, where straight flank merges into the circular nose and apex of the circular nose. Assume that there is no dwell between ascent and descent.

(20 Marks)

**PART – B**

- 5 a. Explain with neat sketch the balancing of several masses revolving in the same plane. (08 Marks)
- b. The four masses A, B, C and D revolve at equal radii and are equally spaced along the shaft. The mass B is 6 kg and the radii of C and D make  $90^\circ$  and  $240^\circ$  with respect to B. Determine the magnitude of the masses A, C and D and angular position of mass A so that system may be completely balanced. (12 Marks)
- 6 a. Derive an expression for residual unbalanced force in case of partial primary balance of single cylinder engine. (08 Marks)
- b. A five cylinder in line engine running at 750 rpm has successive cranks  $144^\circ$  degree apart, the distance between cylinder centre lines being 375 mm. the piston stroke is 225 mm and the ratio of connecting rod length to the crank radius is 4. Examine the engine for balance of primary forces and couples. The reciprocating mass per cylinder is 15 kg. (12 Marks)
- 7 a. Explain the following:  
 i) Sensitiveness of governors  
 ii) Stability of governors  
 iii) Isochronous governors  
 iv) Hunting of governors (08 Marks)
- b. The arms of porter governor are 300 mm long. The upper arms are pivoted on the axis of rotation. The lower arms are attached to a sleeve at a distance of 40 mm from the axis of rotation. The mass of load on the sleeve is 70 kg and the mass of each ball is 10 kg. Determine the equilibrium speed when the radius of rotation of the ball is 200 mm. If the friction is equivalent to a load of 20 N at the sleeve, determine the range of speed of governor for their position. (12 Marks)
- 8 a. Derive an expression for a gyroscopic couple. (06 Marks)
- b. A rear engine automobile is travelling along a track of 100 meters mean radius. Each of the four road wheels has a moment of inertia of  $2.5 \text{ kg-m}^2$  and an effective diameter of 0.6 m. The rotating parts of the engine have a moment of inertia of  $1.2 \text{ kg-m}^2$ . The engine axis is parallel to the rear axle and the crank shaft rotates in the same sense as the road wheels. The ratio of engine speed to back axle speed is 3:1. The automobile has a mass of 1660 kg and has its centre of gravity 0.5 m above road level. The width of the track of the vehicle is 1.5 m.  
 Determine the limiting speed of the vehicle around the curve for all four wheels to maintain contact with the road surface. Assume that centre of gravity of automobile lies centrally with respect to the four wheels. (14 Marks)

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