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**Fifth Semester B.E. Degree Examination, Dec.2016/Jan.2017**  
**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. State the condition for static equilibrium of a body subjected to a system of, (i) two forces (ii) three forces (iii) member with two forces and a torque. (06 Marks)
- b. For the mechanism shown in Fig. Q1 (b), find the required input torque for the static equilibrium. The lengths  $OA = 250$  mm and  $AB = 650$  mm,  $F = 500$  N. (14 Marks)

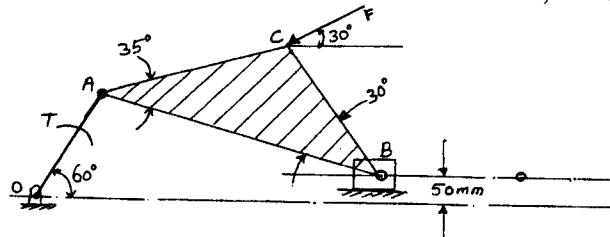


Fig. Q1 (b)

- 2 a. State and explain D'Alembert's principle. (05 Marks)
- b. The turning moment diagram of a multicylinder engine has been drawn to a scale of 1 mm = 500 Nm torque and 1 mm to 6° of crank displacement. The intercepted areas between output torque curve and mean resistance line, taken in order from one end, in square millimeter area : -30, +410, -280, +320, -330, +250, -360, +280 and -260. If the mean speed is 800 rpm and fluctuation of speed is not to exceed 2% of mean speed, determine
- Mass of the flywheel
  - Mean diameter of the flywheel, if the centrifugal stress in the flywheel rim is limited to  $8 \text{ N/mm}^2$ .
  - Dimensions of the rectangular cross section of the rim by taking the width of the rim as 5 times the thickness. The density of cast iron is  $7200 \text{ kg/mm}^3$ . (15 Marks)
- 3 a. Derive an expression for friction torque in case of flat collar with uniform pressure theory. (05 Marks)
- b. An open belt transmits 15 kW power at a belt speed of 900 m/min. The belt embraces  $4/9$  circumference of the pulley. The thickness of belt is 10 mm. The coefficient of friction between belt and pulley surface is 0.3. Safe working stress in the material is 1.5 MPa. Density of the belt material is  $1000 \text{ kg/m}^3$ . Determine the width of the belt. (15 Marks)
- 4 a. What do you mean by static and dynamic balancing? (05 Marks)
- b. A shaft carries four masses in parallel planes A, B, C, D in this order along its length. The masses at B and C are 18 kg and 12.5 kg respectively and each has an eccentricity of 60 mm. The masses at A and D have an eccentricity of 80 mm. The angle between the masses at B and C is  $100^\circ$  and that between masses at B and A is  $190^\circ$ , both being measured in the same direction. The axial distance between the planes A and B is 100 mm and that between B and C is 200 mm. If the shaft is in complete dynamic balance, determine (i) The magnitude of the masses at A and D (ii) The distance between planes A and D. (iii) The angular position of the mass at D. (15 Marks)

**PART – B**

- 5 a. Explain why only partial balancing is possible in reciprocating masses. (05 Marks)
- b. A four crank engine has the two outer cranks set at  $120^\circ$  to each other, and their reciprocating masses are each 400 kg. The distance between the planes of rotation of adjacent cranks are 450 mm, 750 mm and 600 mm. If the engine is to be in complete primary balance, find the reciprocating mass and the relative angular position for each of the inner cranks.  
If the length of each crank is 300 mm the length of each connecting rod is 1.2 m and the speed of rotation is 240 rpm. What is the maximum secondary unbalanced force? (15 Marks)
- 6 a. Define the following with respect to the working of governors : (i) Sensitiveness (ii) Isochronism (iii) Effort of a governor (iv) Stability of a governor. (08 Marks)
- b. The arms of a porter governor are each 300 mm long and are hinged on the axis of rotation. The mass of each ball is 5 kg and mass of the sleeve is 15 kg. The radius of rotation of the ball is 200 mm, when the governor begins to lift and 250 mm, when the governor is at the maximum speed. Determine (i) Range of speed neglecting the sleeve friction. (ii) Range of speed, if the frictional force at the sleeve is 30 N. (12 Marks)
- 7 a. With neat sketches, explain the effect of gyroscopic couple on steering, pitching and rolling of a ship. (08 Marks)
- b. An aeroplane flying at 240 km/h turns towards the left and completes a quarter circle of 60 m radius. The mass of the rotary engine and the propeller of the plane is 450 kg with a radius of gyration of 320 mm. The engine speed is 2000 rpm clockwise when viewed from the rear. Determine the gyroscopic couple on the aircraft and its effect.  
In what way is the effect changed when the,  
(i) Aeroplane turns towards right.  
(ii) Engine rotates clockwise when viewed from the front (nose end) and the aeroplane turns left and right? (12 Marks)
- 8 The following data relate to a circular cam operating a flat faced follower:  
Least diameter = 40 mm, Lift = 12 mm, Angle of action =  $160^\circ$ , Speed = 500 rpm. If the period of acceleration of the follower is  $60^\circ$  of the retardation during the lift, determine  
(i) Principle dimensions of CAM.  
(ii) Acceleration of the main points.  
What is the maximum acceleration and deceleration during the lift? (20 Marks)

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