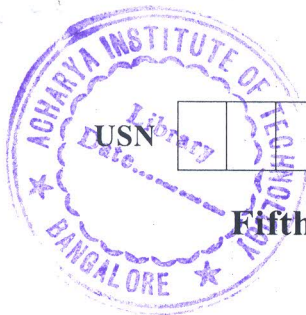


# CBCS SCHEME



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15AU52

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

## Dynamics of Machines

Time: 3 hrs.

Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

### Module-1

- 1 a. Explain static force analysis of slider crank mechanism (preferably with 4 links). (06 Marks)
- b. What is meant by :
  - i) Equilibrium of two force members
  - ii) Equilibrium of three force members. (02 Marks)
- c. In a four bar mechanism shown in Fig.Q1(c) torque  $T_3$  and  $T_4$  have magnitude of 3000 Nm and 2000Nm respectively. Assume  $AD = 800\text{mm}$ ,  $AB = 300\text{mm}$ ,  $BC = 700\text{mm}$  and  $CD = 400\text{mm}$ . For static equilibrium of mechanism, find the required input torque on the crank. [Graphical solution need to be adopted]. (08 Marks)

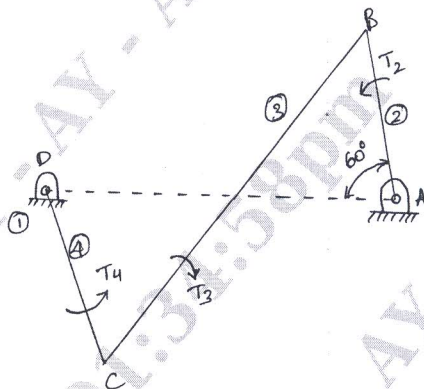


Fig.Q1(c)

OR

- 2 a. State and explain D'Alembert's principle. (03 Marks)
- b. Mention the numericals associated with the following terms in a reciprocating engine.
  - i) Piston effort
  - ii) Crank pin effort and thrust on crank shaft bearing
  - iii) Torque on the crank shaft. (03 Marks)
- c. The following data relate to a connecting rod of a reciprocating engine : Mass = 50kg; Distance between bearing centers = 900mm; diameter of small end bearing = 70mm; Diameter of big end bearing = 90mm. Time of oscillation when the connecting rod is connected from small end = 1.9 seconds; Time of oscillation when the rod is connected from big end = 1.7 seconds. Determine :
  - i) Radius of gyration of the rod about an axis through centre of mass perpendicular to the plane of oscillation
  - ii) Moment of inertia of the rod about the same axis
  - iii) Dynamically equivalent system of the connecting rod comprising two masses, one at the small end bearing center. (10 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
 2. Any revealing of identification, appeal to evaluator and /or equations written eg. 42+8 = 50, will be treated as malpractice.

Module-2

- 3 a. With the help of neat sketches, explain the steps to draw couple and force polygon in order to balance several masses rotating in different planer having atleast six masses. (06 Marks)
- b. A rotating shaft carries four masses 1, 2, 3 and 4 which are radially attached to it. The mass centers are 30mm, 38mm, 40mm and 35mm respectively from the axis of rotation. The masses 1, 3 and 4 are 7.5, 5 and 4 kg respectively. The axial distance between the planes 1 and 2 is 400mm and between 2 and 3 is 500mm. The masses 1 and 3 are at right angles to each other. Find for complete balance,
- Angle between 1, 2, and 1, 4
  - Axial distance between 3 and 4
  - Magnitude of mass 2.

(10 Marks)

OR

- 4 In a four cylinder engine, the two outer crank are at  $120^\circ$  to each other and their reciprocating masses are each 100kg. The distance between the planes of rotation of adjacent cranks are 450mm, 750mm and 450mm, length of each crank is 300mm and length of each connecting rod is 1200mm, speed of engine is 240 RPM. Find :
- The reciprocating masses and relative angular positions for each of the inner cranks
  - The unbalanced secondary forces and couples if any, measured about the central plane for this arrangement arrived at for primary balancing.

(16 Marks)

Module-3

- 5 a. Derive for height of Porter governor analytically. (08 Marks)
- b. The TMD of a single cylinder double acting engine consists of 2 isosceles triangles. The maximum T.m are 2000 and 1500 Nm respectively when the engine works against a uniform resistance at a mean speed of 240RPM. Find :
- Power
  - Maximum fluctuation of energy
  - Mass of flywheel
- Radius of gyration is 0.75m and the fluctuation of speed is limited to 20% mean speed.

(08 Marks)

OR

- 6 a. A porter governor has all four arms 300mm long, the upper arms are pivoted on the axis of rotation and lower arms are attached to the sleeve at a distance 35mm from axis. The mass of each ball is 7kg and the load on the sleeve is 540N. Determine the equilibrium speed for the two extreme radii of 200mm and 260mm of rotation of governor balls. (08 Marks)
- b. In a spring controlled governor, the curve of controlling force is a straight line. When the balls are 0.4m apart, the controlling force is 1500N and when 0.25m apart it is 750N. At what speed the governor will run when the balls are 0.3m apart. What initial tension will be required for isochronisms and what would be the speed mass of each ball is 6kg. (08 Marks)

Module-4

- 7 a. Explain the laws of friction. (06 Marks)
- b. Derive for uniform pressure and uniform wear for a flat collar bearing. (06 Marks)
- c. A vertical shaft 140mm diameter rotating at 120 RPM rests on a flat end foot step bearing. The shaft carries a vertical load of 30kN. The coefficient of friction is 0.06. Estimate the power lost in friction, assuming i) uniform pressure ii) uniform wear. (04 Marks)

OR

- 8 a. Determine centrifugal tension in a flat belt. Also find centrifugal stress. (06 Marks)
- b. Two parallel shafts 5m apart are connected by open flat belt drive. The diameter of the bigger pulley is 1.5m and that of the smaller pulley is 0.75m. The initial tension in the belt is 2.5 kN. The mass of the belt is 1.25kg/m length and co-efficient of friction is 0.25. Taking centrifugal tension into account, find the power transmitted, when smaller pulley rotates at 450 RPM. (06 Marks)
- c. Derive for ratio of belt drives in V-belt drive. (04 Marks)

**Module-5**

- 9 a. In detail, explain the effect of gyroscope on a naval ship. (06 Marks)
- b. A rear engine automobile is travelling along a track of 100m mean radius. Each of the four wheels has a moment of inertia of  $2\text{kgm}^2$  and an effective diameter of 0.6m. The rotating parts of the engine have a moment of inertia of  $1.25\text{kgm}^2$ . The engine axis is parallel to the rear axle and the crankshaft rotates in the same direction as the wheels. The gear ratio of engine to back axle is 3 : 1. The automobile mass is 1500kg and its centre of gravity 0.5m above the road level. The width of track of the vehicle is 1.5m. Determine the limiting speed of the vehicle around the curve for all four wheels to maintain contact with the road surface if it is not banked. (08 Marks)
- c. An aeroplane makes a complete half circle radius towards left when flying at 210km/h. The rotary engine and the propeller of the plane is of 50kg mass having a radius of gyration of 300mm. The engine rotates at 2400 RPM clockwise as seen from the rear. Find the gyroscopic couple on the aircraft and its effect on the plane. (02 Marks)

OR

- 10 a. How do you analyse a tangent cam with roller follower? Explain in detail. (Preferably follower in contact with straight flank). (08 Marks)
- b. Explain the analysis of circular arc cam with flat faced follower. (preferably follower in contact with circular flank). (08 Marks)

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