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17MT45

## Fourth Semester B.E. Degree Examination, Feb./Mar. 2022 Theory of Machines

Time: 3 hrs.

Max. Marks: 100

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

### Module-1

- 1 a. Define the following: i) Kinematic link      ii) Kinematic pair      iii) Mechanism  
iv) Structure      v) Degrees of freedom.      (10 Marks)
- b. With neat sketches, explain the inversions of four bar chain mechanism.      (10 Marks)

OR

- 2 a. With a neat sketch, explain Geneva mechanism.      (10 Marks)
- b. Briefly explain the classification of kinematic pair.      (10 Marks)

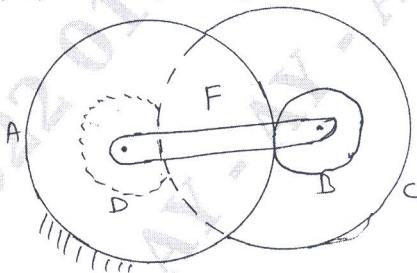
### Module-2

- 3 a. Define gears. Explain the classification of gears.      (10 Marks)
- b. Two spur gears have 24 and 30 teeth of module = 10mm standard addendum = 1 module, pressure angle = 20°. Find: i) Length of arc of contact      ii) Contact ratio.      (10 Marks)

OR

- 4 a. With a neat sketch, explain simple gear train and compound gear train.      (10 Marks)
- b. The gear train shown in below Fig.Q.4(b). Gear A meshes with gear B. In the compound gear B-C, gear C meshes with gear D, rotating relative to A around the same axis of A. If the gear A is fixed, arm F is used as the driving member, determine the speed ratio  $n_D/n_F$ . Number of teeth on wheels A, B, C and D are 61, 61, 62 and 60 respectively.      (10 Marks)

Fig.Q.4(b)



### Module-3

- 5 a. Explain the classification of followers according to the surface in contact.      (06 Marks)
- b. A cam with 3cm as minimum radius is rotating clockwise at a uniform speed of 1200rpm and has to give the motion to the knife edge follower as defined below:
- Follower to move outward through 3cm during 120° of cam radius with uniform velocity.
  - Dwell for the next 60°.
  - Follower to return to its starting position during the next 90° with SHM.
  - Dwell for the remaining period.
- Draw the cam profile follower axis passes through cam axis.      (14 Marks)

OR

- 6 Draw to full size the profile of a cam which will give a lift of 38mm to a follower carrying a roller of 25mm diameter. The axis of the follower is off-set by 18mm to the right of the axis of cam. Ascent of the follower takes place with SHM in 0.05 seconds followed by a period of rest 0.0125 second. The follower by then descent with UARM during 0.125 second, the acceleration being  $\frac{3}{5}$  times retardation. The cam rotates in clockwise direction at a constant speed of 240rpm and the base circle radius of 50mm. (20 Marks)

Module-4

- 7 a. Explain static and dynamic balancing. (08 Marks)  
 b. Five masses  $M_1, M_2, M_3, M_4$  and  $M_5$  revolve in the same plane. Magnitudes of  $M_1, M_2$  and  $M_3$  are 5, 2.5 and 4kg respectively. Angular positions of  $M_2, M_3, M_4$  and  $M_5$  are  $60^\circ, 135^\circ, 210^\circ$  and  $270^\circ$  from  $M_1$ . Determine the masses  $M_4$  and  $M_5$ . (12 Marks)

OR

- 8 a. Derive the expression for  
 i) Ratio of belt tensioning  
 ii) Centrifugal tension of the flat belt drive. (10 Marks)  
 b. An open belt drive is required to transmit 10kW from a motor running at 600rpm. The belt is 12mm thick and has a mass density of  $0.001\text{gm/mm}^3$ . Safe stress in the belt is not to exceed  $2.5\text{N/mm}^2$ . Effective diameter of the driving pulley is 250mm whereas the speed of driven pulley is 220rpm. The 2 shafts are 1.25m apart. If the coefficient of friction is 0.25, determine the width of the belt. (10 Marks)

Module-5

- 9 a. Explain the effect of gyroscopic couple of an aeroplane. (08 Marks)  
 b. The rotor of the turbine of a ship has a mass of 2500kg and rotates at a speed of 3200rpm counter clockwise when viewed from stern. The rotor has radius of gyration of 0.4m. Determine the gyroscopic couple and its effect when  
 i) The ship steers to the left in a curve of 80m at a speed of 27900m/hr.  
 ii) The ship pitches  $5^\circ$  above and  $5^\circ$  below the normal position and the bow is descending with its maximum velocity. The pitching motion is simple harmonic with a periodic time of 40sec.  
 iii) The ship rolls and at the instant the angular velocity is 0.04rad/sec. clock wise when viewed from stern. (12 Marks)

OR

- 10 a. Define the following:  
 i) Sensitiveness  
 ii) Governor effect  
 iii) Hunting  
 iv) Stability  
 v) Governor power. (10 Marks)  
 b. Each arm of a porter governor is 300mm long and its pivoted on the axis of the governor. Each ball has a mass of 6kg and the mass of sleeve is 18kg. The radius of rotation of ball is 200mm. When the governor begins to lift and 250mm when the speed is maximum. Determine the maximum and minimum speed and range of speed of governor. (10 Marks)

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