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18MT45

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) Kinematic chain  
(iv) Mechanism (06 Marks)
- b. Difference between Machine and Mechanism. (04 Marks)
- c. Explain with neat sketch different types of Inversion of Single Slider Crank Chain. (Explain any two.) (10 Marks)

OR

- 2 a. Determine the degree of freedom of the linkage as shown in Fig.Q2(a).

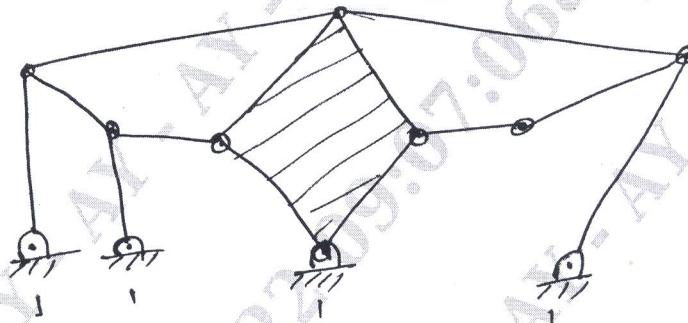


Fig.Q2(a)

- b. Sketch and explain Geneva Wheel Mechanism and Ratchet and Pawl Mechanism. (09 Marks)
- c. Explain with neat sketch Ackermann steering gear mechanism. (07 Marks)

Module-2

- 3 a. Sketch and explain the Spur Gear Terminology. (06 Marks)
- b. Two mating gears with module pitch 6 mm have 20 and 50 teeth of pressure angle  $20^\circ$  and Addendum 6 mm. Determine the number of pairs of teeth in contact. (06 Marks)
- c. Explain with neat sketch different types of gear trains. (08 Marks)

OR

- 4 a. Two spur wheels have 24 and 30 teeth and a standard addendum of 1 module. The pressure angle is  $20^\circ$ . Calculate the path of contact and arc of contact. Derive the equations used. (06 Marks)

- b. The Fig.Q4(b) shows an epicyclic gear train in which arm 'A' is fixed to the shaft 'S', 'B' is freely rotating on 'S' and 'F' is separately driven. 'A' receives 10 KW at 200 rpm and 'F' is driven in the same direction at 100 rpm. Determine:
- Number of teeth on gear 'C'
  - Speed of gear 'B'
  - Torque on gear 'B'

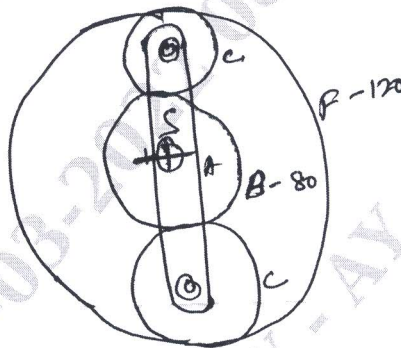


Fig.Q4(b)

(14 Marks)

**Module-3**

- 5 a. Explain with neat sketch different types of followers. (06 Marks)
- b. A cam with 3 cm as minimum radius is rotating clockwise at a uniform speed of 1200 rpm and has to give the motion to the knife edge follows as defined below:
- Follower to move outward through 3 cm during  $120^\circ$  cam rotation with SHM.
  - Dwell for the next  $60^\circ$
  - Follower to return to its starting position during the next  $90^\circ$  with UARM
  - Dwell for the remaining period.
- Draw the cam profile when the follower axis passes through cam axis. (14 Marks)

**OR**

- 6 a. Explain with neat sketch, different types of cams. (06 Marks)
- b. A cam rotating clockwise at uniform speed of 300 rpm operates a reciprocating follower through a roller 1.5 cm diameter. The follower motion is defined as below:
- Outward during  $150^\circ$  with UARM
  - Dwell for the next  $30^\circ$
  - Return during next  $120^\circ$  with SHM
  - Dwell for the remaining period.
- Stroke of the follower is 3 cm. Minimum radius of the cam is 3 cm. Draw the cam profile. Follower axis passes through cam axis. (14 Marks)

**Module-4**

- 7 a. Explain with neat sketch Balancing of Several masses rotating in the same plane and different planes. (06 Marks)
- b. Explain static and dynamic balancing. (04 Marks)
- c. Four masses  $M_1 = 100$  kg,  $M_2 = 175$  kg,  $M_3 = 200$  kg and  $M_4 = 125$  kg are fixed to the crank of 200 mm radius and revolve in planes 1, 2, 3 and 4 respectively. The angular position of the plane 2, 3 and 4 with respect to 1 are  $75^\circ$ ,  $135^\circ$ ,  $240^\circ$  taken in the same sense. Distance of the planes 2, 3 and 4 from 1 are 600 mm, 1800 mm and 2400 mm. Determine magnitude and position of the balancing masses at radius 600 mm in planes 'L' and 'M' located in the middle of 1 and 2 and in the middle of 3 and 4 respectively. (10 Marks)



OR

- 8 a. Derive an expression for Ratio of belt tension in flat belt drives. (06 Marks)  
 b. Derive an expression for centrifugal tension in flat belt drive. (06 Marks)  
 c. A shaft running at 200 rpm is to drive a parallel shaft at 300 rpm. The pulley on the driving shaft is 60 cm diameter. Calculate the diameter of the pulley on the driven shaft.  
 (i) Neglect belt thickness.  
 (ii) Taking belt thickness in to account, which is 5 mm thick.  
 (iii) Assuming in the latter case a total slip of 4%. (08 Marks)

Module-5

- 9 a. Explain with neat sketch effect of gyroscopic couple on a Naval Ship. (10 Marks)  
 b. Find the angle of Inclination with respect to the vertical of a two wheeler negotiating a turn given combined mass of vehicle with rider = 250 kg, mass moment of inertia for engine fly wheel =  $0.3 \text{ kg}\cdot\text{m}^2$ , moment of inertia of each road wheel =  $1 \text{ kg}\cdot\text{m}^2$ , speed of engine fly wheel 5 times that of road wheels and in the same direction, height of centre of gravity of rider with vehicle 0.6 m, two wheeler speed 90 km/hr, wheel radius 300 mm and radius of turn 50 m. (10 Marks)

OR

- 10 a. Define Governor and different types of governors. (06 Marks)  
 b. Explain the following terms:  
 (i) Sensitiveness  
 (ii) Governor effort  
 (iii) Governor power  
 (iv) Hunting (04 Marks)  
 c. The arms of the porter governor are 30 cm long. Upper arms are pivoted to the axis of rotation. Lower arms are attached to the sleeve at a distance of 3.75 cm from the axis. The mass of sleeve is 75 kg. Mass of each ball is 10 kg. Determine the equilibrium speed when the radius of ball is 22.5 cm. What will be the range of speed for this position? If the frictional resistance of the sleeve is 24.5 N. Find also the coefficient of insensitiveness. (10 Marks)

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