CBCS SCHEME

17MT45

Fourth Semester B.E. Degree Examination, July/August 2021
Theory of Machines

Time: 3 hrs.   Max. Marks: 100

Note: Answer any FIVE full questions.

1   a.   Define the following: i) Mechanism   ii) Inversion   iii) Machine   iv) Structure
         v) Kinematic chain   **(05 Marks)**
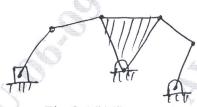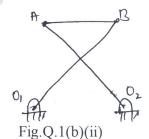   b.   Determine the mobility of the mechanism given below:

Fig.Q.1(b)(i)   Fig.Q.1(b)(ii)

                                                                                (06 Marks)
    c.   With a neat sketch, explain whitworth quick return motion mechanism.   **(09 Marks)**

2   a.   With a neat sketch explain Geneva mechanism.   **(10 Marks)**
    b.   Explain Ackermann steering gear mechanism.   **(10 Marks)**

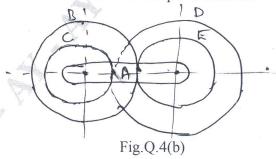3   a.   Define the following: i) Module   ii) Diametral pitch   iii) Pressure angle   iv) Path of
         contact   v) Contact ratio.   **(05 Marks)**
    b.   State and prove law of gearing (or) condition for correct gearing.   **(08 Marks)**
    c.   A pinion having 30 teeth drives a gear having 80 teeth. The profile of the gear is involute
         with 20° pressure angle, 12mm module and 10mm addendum. Find the length of path of
         contact, arc of contact and the contact ratio.   **(07 Marks)**

4   a.   Explain the types of gear trains.   **(05 Marks)**
    b.   In a reverted epicyclic gear train, the arm A carries two gears B and C and a compound gear
         D-E. The Gear B meshes with Gear E and gear C meshes with gear D. The number of teeth
         on Gears B, C and D are 75, 30 and 90 respectively. Find the speed and direction of gears C.
         When Gear B is fixed and the arm A makes 100rpm clockwise.   **(15 Marks)**

Fig.Q.4(b)

5 a. Explain the different types of followers. (05 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.
      i) Follower to move outward through 3cm during 120° of cam radius with SHM.
      ii) Dwell for the next 60°.
      iii) Follower to return to its starting position during next 90° with UARM.
      iv) Dwell for the remaining period. Draw the cam profile when follower axis passes through cam axis. (15 Marks)

6   A cam rotating clockwise at a uniform speed of 1000rpm is required to give a roller follower the motion defined below.
      i) Follower to move outward through 50mm during 120° of cam rotation.
      ii) Follower to dwell for next 60 of cam rotation.
      iii) Follower to return to its starting position during next 90° of cam rotation.
      iv) Follower to dwell for the rest of cam rotation.
      The minimum radius of the cam is 50mm and the diameter of roller is 10mm. The line of stroke of the follower is off-set by 20mm from the axis of the cam shaft. If the displacement of the follower takes place with uniform and equal acceleration and retardation on both outward and return strokes, draw profile of the cam and find the maximum velocity and acceleration during out stroke and return stroke. (20 Marks)

7 a. Explain the necessity of balancing in machine elements. (05 Marks)
   b. A shaft carrier four masses A, B, C and D of magnitude 200kg, 300kg, 400kg and 200kg respectively and revolving at radii 80mm, 70mm, 60mm and 80mm in planes measured from A at 300mm, 400mm and 700mm. The angle between the cranks measured anticlock wise are A to B 45°, B to C 70° and C to D 120°. The balancing masses are to be placed in planes X and Y. The distance between the planes A and X is 100mm, between X and Y is 400mm and between Y and D is 200mm. If the balancing masses revolve at radius of 100mm. Find magnitudes and angular position. (15 Marks)

8 a. With usual notations derive $\dfrac{T_1}{T_2} = e^{\mu\theta}$. (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 $0.001 gm/mm^3$. Safe stress in the belt is not to exceed $2.5 N/mm^2$. Effective diameter of the driving pulley is 250mm where as the speed of driven pulley is 220rpm. The two shafts are 1.25m apart. If the coefficient of friction is 0.25, determine the width of the belt. (10 Marks)

9 a. Explain the Gyroscopic effect of steering, pitching and rolling of a ship moving in a heavy sea. (08 Marks)
   b. An aeroplane makes a complete half circle of 50m radius, towards left when flying at 200km/hr. The rotary engine and the propeller of the plane has a mass of 400kg and a radius of gyration of 0.3m. The rotates at 2400rpm clock wise when viewed from the rear. Find the gyroscopic couple on the air craft and state its effect on it. (12 Marks)

10 a. Define the following: i) Sensitiveness   ii) Hunting   iii) Stability   iv) Isochronous governor. (08 Marks)
    b. A porter governor has arms 250mm long, each are pivoted on the axis of rotation. Mass of each governor ball is 2kg. At the mean speed of 200rpm, it is found that centrifugal force exerted at each ball is 100N neglecting friction, determine the central load if the sleeve movement is restricted to ±20mm. Also determine the range of speed. (12 Marks)

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