CBCS Scheme

USN ☐☐☐☐☐☐☐☐☐☐   15AU43

Fourth Semester B.E. Degree Examination, June/July 2017
Kinematics of Machines

Time: 3 hrs.   Max. Marks: 80

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

Module-1

1   a.   Define the following terms with example:
     i)   Kinematic pair   ii) Kinematic chain   iii) Mechanism
     iv) Degree of freedom   v) Structure   (08 Marks)
    b.   Explain with a neat sketch any two inversions of double slider crank chain mechanism.
                                                           (08 Marks)

OR

2   Sketch and explain the following mechanism:
    a.   Crank and slotted lever quick return mechanism   (06 Marks)
    b.   Peaucellier's mechanism   (04 Marks)
    c.   Ackermann steering gear mechanism   (06 Marks)

Module-2

3   a.   What is Coriolis component of acceleration? Derive the expression for the same.   (06 Marks)
    b.   In the mechanism shown in Fig,Q3(b), the slider C is moving to the right with a velocity of 1 m/s and an acceleration of 2.5 m/s². The dimensions of various links are AB = 3 m inclined at 45° with the vertical and BC = 1.5 m inclined at 45° with the horizontal. Determine: i) The magnitude of vertical and horizontal component of acceleration of the point B and (ii) The angular acceleration of the links AB and BC.   (10 Marks)
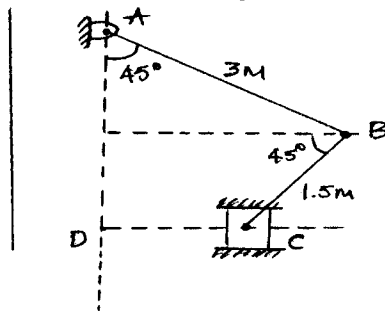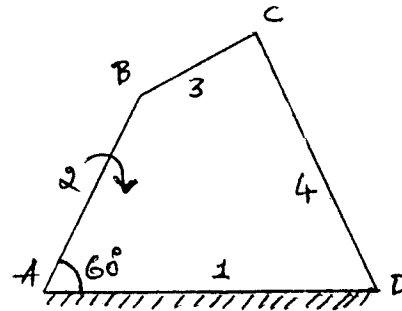

Fig.Q3(b)   Fig.Q4

OR

4   A pin jointed four bar mechanism ABCD is shown in Fig.Q4. Link AB = 150 mm, BC = 180 mm, CD = 180 mm and the fixed link AD = 300 mm. Link AB makes 60° with the link AD, and rotates uniformly at 100 rpm. Locate all the instantaneous centres and find the angular velocity of link BC and the linear velocity of link CD.   (16 Marks)

Module-3

5   a.   Explain in brief loop closure equation.   (05 Marks)
    b.   In four bar mechanism ABCD, link AB = 300 mm, BC = 360 mm, CD = 360 mm and fixed link AD = 600 mm. The angle BAD = 60°. The link AB has an angular velocity of 10 rad/sec and angular acceleration of 30 rad/sec² both clockwise.
      Determine the angular velocity and angular acceleration of link BC and CD by using Raven's approach.   (11 Marks)

OR

6   In a reciprocating engine, the length of crank is 250 mm and length of connecting rod is 1000 mm. The crank rotates at an uniform speed of 300 rpm in clockwise direction and the crank is inclined at 30° with inner dead centre. The centre of gravity of the connecting rod is 400 mm away from the crank end. By Klein's construction, determine:
   i) Velocity and acceleration of piston
   ii) Angular velocity and angular acceleration of connecting rod
   iii) Velocity and acceleration at the centre of gravity of the connecting rod.   **(16 Marks)**

Module-4

7 a. State and prove law of gearing or condition for correct steering.   **(06 Marks)**
   b. Two 20° involute spur gears mesh externally and give a velocity of ratio 3. Module is 3 mm and the addendum is equal to 1.1 module. If the pinion rotates at 120 rpm, determine:
       i) Minimum number of teeth on each wheel to avoid interference.
       ii) Number of pairs of teeth in contact.   **(10 Marks)**

OR

8 a. Sketch and explain an automobile differential.   **(06 Marks)**
   b. In an epicyclic gear train shown in Fig.Q8(b), the compound wheels A and B as well as internal wheels C and D rotate independently about the axis O. The wheels E and F rotate on the pins fixed to the arm 'a'. All the wheels are of the same module. The number of teeth on the wheels are $T_A = 52$, $T_E = T_F = 36$. Determine the speed of C if:
       i) The wheel D is fixed and arm rotates at 200 rpm clockwise.
       ii) The wheel D rotates at 200 rpm counter clockwise and arm 'a' rotates at 20 rpm in CCW direction.
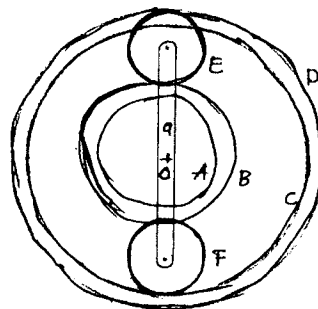

Fig.Q8(b)   **(10 Marks)**

Module-5

9   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:
   i) Outward during 150° with UARM   ii) Dwell for next 30°
   iii) Return during next 120° with SHM   iv) Dwell for the remaining period.
   Stroke of the follower is 3 cm. Minimum radius of the cam is 3 cm. Draw the cam profile when follower axis is offset to right by 1 cm.   **(16 Marks)**

OR

10 a. Define the following terms as applied to a cam with a neat sketch:
        i) Base circle   ii) Pitch circle
        iii) Pressure angle   iv) Stroke of the follower   **(04 Marks)**
    b. Draw the profile of a cam operating a knife edge follower having a lift of 30 mm. The cam raises the follower with SHM for 150° of the rotation followed by a period of dwell for 60°. The follower descends for next 100° rotation of the cam with uniform velocity, again followed by a dwell period. The cam rotates in an anticlockwise sense at a uniform velocity of 120 rpm and has a least radius of 25 mm. What will be the maximum velocity and acceleration of the follower during the lift?   **(12 Marks)**

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