USN ☐☐☐☐☐☐☐☐☐☐ **18ME44**

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

Time: 3 hrs. Max. Marks: 100

Note: *Answer any FIVE full questions.*

1 a. Define the following :
   i) Constrained motion   ii) Structure   iii) Mechanism   iv) Kinematic pairs
   v) Kinematic chain   vi) Degree of freedom. **(06 Marks)**
   b. Find degree of freedom for the chains shown in Fig Q1(b) (i), (ii), (iii)
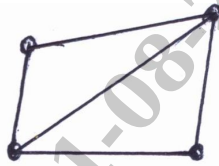

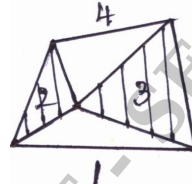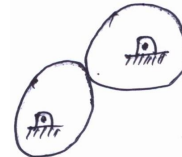   Fig Q1(b) – (i)   Fig Q1(b) – (ii)   Fig Q1(b) – (iii)   **(06 Marks)**
   c. Draw a neat sketch of Peaucellier straight line mechanism. Explain with proof how the tracing point describes a straight path. **(08 Marks)**

2 a. What is quick return motion? Explain with neat sketch crank slotted lever mechanism.
   (10 Marks)
   b. Explain with neat sketches :
   i) Toggle mechanism   ii) Ratchet and Pawl mechanism. **(10 Marks)**

3 PQRS in a four bar chain with link PS fixed. The lengths of the links are PQ = 62.5mm, QR = 175mm, RS = 112.5mm and PS = 200mm. The crank PQ rotates at 10 rad/sec clockwise. Draw the velocity and acceleration diagram when angle QPS = 60º and Q and R lie on the same side of PS. Find the angular velocity and angular acceleration of link QR and RS by graphical method. **(20 Marks)**

4 a. State and prove Kennedy's theorem. **(08 Marks)**
   b. Find all the instantaneous centres of the slider crank mechanism shown in Fig Q4(b) below and find the velocity of the slider when the crank OA rotates with an angular velocity of 10 rad/s. Also determine the angular velocity of the connecting rod. The length of the connecting rod and crank are 800mm and 240mm and the crank makes an angle of 45º from the inner dead centre.
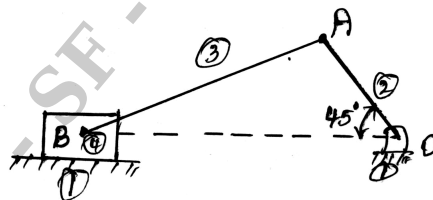

   Fig Q4(b) **(12 Marks)**

5 The crank of an IC engine is 90mm and connecting rod length is 450mm. The crank is rotating in anticlockwise direction with angular velocity of 15rad/s and angular acceleration of 100rad/s^2. Find the acceleration of the piston and the angular acceleration of the connecting rod when the crank has turned 60º from the inner dead centre. **(20 Marks)**

6 a. Derive Freudenstein's equation for four bar mechanism. **(12 Marks)**

   b. A four bar mechanism is required such that the input and output angles are coordinated as given in the table synthesize the four bar mechanism :

    Input crank angle   –   40º 60º 90º

    Output follower angle –   0º   35º 65º

                                                          (08 Marks)

7 Construct the profile of a cam to suit the following specification:

    Cam shaft diameter   =   40mm

    Least radius of cam   =   25mm

    diameter of roller   =   25mm

    angle of lift   =   120º

    angle of fall   =   150º

    lift of the follower   =   40mm

    Number of pauses (Dwell) are two of 45º equal interval between motions.

    During the lift, the motion is S.H.M

    During the fall the motion is UARM

    The speed of the cam shaft is uniform

    The line of stroke of the follower is off-set 13mm from the centre of the cam. **(20 Marks)**

8 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 120º of cam rotation with cycloidal motion

   ii) Dwell for the next 60º

   iii) Dwell to return to its starting position during the next 90º with UARM

   iv) Dwell for the remaining period.

    Draw the cam profile when follower axis is off-set to the right by 1cm. **(20 Marks)**

9 a. Derive an expression for the length of path of contact. **(08 Marks)**

   b. A pair of 20 º full depths involutes spur gears having 30 and 50 teeth respectively of module 4mm are in mesh. The smaller gear rotates at 1000rpm. Determine :

   i)   Sliding velocities at engagement and at disengagement of pair of a teeth

   ii) Contant ratio. **(12 Marks)**

10 a. List and explain the types of gear trains. **(08 Marks)**

   b. An epicyclic gear consists of three gears A, B and C as shown in Fig Q10(b). The gear A has 72 internal teeth and gear C has 32 external teeth. The gear B meshes with both A and C and is carried on an arm EF which rotates about the centre of A at 18rpm. If the gear A is fixed, determine the speed of gears B and C.
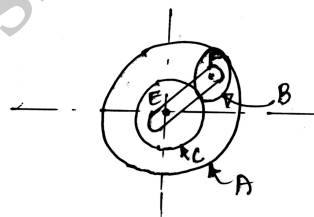

Fig Q10(b) **(12 Marks)**

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