CBCS SCHEME

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15ME42

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

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. With a neat sketch define the following:
(i) Kinematic link
(ii) Kinematic pair
(iii) Kinematic chain.
(iv) Kinematic mechanism **(08 Marks)**

b. With a neat sketch, explain Crank and Slotted lever quick return mechanism. **(08 Marks)**

OR

2 a. Sketch and explain the working of Ackerman steering gear mechanism. Also obtain the condition for correct steering. **(10 Marks)**

b. Define degrees of freedom. Find the degrees of freedom for the following mechanism:

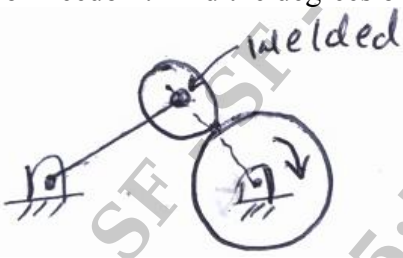

Fig.Q2 (a) – (i)

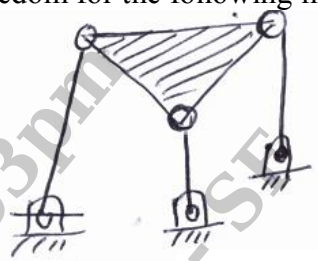

Fig.Q2 (a) – (ii)

(06 Marks)

Module-2

3 In a slider crank mechanism, the crank OB = 30 mm and the connecting rod BC = 120 mm. The crank rotates at a uniform speed of 300 rpm clockwise. For the crank position shown in Fig. Q3. Find (i) Velocity of Piston 'C' and angular velocity of connecting rod BC.
(ii) Acceleration of Piston 'C' and angular acceleration of connecting rod BC. Solve the relative method. **(16 Marks)**

OB = 30 mm,
BC = 120 mm

Fig. Q3

OR

4 a. State and prove Kennedy's theorem. **(06 Marks)**

b. Locate all the instantaneous centres for the slider Crank mechanism. **(04 Marks)**

c. State the procedure of Klein's construction for velocity analysis of slider crank m/Sm. **(06 Marks)**

Module-3

5 a. Using Complex algebra derive the expressions for velocity and acceleration of the piston for slider crank mechanism. **(08 Marks)**

b. In a reciprocating engine length of crank is 250 mm and length of connecting rod is 1000 mm. The crank rotates at a uniform speed of 300 rpm clockwise. Crank is at 30˚ from I.D.C. Determine

(i) Velocity of piston and angular velocity of connecting rod.

(ii) Acceleration of piston and angular acceleration of connecting rod compiler algebra method. **(08 Marks)**

OR

6 Synthesis a 4-bar linkage using Freudenstein's equation to generate the function $Y = x^{1.5}$ for the interval $1 \le x \le 4$. The input crank is to start from $\phi_S = 30^\circ$ and have a range of 90˚. The output follower is to start at $\psi_S = 0^\circ$ have a range of 90˚. Take three accuracy points. **(16 Marks)**

Module-4

7 a. Derive an expression for the minimum number of teeth on a gear to avoid interference. **(08 Marks)**

b. Two-gear wheels mesh externally and are to give a velocity ratio of 3 to 1. The teeth are of involute type : Module = 6 mm ; addendum = one module, Pressure angle = 20˚. The pinion rotates at 90 rpm. Find

(i) The number of teeth on the pinion to avoid interference on it.

(ii) Length of path and arc of contact.

(iii) The number of pairs of teeth in contact.

(iv) Maximum velocity of slicling. **(08 Marks)**

OR

8 a. With neat sketch show the compound gear train and explain how it differs from a simple gear train. **(06 Marks)**

b. An epicyclic gear train consists of three gears : 1, 2 and 3 as shown in Fig. Q8 (b). The internal gear 1 has 72 teeth and gear 3 has 32 teeth. The gear 2 meshes with both gear 1 and gear 3 and is carried on an arm 'A', which rotates about the centre O_2 at 20 rpm. If the gear 1 is fixed, determine the speed of gear 2 and 3. **(10 Marks)**

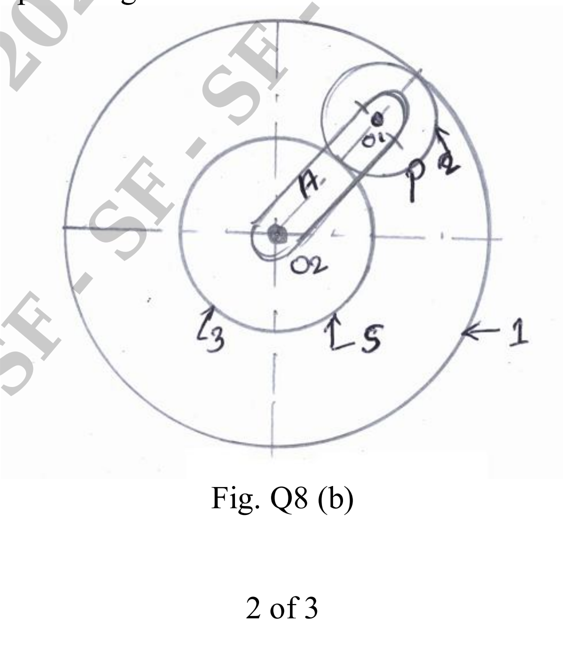

Fig. Q8 (b)

Module-5

9 Draw the Cam profile for a knife-edge follower with the following data:
  (i) Cam life = 40 mm, during 90˚ of cam rotation with S.H.M.
  (ii) Dwell for the next 30˚.
  (iii) During the next 60˚ of cam rotation, the follower returns to its original position with S.H.M.
  (iv) Dwell during the remaining 180˚.

The radius of the base circle of cam is 40 mm. Determine the maximum velocity of the follower during its ascent and descent, if the cam rotates at 240 rpm in clockwise direction. **(16 Marks)**

OR

10 A symmetrical circular arc cam operating a flat faced follower has the following particulars : Least radius of the cam is 30 mm, Lift is 20 mm, Angle of lift is 75˚, Nose radius is 5 mm, Speed is 600 rpm. Find
  (i) Principal dimensions of the cam.
  (ii) The acceleration of the follower at the beginning of lift, at the end of contact with the circular flank at the beginning of contact with nose and at the apex of the nose.

(16 Marks)

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