B.E. (Mechanical Engineering / Power Engineering (New)) Third Semester (C.B.S.)

Kinematics of Machines

P. Pages : 4

Time : Three Hours

|| *0529* ||

Max. Marks : 80

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Notes : 1. All questions carry marks as indicated.
2. Solve Question 1 OR Questions No. 2.
3. Solve Question 3 OR Questions No. 4.
4. Solve Question 5 OR Questions No. 6.
5. Solve Question 7 OR Questions No. 8.
6. Solve Question 9 OR Questions No. 10.
7. Solve Question 11 OR Questions No. 12.
8. Due credit will be given to neatness and adequate dimensions.
9. Assume suitable data whenever necessary.
10. Illustrate your answers whenever necessary with the help of neat sketches.
11. Use of non programmable calculator is permitted.
12. Use drawing sheets for graphical solutions.

1. a) Answer **any five.** **10**

   i) Define mechanism. Give two examples of mechanisms along with the names of machines in which they are used.

   ii) Explain how higher pair is equivalent to two lower pairs and an additional link.

   iii) Draw neat sketch of linkage with six links with single DOF.

   iv) Draw neat sketch of handpump mechanism as an inversion of single slider crank mechanism.

   v) Draw kinematic sketch of mechanism used in car wiper. Whether it is Grashoff's linkage or not?

   vi) Define lower pair. Give names of all six lower pairs.

   b) Draw neat sketches of any two straight line mechanisms. **4**

OR

2. a) Determine mobility of the following. **8**

a.

b.

c.

d.
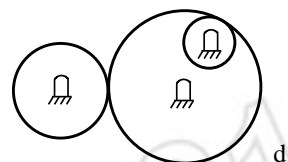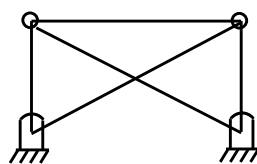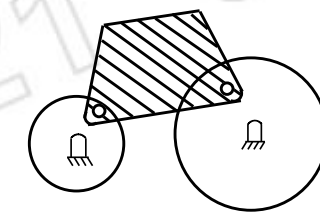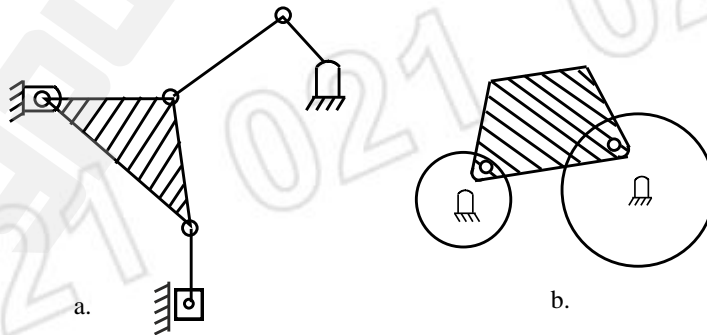
b) Draw neat sketch of slider crank mechanism with following data. Show the mechanism in six different position (Q = 0, 60, 120, 180, 240, 300). If C is the midpoint of coupler link AB. What will be the nature of coupler curve traced by point C. Crank (OA) 3 cm, connecting rod (AB) - 7 cm. **5**

3. For the mechanism shown determine the acceleration of point C. Also determine the angular accelerations of coupler & follower. **13**

$O_2O_4 - 9cm$

$O_2A - 3cm$

$AB - 8cm$

$O_4B - 7cm$

$AC - 3cm$

$w_2 - 20 rad/s (cw)$
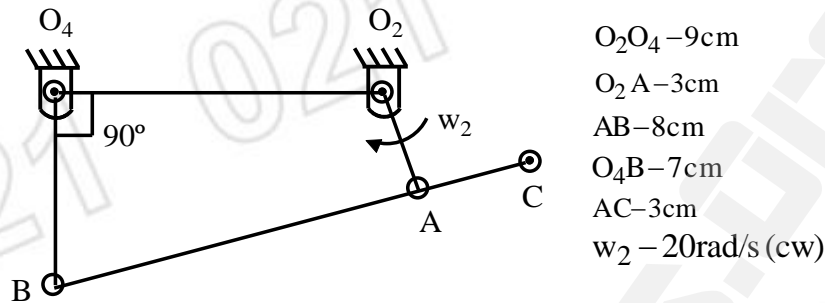
OR

4. a) What is Coriolis component of acceleration? Derive the relation for its magnitude & show the directions. **6**

b) Determine velocity of slider B and angular velocity of connecting rod AB using instantaneous centres. **7**

$$AB - 8cm, \quad O_2A - 3cm, \quad \theta = 140° \quad w_2 - 50 rad/s (cw)$$
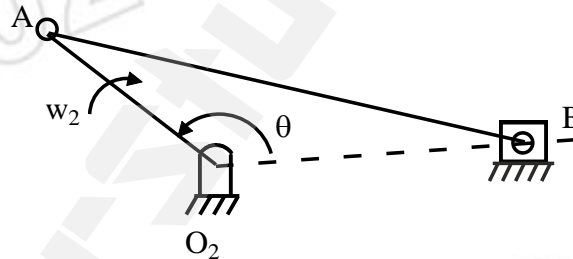
5. a) Compare cam follower mechanisms with linkages. Give names of few machines in which cam follower mechanism is used. **3**

b) Explain how cams are classified. **4**

c) With neat sketch define following terms for cams **6**

   i) Base circle   ii) Pitch curve

   iii) Pressure angle   iv) Pitch point

OR

6. Draw the profile of a cam to raise a valve with simple harmonic motion through 5 cm in $1/3^{rd}$ of a revolution, keep it fully raised through $1/12^{th}$ revolution and to lower it with harmonic motion in $1/6^{th}$ revolution. The valve remains closed during the rest of the revolution. The diameter of the roller is 2 cm and minimum radius of the cam to be 2.5 cm. If the Camshaft rotates a 300 rpm clockwise determine maximum velocity & acceleration during lifting. **14**

7. a) What are different types of gears? Explain with neat sketches. **4**

b) Find the number of teeth and the circular pitch of a gear whose pitch diameter is 200 mm if the module is 8 mm. **2**

c) A gear having a module of 4 mm and 21 teeth drives another gear at a speed of 240 rpm. How fast is the 21 - tooth gear rotating if the shaft center distance is 156 mm? **3**

d) Derive the relation for minimum number of teeth when a pinion meshes with a rack. **4**

OR

8. a) Why helical gears are used when more power is to be transmitted at high speeds. **3**

b) In an epicyclic gear train as shown in fig. 8, the arm A is fixed to shaft S. The wheel B having 100 teeth rotates freely on the shaft S and wheel F with 150 teeth is separately driven. If the arm A runs at 200 rpm and wheel F at 100 rpm in same direction, find (a) Number of teeth on wheel C (b) speed of wheel B. **10**
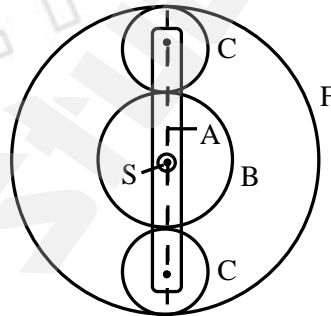
9. a) What is kinematic synthesis? Explain what is type, number and dimensional synthesis. **4**

b) What are the advantages of analytical method of synthesis. Derive Freudenstein's equation used for analytical synthesis of four bar mechanism. **9**

OR

10. Design a crank rocker mechanism for a wiper of a truck with wiping angle of 90°. Assume the length of rocker arm on which wiper blade is mounted as 10 cm. Also determine the maximum & minimum transmission angles. Explain the significance of transmission angle in this case. **14**

11. a) What are different types of dynamometers? Explain with neat sketch the working of rope brake dynamometer. **5**

b) A simple band brake is operated by a lever of length 500 mm. The brake drum has a diameter of 500 mm and the brake band embraces 5/8 of the circumference. One end of the band is attached the fulcrum of the lever while the other is attached to a pin on the lever 100 mm from the fulcrum. If the effort applied to the end of the lever is 200 N and $\mu = 0.25$, find the maximum braking torque on the drum. **8**
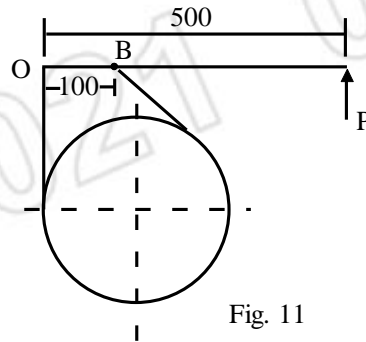

Fig. 11

OR

12. a) Explain the terms. **6**
      Limiting angle of friction and angle of repose.

b) A multiplate clutch has three pairs of contact surfaces. The outer and inner radii at the contact surfaces are 100 mm and 50 mm respectively. The axial spring force is 1 kN. Assuming uniform wear, find the power transmitted at 1500 rpm. Take $\mu = 0.35$. **7**

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