B.E. Mechanical Engineering Sem-III (Old + C.B.C.S.)

ME303 - Theory of Machines-I / Kinematics of Machines

P. Pages : 4 **GUG/S/19/11518**

Time : Three Hours Max. Marks : 80

Notes :
1. Answer Q. 1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.
2. All questions carry marks as indicated.
3. Assume suitable data wherever necessary.
4. Illustrate your answers necessary with the help of neat sketches.
5. Use of non-programmable calculator and drawing instruments is permitted.

1. a) Differentiate between higher pair and lower pair by giving examples. **4**

b) What is redundant degree of freedom of a mechanism? **4**

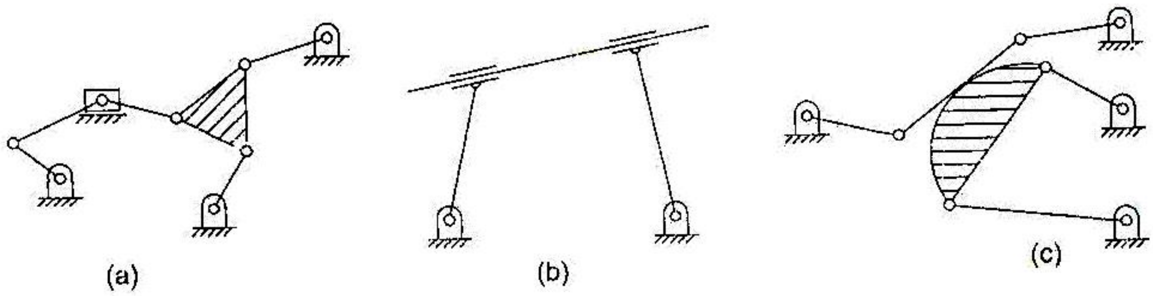
c) What is Kinematic inversion? Explain the inversions of double slider crank chain with suitable sketches. **8**

OR

2. a) Explain Harding's notations with suitable examples. **3**

b) Explain Peaucellier straight line mechanism. **4**

c) Draw the following mechanisms, identify the links and determine the degree of freedom- **9**



3. A mechanism of a crank and slotted level quick return motion is shown in fig. Q. 3. If the crank rotates counter clockwise at 120 rpm, determine for the configuration shown, the velocity and acceleration of the ram D. Also determine the angular acceleration of slotted lever. **16**

Crank AB = 150mm, Slotted arm, OC = 700mm and Link CD = 200mm.

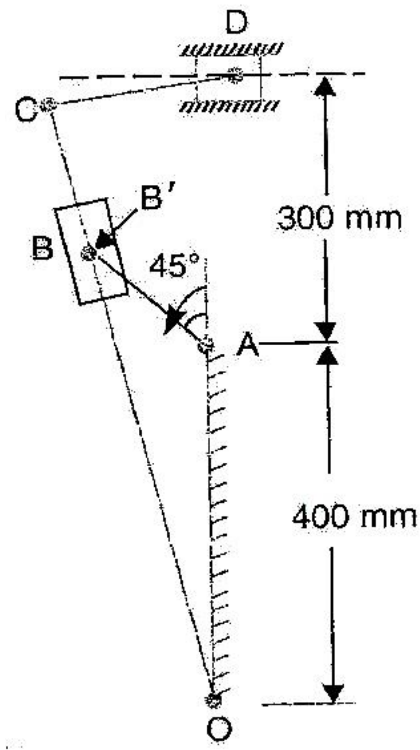


Fig. Q. 3

OR

4. a) What is Coriolis component of acceleration? How its magnitude and direction are determined? **4**

b) State Kennedy's theorem. **2**

c) For inverted slider crank mechanism shown in fig. Q. 4 (c), find the angular velocity of the link QR and sliding velocity of the block on the link QR. The crank OA is 300mm long and rotates 20 rad/sec in the clockwise direction OQ =650mm, $\angle QOA = 40^o$. **10**

Use Instantaneous centre of rotation method.

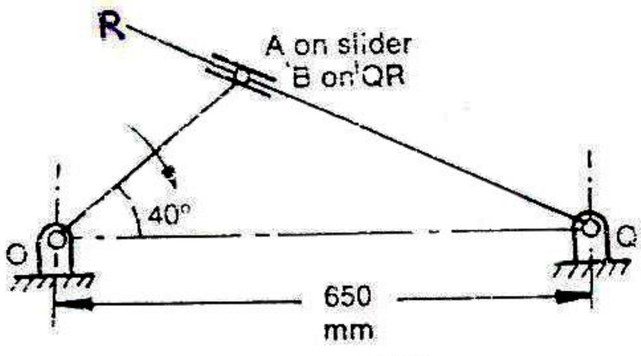


Fig. Q. 4 (c)

5. A cam rotating clockwise at a uniform speed of 300 rpm, is required to give a flat faced follower, the motion defined below:- **16**

i) Follower to move outward through 3 cm during 120º of cam rotation.
ii) Follower to dwell for next 60º of cam rotation.
iii) Follower to return to its starting position during next 90º of cam rotation.
iv) Follower to dwell for rest of rotation the minimum radius of cam is 5cm. If the displacement of the follower takes place cycloidal motion during outstroke and with the uniform acceleration and retardation during return stroke acceleration is $\frac{2}{3}$ of the retardation.
   a) Draw the displacement diagram.
   b) Draw the cam profile.
   c) Calculate the maximum velocity and acceleration during outstroke.

OR

6. a) What is a tangent cam? Derive an expression for the lift, velocity and acceleration of the reciprocating roller follower of tangent cam, when the roller on the flank. **7**

b) i) Synthesize a tangent cam to drive a roller follower through a total lift of 1.25cm for a cam rotation of 65º. The distance between the cam centre and follower centre at full lift is 45mm and the roller is 20mm in diameter. Nose radius is 8.5mm. **9**

ii) Find the velocity and acceleration of the follower when the cam has turned through half the rise angle the cam speed is 30rpm.

7. a) State and derive the law of gearing. **6**

b) Two gears in mesh have a module of 10mm and a pressure angle of 25º. The pinion has 20 teeth and the gear has 52. The addendum on both the gears is equal to one module Determine - **10**

i) The number of pairs of teeth in contact

ii) The angle of action of the pinion and the wheel.

iii) The ratio of sliding velocity to the rolling velocity at the pitch point, at the beginning and end of engagement.

OR

8. a) What is interference in involute gears? How it can be avoided? **6**

b) Two mating gears have 20 and 40 involute teeth of module 10mm and 20º pressure angle. If the addendum on each wheel is such that the path of contact is maximum and interference is just avoided, Find the addendum for each gear wheel, path of contact, arc of contact and contact ratio. **10**

9. a) Derive an expression for train value for the following gear trains:- **6**

i) Compound gear train.
ii) Reverted gear train.

b) In an epicyclic gear train shown in fig. Q. 9(b) the wheel C is keyed to the shaft B and wheel F is keyed to shaft A. The wheels D and E rotate together on a pin fixed to the arm G. The number of teeth on wheels C, D and E are 35, 65 and 32 respectively. If the shaft A rotates at 66 rpm and the shaft B rotates at 28 rpm in the opposite direction. Find the speed and direction of rotation of arm G. **10**

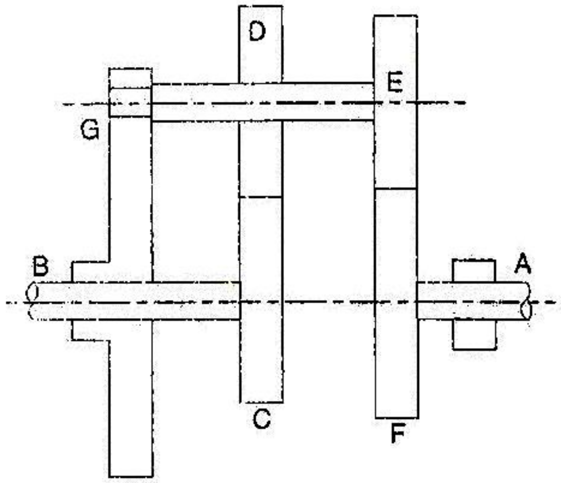


Fig. Q. 9 (b)

OR

10. a) Show that in a pair of spiral gears connecting inclined shafts the efficiency is maximum when the spiral angle of the driving wheel is half the sum of the shaft and friction angles. **8**

b) It is required to replace a gear pair consisting of 20º full depth spur gear of 30 and 75 teeth having a module 4mm, by helical gears of 4mm normal module and 20º full depth design the gear pair. **8**

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