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**Question Paper Code: 54702**

B.E./B.Tech. DEGREE EXAMINATION, MAY 2018

Fourth Semester

Mechanical Engineering

15UME402 – KINEMATICS OF MACHINERY

(Regulation 2015)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. A planar mechanism has 8 links and 10 rotary joints. The number of degrees of freedom of the mechanism, using Grubler's criterion, is CO1-U  
(a) 0                      (b) 1                      (c) 2                      (d) 3
2. The mechanism used in a shaping machine is CO1-R  
(a) A closed 4-bar chain having 4 revolute pairs  
(b) A closed 6-bar chain having 6 revolute pairs  
(c) A closed 4-bar chain having 2 revolute and 2 sliding pairs  
(d) An inversion of the single slider-crank chain
3. There are two points P and Q on a planar rigid body. The relative velocity between the two points CO2-U  
(a) Should always be along PQ  
(b) Can be oriented along any direction  
(c) Should always be perpendicular to PQ  
(d) Should be along QP when the body undergoes pure translation
4. Consider the following statements: CO2-R  
Coriolis component of acceleration depends on  
1. velocity of slider 2. angular velocity of the link  
3. acceleration of slider 4. angular acceleration of link  
Of these statements  
(a) 1 and 2 are correct                      (b) 1 and 3 are correct  
(c) 2 and 4 are correct                      (d) 1 and 4 are correct

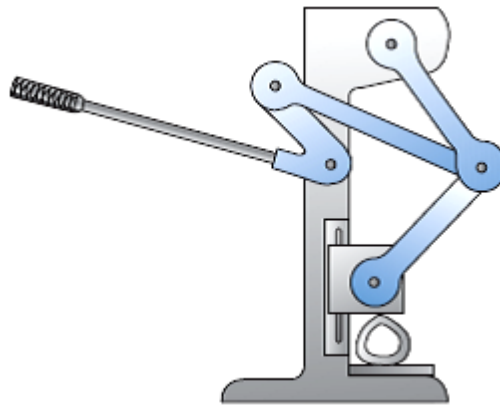
5. Angle of ascent of cam is defined as the angle CO3- R
- (a) During which the follower returns to its initial position
  - (b) Of rotation of the cam for a definite displacement of the follower
  - (c) Through which the cam rotates during the period in which the follower remains in highest position
  - (d) Moved by the cam from the instant the follower begins to rise, till it reaches its highest position
6. For a spring-loaded roller-follower driven with a disc cam CO3- R
- (a) The pressure angle should be larger during rise than that during return for ease of transmitting motion.
  - (b) The pressure angle should be smaller during rise than that during return for ease of transmitting motion.
  - (c) The pressure angle should be large during rise as well as during return for ease of transmitting motion
  - (d) The pressure angle does not affect the ease of transmitting motion
7. Which of the following is not true about gears? CO4- R
- (a) Positive drive
  - (b) Constant velocity ratio
  - (c) Transmit large power
  - (d) Bulky construction
8. Interference is caused by? CO4-U
- (a) Overlapping of tooth profiles
  - (b) Large size of dedendum
  - (c) Meshing of involute and non-involute profiles
  - (d) All of the mentioned
9. For a simple gear train, velocity ratio is the ratio of CO5- R
- (a) Speed of driving shaft and speed of driven shaft
  - (b) Speed of driven shaft and speed of driving shaft
  - (c) Speed of driven shaft and (speed of driving shaft + speed of idler gears)
  - (d) Speed of driving shaft and (speed of driven shaft + speed of idler gears)
10. In which of the following type of gear train the first gear and the last gear are co-axial CO5- R
- (a) Simple gear train
  - (b) Compound gear train
  - (c) Reverted gear train
  - (d) None of the mentioned

PART – B (5 x 2= 10Marks)

11. Define Grashof's law. State how it helps in classifying the four link mechanisms into different types CO1-U
12. What is velocity of rubbing? Also find the velocity of rubbing when the angular velocities of the two links joined together are in the same direction? CO2-U
13. Define base circle and pressure angle in cam? CO3-U
14. What do you mean by undercutting of gears ? CO4-U
15. What is the difference between simple and compound gear train ? CO5-U

PART – C (5 x 16= 80Marks)

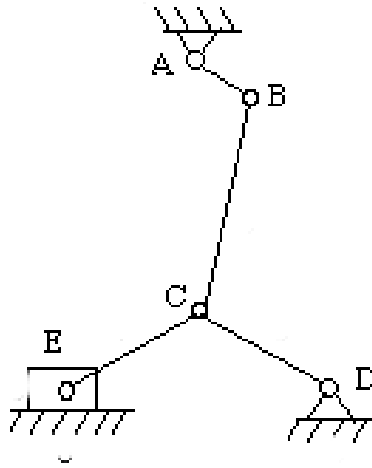
16. (a) (i) Figure shows a mechanical press used to exert large forces to insert a small part into a larger arm. Draw a kinematic diagram, using the end of the handle as a point of interest. Also compute the degrees of freedom. CO1- App (8)



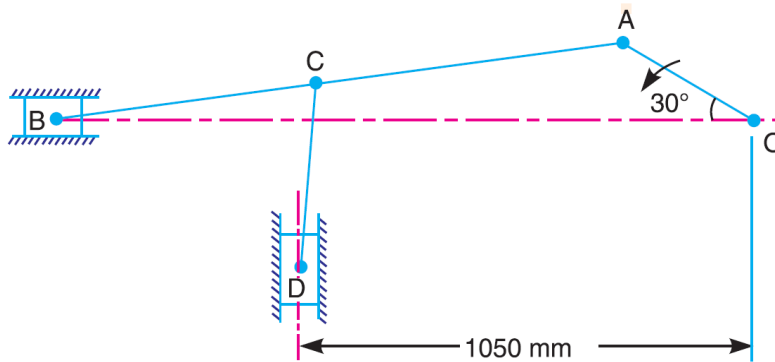
- (ii) Explain any one inversion of a double slider crank mechanism? CO1- U (8)

Or

- (b) (i) What are quick-return mechanisms? Where are they used? Discuss the functioning of any one of them CO1-U (8)
- (ii) Compute the DOF for the mechanism shown below CO1-U (8)

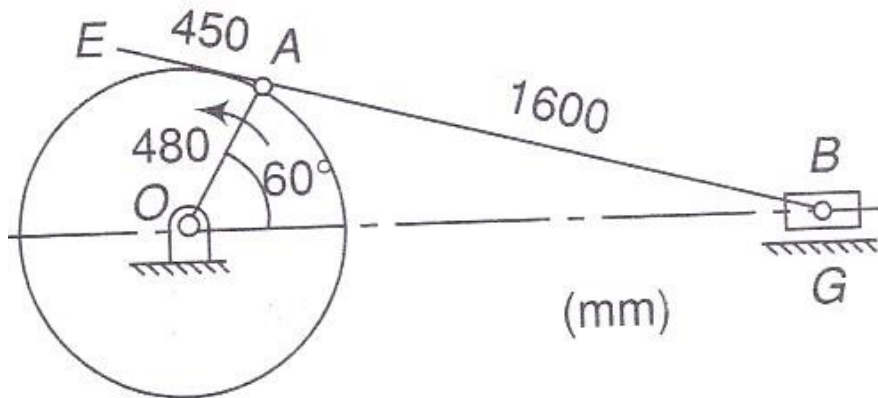


17. (a) In the mechanism, as shown in figure, the crank OA rotates at 20 r.p.m. anticlockwise and gives motion to the sliding blocks B and D. The dimensions of the various links are  $OA = 300$  mm;  $AB = 1200$  mm;  $BC = 450$  mm and  $CD = 450$  mm. For the given configuration, determine : (i). velocities of sliding at B and D, (ii). Angular velocity of CD, (iii). linear acceleration of D, and (iv). angular acceleration of CD. CO2-App (16)



Or

- (b) For the given configuration of a slider-crank mechanism shown below, calculate the CO2- Ana (16)
- (i) acceleration of the slider at B
  - (ii) acceleration of the point E
  - (iii) angular acceleration
- OA rotates at 20 rad/s counter-clockwise



18. (a) 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  $150^\circ$  of the rotation followed by a period of dwell for  $60^\circ$ . The follower descends for the next  $100^\circ$  rotation of the cam with SHM, again followed by a dwell period. The cam rotates at a uniform velocity of 120 rpm and has a least radius of 20 mm. What will be the maximum velocity and acceleration of the follower during the lift and return? CO3- Ana (16)

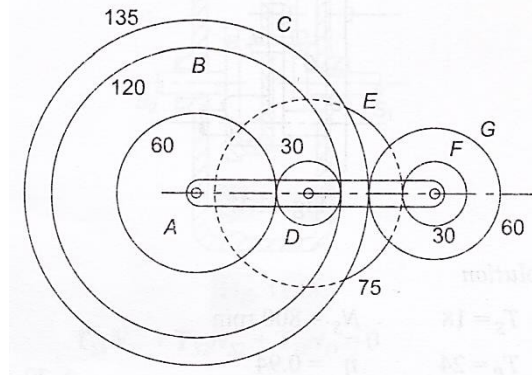
Or

- (b) A cam, with a minimum radius of 25 mm, rotating clockwise at a uniform speed is to be designed to give a roller follower at the end of a valve rod, the following motions described below : CO3 Ana (16)  
 The cam raises the valve through 50 mm during  $150^\circ$  rotation of the cam with uniform velocity and keeps the valve fully raised through next  $50^\circ$ . Then the follower lowers the valve during next  $100^\circ$  with uniform velocity and keeps the valve closed during rest of the revolution i.e.  $60^\circ$ . Draw the profile of the cam operating the roller reciprocating follower with 20 mm diameter.
19. (a) Two involute profiled gears in a mesh have a module of 8 mm and a pressure angle of  $20^\circ$ . The larger gear has 57 while the pinion has 23 teeth. If the addenda on pinion and gear wheels are equal to one module, find the CO4- U (16)
- (i) Contact ratio (the number of pairs of teeth in contact)
  - (ii) Angle of action of the pinion and the gear wheel
  - (iii) Ratio of the sliding to rolling velocity at the beginning of contact, pitch point and end of contact

Or

- (b) Two  $20^\circ$  involute spur gears have a module of 10 mm. The addendum is one module. The larger gear has 50 teeth and the pinion has 13 teeth. Does interference occur? If it occurs, to what value should the pressure angle be changed to eliminate interference? CO4- Ana (16)

20. (a) Figure shows a gear train in which gears D-E and F-G are compound gears with A and B; E gears with F; and G gears with C. The numbers of teeth on each gear are  $A = 60$ ,  $B = 120$ ,  $C = 135$ ,  $D = 30$ ,  $E = 75$ ,  $F = 30$ ,  $G = 60$ . If the wheel A is fixed and the arm makes 20 revolutions clockwise, find the revolutions of B and C CO5- U (16)



Or

- (b) A four speed sliding gear box of an automobile is to be designed to give speed ratios of 4, 2.5 and 1 approximately for the first, second, third and top gears respectively. The input and the output shaft have the same alignment as shown in figure. The horizontal centre distance between them and the lay shaft is 90 mm. The teeth have a module of 4 mm. No wheel has less than 15 teeth. Calculate suitable number of teeth on each wheel and actual speed ratios attained CO5- U (16)

