KINEMATICS OF MACHINARY UBMC302 – QUESTION BANK

UNIT-I BASICS OF MECHANISMS

PART-A

1. Define the term "Kinematic link".
2. Classify kinematic links.
3. What is Mechanism?
4. Define the terms "Kinematic pair".
5. What is "Kinematic chain"?
6. Define "Degrees of freedom".
7. What is "Inversion of a mechanism"?
8. State Grashof's law.
9. Give the equation for Grubler's criterion.
10. What is Kutzbach criterion?
11. Define structure?
12. Define Lower pair.
13. What is higher pair?
14. Define screw pair.
15. What is sliding pair?
16. What is the application of coupling rod of locomotives?
17. What is beam engine?
18. Define completely constrained motion.
19. What is incompletely constrained motion?
20. What is successfully constrained motion?

PART-B

1. Differentiate Machine and Structure.
2. Name the inversions of a 4 bar chain and Single slider crank mechanism.
3. Give the equations for Kutzbach criterion and Grubler's criterion.
4. Classify kinematic pairs.
5. What are the types of constrained motion?
6. What are lower pair and higher pair?
7. What are sliding pair and turning pair?
8. What are rolling pair and screw pair?
9. Define Spherical pair and higher pair?
10. Define self closed pair and force closed pair.
11. What are the applications of double slider crank mechanisms?
12. What are the inversions of single slider crank mechanisms?
13. Define kinematic pair and kinematic chain.

14. Define kinematic chain and mechanism.
15. What is the difference between completely constrained motion and successfully constrained motion?

PART-C

1. Define Grashof's law for four bar mechanism and explain the inversions of a four bar mechanism with neat sketches?
2. With a neat sketch, explain the following Inversions a) Beam Engine b) Coupling rod of a locomotive
3. Explain any 3 inversions of single slider crank mechanism.
4. Explain the inversions of double slider crank mechanism.
5. With a neat sketch explain the working of Quick return mechanism?
6. With a neat sketch, explain the following Inversions a) Scotch Yoke mechanism 2) Oldham's Coupling

UNIT II KINEMATICS OF LINKAGE MECHANISMS
PART-A

1. Define velocity?
2. Define kinematic link?
3. Define Mobility?
4. What do you mean by Angular velocity?
5. Write down the formula to calculate angular velocity?
6. What is meant by "Degrees of freedom"?
7. Write down the formula to calculate velocity of the link?
8. Define rubbing velocity?
9. Draw and Mark parts of a simple four bar chain?
10. What do you mean by "Space diagram"?
11. Define "rubbing speed"
12. What is the use of Velocity diagram?
13. What is meant by Mechanical Advantage?
14. What is meant by Crank Effort?
15. List down the two components of Acceleration?
16. Write down the formula for "Radial component of acceleration"
17. Write down the formula for "Tangential component of acceleration"
18. What do you mean by "Toggle mechanism"?

19. Draw and mark parts of Toggle Mechanism
20. Draw and mark parts of Single slider crank mechanism?

PART-B

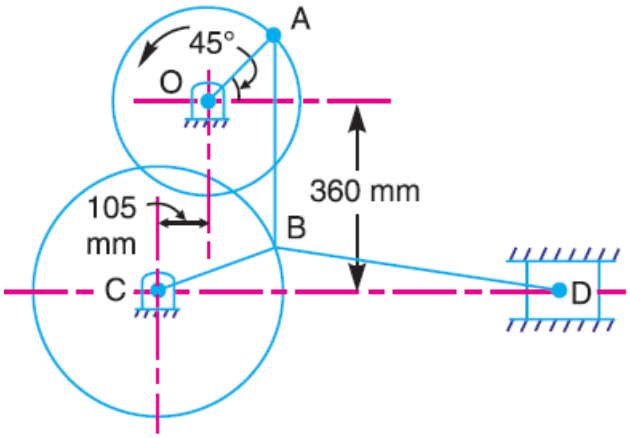
1. Write down the steps to determine the velocity of a Four Bar Mechanism with model velocity diagram?
2. Write down the steps to determine the Acceleration of a Four Bar Mechanism with model velocity and Acceleration diagram?
3. In a four bar chain ABCD, AD is fixed and is 100 mm long. The crank AB is 40 mm long and rotates at 170 r.p.m. clockwise, while the link CD = 80 mm oscillates about D. BC and AD are of equal length. Find the angular velocity of link CD when angle BAD = 60°.
4. Draw and mark parts of a Quick Return mechanism?
5. With a neat sketch explain the working of a toggle mechanism?
6. Write down the formulas and conditions for drawing Acceleration Diagram for a Link.
7. In a four bar chain ABCD, AD is fixed and is 150 mm long. The crank AB is 40 mm long and rotates at 120 r.p.m. clockwise, while the link CD = 80 mm oscillates about D. BC and AD are of equal length. Find the angular velocity of link CD when angle BAD = 50°.
8. Write down the steps to determine the Acceleration of a Single Slider Mechanism with model velocity and Acceleration diagram?
9. In a four bar chain ABCD, AD is fixed and is 170 mm long. The crank AB is 55 mm long and rotates at 130 r.p.m. clockwise, while the link CD = 80 mm oscillates about D. BC and AD are of equal length. Find the angular velocity of link CD when angle BAD = 70°.
10. Explain the steps to measure velocity of a kinematic link?
11. Explain the steps to measure Acceleration of a kinematic link?
12. Explain how shaper machine works?
13. In a four bar chain ABCD, AD is fixed and is 170 mm long. The crank AB is 55 mm long and rotates at 90 r.p.m. clockwise, while the link CD = 80 mm oscillates about D. BC and AD are of equal length. Find the angular velocity of link CD when angle BAD = 70°.
14. How will you draw the velocity diagram for a four bar mechanism?
15. List down the formulas and steps for acceleration diagram?

PART-C

1. A four bar mechanism has the following dimensions: DA = 300 mm ; CB = AB = 360 mm ; DC = 600 mm. The link DC is fixed and the angle ADC is 60°. The driving link DA rotates uniformly at a speed of 100 r.p.m. clockwise. Determine the velocity of the point B and angular velocity of the driven link CB

2. A four bar mechanism has the following dimensions : DA = 600 mm ; CB = AB = 720 mm ; DC = 1200 mm. The link DC is fixed and the angle ADC is 45°. The driving link DA rotates uniformly at a speed of 300 r.p.m. clockwise. Determine the velocity of the point B and angular velocity of the driven link CB

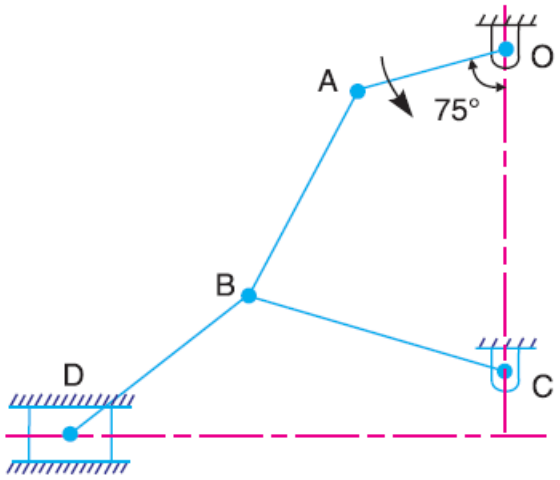
3. In the toggle mechanism, as shown in Fig, the slider D is constrained to move on a horizontal path. The crank OA is rotating in the counter-clockwise direction at a speed of 180 r.p.m. The dimensions of various links are as follows : OA = 180 mm ; CB = 240 mm ; AB = 360 mm ; and BD = 540 mm. For the given configuration, find : **1.** Velocity of slider D, **2.** Angular velocity of links AB, CB and BD



4. The crank of a slider crank mechanism rotates clockwise at a constant speed of 300 r.p.m. The crank is 150 mm and the connecting rod is 600 mm long. Determine : 1. Linear velocity and acceleration of the midpoint of the connecting rod, and 2. angular velocity and angular acceleration of the connecting rod, at a crank angle of 45° from inner dead centre position.

5. A four bar mechanism has the following dimensions : DA = 250 mm ; CB = AB = 600 mm ; DC = 1400 mm. The link DC is fixed and the angle ADC is 60°. The driving link DA rotates uniformly at a speed of 250 r.p.m. clockwise. Determine the velocity of the point B and angular velocity of the driven link CB

6. In Figure shown below, the angular velocity of the crank OA is 600 r.p.m. Determine the linear velocity of the slider D and the angular velocity of the link BD, when the crank is inclined at an angle of 75° to the vertical. The dimensions of various links are : OA = 28 mm ; AB = 44 mm ; BC =49 mm ; and BD = 46 mm. The centre distance between the centres of rotation O and C is 65 mm. The path of travel of the slider is 11 mm below the fixed point C. The slider moves along a horizontal path and OC is vertical.



UNIT-III KINEMATICS OF CAM MECHANISMS

PART-A

1. Define Cams.
2. What are the types of cams?
3. What is cylindrical cam?
4. Define radial cam.
5. What is the difference between cylindrical cam and radial cam?
6. What do you mean by reciprocating follower?
7. What is oscillating or rotating follower?
8. Define radial follower.
9. Define off set follower.

10. Define pitch circle of cam?
11. Define prime circle of cam.
12. What is lift or stroke of the follower?
13. What are the types of motions of the follower?
14. Define uniform velocity.
15. Define SHM.
16. Define uniform acceleration and retardation.
17. What is cycloidal motion?
18. Draw a neat diagram of a cam and follower.
19. Define trace point.
20. Give 4 examples for radial followers.

PART-B

1. Define the following. (i) Maximum fluctuation of energy (ii) Maximum fluctuation of speed.
2. Explain the function of a flywheel in a machine.
3. Differentiate flywheel with a governor.
4. Explain the types of cams in brief.
5. Classify followers.
6. How followers are classified according to the surface in contact?
7. Define the following (i) Cylindrical cam (ii) Radial cam.
8. What are (i) Reciprocating follower (ii) Oscillating follower.
9. Define radial follower and off set follower.
10. What are base circle and prime circle of cams?
11. Define the terms Trace point and Pressure angle of cams.
12. What are the terms used in cams?
13. Define the following. (i) Pitch point and (ii) Pitch circle.
14. Define lift or stroke of follower and pressure angle.
15. What are the different motions of the follower?

PART-C

1. A cam with 30 mm as minimum diameter rotates clockwise at a uniform speed of 1200 rpm and has to give the following motion to a roller follower of 10 mm diameter. (i) Follower to complete outward stroke of 25 mm during 120° of cam rotation with SHM. (ii) Follower to dwell for 60° of cam rotation (iii) Follower to return to its initial position during 90° of cam rotation with equal SHM (iv) follower to dwell for the remaining 90° of cam

rotation. Draw the cam profile if the axis of the roller follower passes through the axis of the cam.

2. A cam, with a minimum radius of 40 mm, rotating clockwise at a uniform velocity is required to give a knife edge follower the motion as described below. (i) To move outwards through 40 mm during 100° rotation of the cam (ii) To dwell for next 80° (iii) To return to its starting position during next 90° and (iv) To dwell for the rest period of revolution. Draw the profile of the cam when the axis of the cam shaft passes through the axis of the follower.
3. A cam, with a minimum radius of 50 mm, rotating clockwise is required to give a knife edge follower the motion as described below. (i) To move outwards through 40 mm during 100° rotation of the cam with uniform velocity (ii) To dwell for next 80° (iii) To return to its starting position during next 90° with Uniform velocity and (iv) To dwell for the rest period of revolution. Draw the profile of the cam when the axis of the cam shaft passes through the axis of the follower
4. Design a cam for operating the exhaust valve of an oil engine. It is required to give equal uniform acceleration and retardation during opening and closing of the valve each of which corresponds to 60° of cam rotation. The valve must remain in the fully open position for 20° of cam rotation. The lift of the valve is 40 mm and the least radius of the cam is 25 mm. The follower is provided with a roller of radius 20 mm and its line of stroke passes through the axis of the cam.
5. A cam rotating clockwise at a uniform speed is required to give a roller follower. 1) the follower to move outwards through 40mm during 120 degree of cam rotation, 2) follower to dwell for next 60 degree, 3) follower to return to its initial position during 90 deg of cam rotation . The min. radius of cam is 45mm and diameter of roller is 30mm. The offset is 15mm. Draw the profile of cam and the displacement the follower takes with simple harmonic motion for both outward and return strokes.
6. A cam is to give the following motion to a knife edged follower (1) the follower to move outwards through 40mm during 120 degree of cam rotation (2) follower to dwell for next 60 degree (3) follower to return to its initial position during 90 deg of cam rotation. The min. radius of cam is 45mm. The offset is 15mm. Draw the profile of cam when follower takes with simple harmonic motion for both outward and return strokes.

UNIT IV GEARS AND GEAR TRAINS

PART A

1. State law of gearing?
2. List down the two forms of gear?
3. List down the Advantages of involute gears?
4. List down the Advantages of cycloidal gears?
5. Write down the formula to find Length of Path of Contact?
6. Write down the formula to find Length of Arc of Contact?
7. Write down the formula to find Contact Ratio?
8. What is Addendum?
9. What is Deddendum?
10. What do you mean by Interference?
11. How interference can be avoided ?
12. Define Backlash.
13. Where the epicyclic gear trains are used?
14. What you meant by non-standard gear teeth?
15. What is meant by compound gear train?
16. What is the function of the gear box in a car?
17. List any 3 types of gear?
18. Name any three gear materials?
19. Differentiate simple gear and compound gear?
20. List down the effects of interference?

PART B

1. Explain simple gear train with neat sketch?
2. Explain Compund gear train with neat sketch?
3. Explain Reverted Gear Train with neat sketch?
4. Explain Epicyclic Gear Train with neat sketch?
5. Define the following a) Pitch circle.b) Addendum circle.
6. Define the following a) Circular pitch. b) Module.
7. Define the following a) Clearance. b) Backlash
8. Define the following a)Length of the path of contact. b) Arc of contact.
9. What is Advantages and Disadvantages of Gear Drive?
10. When and how Interference happens? Justify?
11. What is the Advantages of involute and Cycloidal gears?
12. What do you mean by “Length of Path of contact” in gears?
13. What is meant by “Length of Arc of contact” in gears?
14. Explain the desirable properties that a Gear should have?
15. Explain the factors that are considered during the selection of Gear materials?

PART C

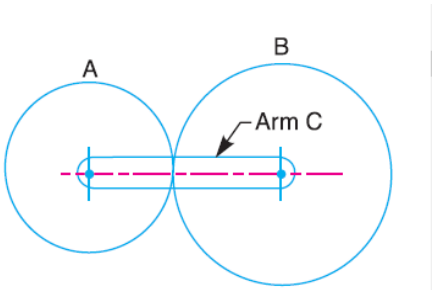
1. A pair of involute spur gears with 16° pressure angle and pitch of module 6 mm is in mesh. The number of teeth on pinion is 16 and its rotational speed is 240 r.p.m. When the gear ratio is 1.75, find in order that the interference is just avoided ; **1.** the addenda on pinion and gear wheel ; **2.** the length of path of contact ; and **3.** the maximum velocity of sliding of teeth on either side of the pitch point.

2. A pair of 20° full depth involute spur gears having 30 and 50 teeth respectively of module 4 mm are in mesh. The smaller gear rotates at 1000 r.p.m. Determine : 1. Sliding velocities at engagement and at disengagement of pair of a teeth, and 2. contact ratio.

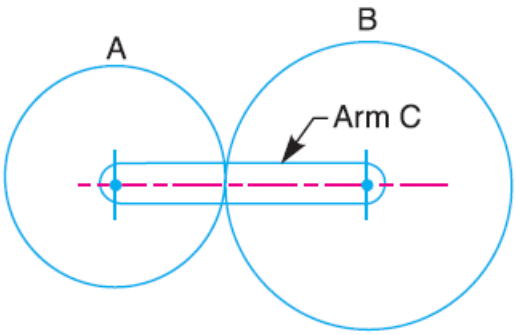
3. Two gear wheels mesh externally and are to give a velocity ratio of 3 to 1. The teeth are of involute form ; module = 6 mm, addendum = one module, pressure angle = 20°. Thepinion rotates at 90 r.p.m. Determine : 1. The number of teeth on the pinion to avoid interference on it and the corresponding number of teeth on the wheel, 2. The length of path and arc of contact, 3.The number of pairs of teeth in contact, and 4. The maximum velocity of sliding.

4. A pair of involute spur gears with 15° pressure angle and pitch of module 6 mm is in mesh. The number of teeth on pinion is 16 and its rotational speed is 300 r.p.m. When the gear ratio is 2, find in order that the interference is just avoided ; **1.** the addenda on pinion and gear wheel ; **2.** the length of path of contact ; and **3.** the maximum velocity of sliding of teeth on either side of the pitch point.

5. In an epicyclic gear train, an arm carries two gears A and B having 36 and 45 teeth respectively. If the arm rotates at 150 r.p.m. in the anticlockwise direction about the centre of the gear A which is fixed, determine the speed of gear B. If the gear A instead of being fixed, makes 300 r.p.m. in the clockwise direction, what will be the speed of gear B ?



6. In an epicyclic gear train, an arm carries two gears A and B having 36 and 45 teeth respectively. If the arm rotates at 180 r.p.m. in the anticlockwise direction about the centre of the gear A which is fixed, determine the speed of gear B. If the gear A instead of being fixed, makes 400 r.p.m. in the clockwise direction, what will be the speed of gear B ?



UNIT V: BELT, ROPE AND CHAIN DRIVES

PART-A

1. What is belt drive?
2. Define slip of belt.
3. What is centrifugal tension?
4. Give the expression for maximum tension in belt.
5. What is initial tension?
6. Give 2 examples for positive drives.
7. What are the materials used for belts?
8. What are the advantages of belt drive over other drives?
9. What are the disadvantages of belt drives over other drives?
10. What is the condition for maximum power transmission of belt?
11. What is chain drive?
12. Define the term sprocket.
13. What is pitch of chain?
14. Define PCD of chains.
15. Give the relation between pitch and PCD.
16. What are the advantages of chain drive over other drives?
17. What are the disadvantages of chain drives over other drives?
18. Classify chain drives.
19. What is hoisting chain?
20. Define hauling chain.

PART-B

1. What are the types of belt drives?
2. What are the types of belts?
3. Discuss briefly about the materials used for making belts.
4. Write short notes on the following (i) Centrifugal tension (ii) Initial tension
5. What are the conditions for maximum power of belt drive?
6. Differentiate simple belt drive and compound belt drive.
7. What are centrifugal tension and initial tension?
8. Discuss about hair side and flesh side of a flat belt.
9. What are the merits and demerits of belt drives over other drives?
10. What are the advantages and drawbacks of rope drives over other drives?
11. Discuss brief about the merits and demerits of chain drives over other drives?
12. What is the classification of chains?
13. What are the terms used in chain drives?
14. Define PCD and pitch of a chain.
15. Discuss briefly about the terms used in chain drives.

PART-C

1. A shaft which rotates at a constant speed of 160 rpm is connected by belting a parallel shaft 720 mm apart which has to run at 60, 80 and 100 rpm. The smallest pulley on the driving shaft is 40 mm in radius. Determine the remaining radii of the two stepped pulleys for (i) a crossed belt and (ii) an open belt. Neglect the thickness and slip of belt.
2. Two pulleys, one 450 mm in diameter and the other 200 mm in diameter are on parallel shafts 1.95 m apart and are connected by a crossed belt. Find the length of belt required and the angle of contact. What power can be transmitted by the belt when the larger pulley rotates at 200 rpm if the maximum permissible tension on the belt is 1 KN and the coefficient of friction between the belt and pulley is 0.25?
3. An open flat belt drive connects 2 parallel shafts 1.2 m apart. The driving and the driven shafts rotate at 350 rpm and 140 rpm respectively and the driven pulley is 400 mm in diameter. The belt is 5 mm thick and 80 mm wide. The coefficient of friction between the belt and pulley is 0.3 and the maximum permissible stress in belting is 1.4 MN/m^2. Determine (i) diameter of the driving pulley (ii) maximum power that can be transmitted (iii) required initial tension.
4. Two parallel shafts whose centre lines are 4.8 m apart are connected by an open belt drive. The diameter of the larger pulley is 1.5 m and that of smaller

pulley is 1 m. Initial tension in the belt is 3 KN. The mass of the belt is 1.5 kg per meter length. Coefficient of friction between the belt and pulley is 0.3. Taking centrifugal tension into account, calculate the power transmitted when the smaller pulley rotates at 400 rpm.

5. An open belt running over 2 pulleys 600 mm and 240 mm in diameter connects 2 parallel shafts, 3 m apart and transmits 4 KW from the smaller pulley that rotates at 300 rpm. Coefficient of friction between belt and pulley is 0.3 and the safe working tension is 10 N per mm of width. Determine (i) minimum width of the belt (ii) initial tension and (iii) length of the belt required.
6. An engine shaft running at 120 rpm is required to drive a machine shaft by means of a belt. The pulley on the engine shaft is 2 m diameter and that of the machine shaft is 1 m diameter. If the belt thickness is 5 mm, determine the speed of the machine shaft when (i) there is no slip and (ii) when there is a slip of 3%.