Uka Tarsadia University (Diwaliba Polytechnic)
Diploma in Mechanical Engineering
Assignment (Theory of Machines -020020403)

Unit-1 Introduction

2 marks

1] What is link? Classify link.
2] Give comparison of higher pair and lower pair.
3] Explain double slider crank chain.
4] Define machine and mechanism.
5] Give difference between kinematics and kinetics.
6] Draw a neat sketch of Oldham's coupling.
7] Define higher pair and lower pair.
8] Give difference between single slider and double slider crank mechanism.
9] Draw a neat sketch of locomotive coupling rod.
10] Define kinetics and kinematics.
11] Draw a neat sketch of crank and slotted lever mechanism.
12] What is structure and machine?
13] what is kinematic pair? Classify kinematic pair based on its motion.
14] Define: statics and kinetics.
15] Draw a neat sketch of Oldham's coupling

3 Marks

1] Explain beam engine with neat sketch.
2] What is kinematic pair? Classify kinematic pair.
3] Explain any one constrained motion with sketch.
4] Explain any one inversion of single slider crank chain.
5] Explain oscillating cylinder engine with neat sketch.
6] What is inversion of mechanism? and explain any one inversion of four-bar chain.
7] Explain whitworth type Quick return mechanism with neat sketch.
8] Short note on completely constrained motion with sketch.
9] Explain Successfully constrained motion with sketch.
10] Explain four bar chain with grashof's law.
11] Explain bull engine with neat sketch.
12] Give difference between single slider and double slider crank mechanism
13] Short note on completely constrained motion with sketch.
14] Explain locomotive coupling rod with neat sketch.
15] List out inversion of single slider crank chain and explain any one.
16] What are the difference between higher pair and lower pair?
17] Explain Successfully constrained motion with sketch.

18] What is kinematic link? Classify kinematic link.
19] List out inversion of four bar chain and explain any one.
20] Draw a neat sketch of Skotch yoke mechanism

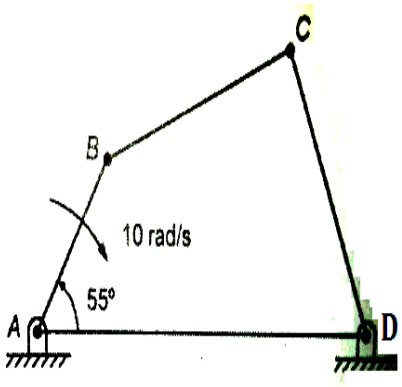
Unit-2 Velocity and Acceleration diagram

2 Marks:

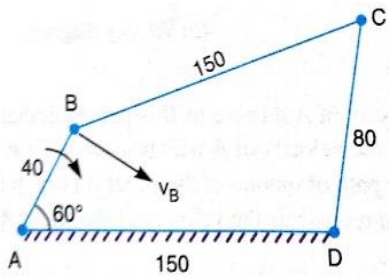
1. Define: Angular velocity and linear velocity.
2. Which are the different methods to find out velocity of any mechanism.
3. If the length of a link is 100 mm is rotating at angular velocity of 15 rad/s and angular acceleration of 50 rad/s2. Then determine centripetal and tangential component of acceleration.
4. Write down the steps to construct the velocity diagram of a four link mechanism.
5. Write the equation of tangential component in acceleration analysis with notations.
6. If the length of a link is 200 mm is rotating at angular velocity of 10 rad/s and angular acceleration of 60 rad/s2. Then determine centripetal and tangential component of acceleration
7. Write down the difference between linear and angular acceleration.
8. What will be the effect on actual acceleration, when angular acceleration is zero?
9. If the length of a link is 300 mm is rotating at angular velocity of 20 rad/s and angular acceleration of 50 rad/s2. Then determine centripetal and tangential component of acceleration.
10. Give equations for linear velocity and linear acceleration.
11. What do you mean by relative velocity? Explain with neat sketch.
12. Which are the different methods to find out acceleration of any mechanism.
13. If the length of a link is 200 mm is rotating at 200 rpm. Then determine centripetal and tangential component of acceleration.
14. Write down the steps to construct the velocity diagram of a single slider mechanism.
15. Which are the different methods to find out acceleration of any mechanism.

3 Marks:

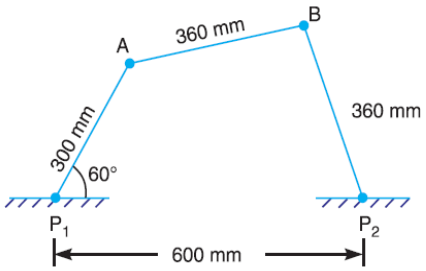
1. PQRS is a four bar chain with link PS fixed. The lengths of the links are PQ = 62.5 mm; QR = 175 mm; RS = 112.5 mm; and PS = 200 mm. The crank PQ rotates at 10 rad/s clockwise. Draw the velocity and acceleration diagram when angle QPS = 60° and Q and R lie on the same side of PS. Find the angular velocity of link QR.
2. The crank of a reciprocating engine is 120 mm long and the connecting rod is 500 mm long. The crank is at 45˚from IDC and it rotates at 600 R.P.M. in anti-clockwise direction. Draw klein's construction.
3. The engine mechanism has crank OB = 50 mm and length of connecting rod AB = 225 mm. . The engine speed is 200 r.p.m. For the position, in which OB is turned 45° from OA. Determine the angular velocity of AB.
4. In the four bar mechanism shown in figure below, the lengths of the various links are: AB = 380 mm, BC = CD = 560 mm, AD = 1000 mm, angle BAD is 55°. The crank AB rotates at 10 rad/sec in clockwise direction. Determine the acceleration of the link BC.



5. In a four bar chain ABCD, AD is fixed and is 150 mm long as shown in Fig.. 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 = 60°.



6. The crank of a reciprocating engine is 150 mm long and the connecting rod is 600 mm long. The crank is at 60˚from IDC and it rotates at 600 R.P.M. in anti-clockwise direction. Draw klein's construction.
7. The engine mechanism has crank OB = 50 mm and length of connecting rod AB=250mm. The engine speed is 300 r.p.m. For the position, in which OB is turned 45° from OA. Determine the angular velocity of AB.
8. The dimensions and configuration of the four bar mechanism, shown in figure below, are as follows: P_1A = 300 mm; P_2B = 360 mm; AB = 360mm, and P_1 P_2 = 600 mm. The angle A P_1 P_2 = 60°. The cranks P_1A, AB and P_2B has a linear velocity of 3 m/s, 2.05 m/s, 2.2 m/s respectively, and the crank P_1A has an angular acceleration of 30 rad/s^2, all clockwise. Determine the acceleration of the joint B.



9. In slider crank mechanism the lengths of crank OA and connecting rod AB are 100 mm and 400 mm respectively. For the position, in which crank OA is turned 45° from OB. If the crank rotates clockwise with an angular velocity of 10 rad/s, find: 1. Velocity of the slider B, and 2. Angular velocity of the connecting rod AB.

10. For a four bar mechanism. The length of various links are; AD = 125 mm, AB = 62.5 mm, BC = CD = 75 mm. If the link AB rotate at velocity of 0.065 m/s in a clockwise direction. Find the angular velocity of the link BC when angle BAD = 60°.
11. The crank of a reciprocating engine is 150 mm long and the connecting rod is 500 mm long. The crank is at 60˚from IDC and it rotates at 450 R.P.M. in anti-clockwise direction. Draw klein's construction.
12. In the four bar mechanism, the lengths of the various links are: AB = 190 mm, BC = CD = 280 mm, AD = 500 mm, angle BAD is 55°. The crank AB rotates at 10 rad/sec in clockwise direction. Determine the acceleration of the link BC.
13. In a four bar chain ABCD, AD is fixed link. Crank AB rotates in clockwise direction at an angular velocity of 10 rad/sec. Link AB = 60mm; BC=CD= 70 mm, AD= 120 mm. When angle DAB=60° and the points B and D are on one side of the link AD, find the angular velocity of link BC.
14. In slider crank mechanism the lengths of crank OA and connecting rod AB are 100 mm and 400 mm respectively. For the position, in which crank OA is turned 60° from OB. If the crank rotates clockwise with an angular velocity of 20 rad/s, find: 1. Velocity of the slider B, and 2. Angular velocity of the connecting rod AB.
15. The crank of a reciprocating engine is 150 mm long and the connecting rod is 600 mm long. The crank is at 45˚from IDC and it rotates at 500 R.P.M. in anti-clockwise direction. Draw klein's construction.
16. The dimensions and configuration of the four bar mechanism, are as follows: P_1A = 300 mm; P_2B = 360 mm; AB = 360mm, and P_1 P_2 = 600 mm. The angle AP_1 P_2 = 60°. The cranks P_1A, AB and P_2B has a linear velocity of 3 m/s, 2.05 m/s, 2.2 m/s respectively, and the crank P_1A has an angular acceleration of 20 rad/s^2, all clockwise. Determine the acceleration of the joint B.
17. In a four bar chain ABCD, AD is fixed link. Crank AB rotates in clockwise direction at an angular velocity of 10 rad/sec. Link AB = 60mm; BC=CD= 70 mm, AD= 120 mm. When angle DAB=45° and the points B and D are on one side of the link AD, find the angular velocity of link CD.
18. In slider crank mechanism the lengths of crank OA and connecting rod AB are 150 mm and 450 mm respectively. For the position, in which crank OA is turned 45° from OB. If the crank rotates clockwise with an angular velocity of 20 rad/s, find: 1. Velocity of the slider B, and 2. Angular velocity of the connecting rod AB.
19. The crank of a reciprocating engine is 150 mm long and the connecting rod is 600 mm long. The crank is at 45˚from IDC and it rotates at 500 R.P.M. in anti-clockwise direction. Draw klein's construction.
20. 16. In the four bar mechanism shown in figure below, the lengths of the various links are: AB = 95 mm, BC = CD = 140 mm, AD = 250 mm, angle BAD is 55°. The crank AB rotates at 10 rad/sec in clockwise direction. Determine the acceleration of the link BC.

Unit-3 Cam, Cam profile and Friction

2 MARKS:

1. Write different types of follower based on surfaces in contact.
2. Enlist types of lubrication in journal bearing.
3. Define pitch with neat sketch.
4. Enlist types of motion of follower.
5. State the condition for self locking of screw.

6. Give differernce between single start thread and multi start thread.
7. Define term: Base circle.
8. Give difference between single plate and multiplate clutch.
9. Enlist types of screw threads
10. Write down difference between radial follower and offset follower.
11. Give classification of thrust bearing.
12. Define helix angle with equation.
13. List the types of cam.
14. State the condition for overhauling of screw.
15. Explain angle of repose.

3 MARKS:

1. Draw displacement diagram of a cam to give the following motion to the reciprocating follower:
   (i) Follower to have a stroke of 25 mm during 90° of cam rotation with simple harmonic motion;
   (ii) Follower to dwell for 45° of cam rotation;
   (iii) Follower to return to its initial position during 90° of cam rotation with simple harmonic motion; and
   (iv) Follower to dwell for remaining rotation period of cam rotation.
2. Give the detailed classification of cam.
3. Draw the neat sketch for the screw jack and show the various parts of the screw jack.
4. Give classification of brakes.
5. A flat face follower is moved with simple harmonic motion by a disc cam. Follower rises for 40 mm during the cam rotation of 120° in anti-clockwise direction, remains in same position during 30° of cam rotation, follower returns to original position during further 120° of rotation of cam and then for last 90° of rotation follower remains stationary. Draw the displacement diagram only.
6. A cam is to give the following motion to a knife-edged follower:
   (i) Outstroke during 90° of cam rotation;
   (ii) For the next 30° of cam rotation;
   (iii) Return stroke during next 60° of cam rotation, and
   (iv) Dwell for the remaining 180° of cam rotation.
   Stroke of the follower is 60 mm and the follower moves with uniform acceleration and deceleration method during both the outstroke and return strokes.

   Draw the displacement diagram only for follower.
7. Draw neat sketch of single plate clutch.
8. Explain prony brake dynamometer with neat sketch
9. A flat face follower is moved with uniform acceleration and deceleration by a disc cam. Follower rises for 40 mm during the cam rotation of 120° in anticlockwise direction, remains in same position during 30° of cam rotation, follower returns to original position during further 120° of rotation of cam and then for last 90° of rotation follower remains stationary. Draw the displacement diagram only.
10. Give the detailed classification of types of follower.

11. Differentiate brake and dynamometer.
12. Explain self-locking and overhauling
13. Draw displacement diagram of a cam to give the following motion to the reciprocating follower:
    (i) Follower to have a stroke of 25 mm during 90° of cam rotation with uniform velocity motion;
    (ii) Follower to dwell for 45° of cam rotation;
    (iii) Follower to return to its initial position during 90° of cam rotation with simple harmonic motion; and
    (iv) Follower to dwell for remaining rotation period of cam rotation.
14. A cam is to be designed for a roller follower with the following data:

(i) Cam lift = 40 mm during 1/4th revolution of cam rotation with simple harmonic motion.
    (ii) Dwell for the next 1/10th revolution.
    (iii) During the next 1/6th revolution, the follower returns to its original position with uniform velocity method.
    (iv) Dwell during the remaining period.
    Draw displacement diagram only for follower.

15. Give classification of friction types.
16. Give classification of clutches.
17. A flat face follower is moved with uniform velocity by a disc cam. Follower rises for 40 mm during the cam rotation of 120° in anti-clockwise direction, remains in same position during 60° of cam rotation, follower returns to original position during further 90° of rotation of cam and then for last 90° of rotation follower remains stationary. Draw the displacement diagram only.
18. Following data relate to the reciprocating follower with a flat mushroom contact face:
    (i) Follower to have a stroke of 60 mm during 120° of cam rotation;
    (ii) Follower to dwell for 20° of cam rotation;
    (iii) Follower to return to its initial position during 90° of cam rotation; and
    (iv) Follower to dwell for remaining 130° of cam rotation.

The minimum radius of the cam is 30 mm. The out stroke of the follower is performed with uniform velocity method and the return stroke with equal uniform acceleration and retardation. Draw cam profile for outstroke only.

19. Give classification of dynamometer.
20. Draw neat sketch of various types of thrust bearings.

Unit-4 Power transmission

2 Marks:

1. Define: i) Velocity ratio ii) Train value
2. Draw sketch cross belt drive and steppes pulley belt drive.
3. Enlist the factors for selecting belt drive.

4. Define: i)Creep of belt ii)slip of belt
5. Draw sketch cross belt drive and open belt drive with idler pulley.
6. Explain need of power transmission.
7. What is initial tension of belt?
8. Draw sketch cross belt drive and open belt drive.
9. What are the factors for selecting belt drive?
10. What is creep of belt?
11. Draw sketch compound belt drive and open belt drive.
12. What is the effect of centrifugal tension on belt drive?
13. Draw sketch cross belt drive and fast and loose belt drive.
14. Define compound gear train?
15. State the selecting criteria for selecting belt drive.

3 Marks:

1. In a belt drive the belt speed is 540m/min ; maximum tension is 2100N and the ratio of tensions is 2.63. Find the power transmitted by belt.
2. Derive the expression for the length of belt for open belt drive.
3. What are the different types of pulleys? Explain briefly.
4. List out different modes of power transmission and discuss chain drive..
5. A belt pulley with 600mm diameter rotates with 300rpm and drives 25 mm wide 6 mm thick belt. If the belt weight 1.1 gm/cm$^{3.}$ Find centrifugal tension. Also find initial tension if tension on tight side and slack side respectively 2500 N and 1110 N.
6. Derive the expression for the length of belt in crossed belt drive.
7. Give different modes of power transmission and discuss any one.
8. Explain simple and epicyclic gear train.
9. In a belt drive the belt speed is 540m/min; maximum tension is 3000N and the ratio of tensions is 3.2. Find the power transmitted by belt and initial tension.
10. Derive the expression for maximum power transmitted by a belt.
11. Explain two types of flat belt-drive.
12. Advantages and disadvantages of V- belt drive
13. A belt pulley with 500mm diameter rotates with 250rpm and drives 25 mm wide 6 mm thick belt. If the belt weight 1.1 gm/cm$^{3.}$ Find centrifugal tension. Also find initial tension if tension on tight side and slack side respectively 2500 N and 1110 N.
14. Derive the expression for tension ratio for V- belt.
15. Advantages and disadvantages of rope drive
16. List out different modes of power transmission and discuss any one.
17. A pulley having 1.5m diameter and rotating at 300 rpm transmits 35kW power. The arc of contact on pulley is 165 degrees. If the coefficient of friction is 0.3, find out tensions in tight side and slack side. Also find initial tension in belt.
18. Derive the expression for tension ratio for flat belt.
19. Advantages and disadvantages of chain drive.
20. List out different modes of power transmission and discuss rope drive.

Unit-5 Flywheel and Governor

2 marks:

1. Write down uses of turning moment diagram.
2. Write equation of fluctuation of speed with all notations.
3. What is isochronism of governor?
4. Give applications of flywheel.
5. Define: Hunting of governer.
6. Write down the equation of sensitiveness of governor
7. Define Stability of governor.
8. How inertia governor works?
9. Give any two differences between flywheel and governor
10. Draw turning moment diagram for a press and punching machine.
11. Write down uses of turning moment diagram.
12. State the functions of governor.
13. Give applications of flywheel.
14. Define: Mean equilibrium speed.
15. what is sensitiveness of governor?

3 Marks:

1. Write down functions of flywheel.
2. Enlist types of flywheel and explain disc type flywheel.
3. Explain working of pendulum type watt governor with neat sketch.
4. Differentiate between gravity controlled governor and spring control governor.
5. Enlist types of flywheel and explain rim and armed type flywheel.
6. Explain turning moment diagram slider crank mechanism with sketch.
7. Explain working of porter governor with neat sketch.
8. The following information recorded from multi cylinder engine turning moment diagram.
   (1) Vertical axis T.M 1mm=650 N.M
   (2) Horizontal axis crank angle 1mm=4.5°

The area in mm^2 around average torque line respectively are -28, +380, -260, +310, -300, +242, -380, +265 & -229.The fluctuation of speed are ±1.7% of average speed. The average speed 500 rpm. Then find mass of flywheel of 0.6m radius.

9. Enlist types of flywheel and explain split type flywheel.
10. Draw turning moment diagram for single cylinder double acting steam engine.
11. Explain working of proell governor with neat sketch.
12. Explain sensitiveness of governor.
13. Explain co-efficient of fluctuation of speed.
14. Draw and explain turning moment diagram for multi cylinder steam engine.
15. Explain working of hartnell governor with neat sketch.
16. The turning moment diagram for a multi-cylinder engine has been drawn to scale 1 mm = 600 Nm on Y-axis and 1 mm = 3°on X axis. The area of output torque curve taken in order are as following: +52, -124, +92,-140, +85,-72 and +107 mm. The engine is running at speed of 500 RPM. Total fluctuations of speed is not exceeding ±1.5% of the mean, find mass of flywheel, if radius of flywheel is 40cm.

17. Draw and explain turning moment diagram for four stroke cycle internal combustion engine.
18. Give comparison of functions of flywheel and governor.
19. Give classification of centrifugal governor.
20. Explain working of wilson-hartnell governor with neat sketch.

Unit-6 Balancing and Vibrations

2 Marks:

1. Define:· i) period ii) amplitude
2. What are the causes of Unbalancing?
3. Explain torsional vibration with sketch.
4. List out the causes of Unbalancing.
5. Define:· i) period ii) natural frequency
6. Explain longitudinal vibration with sketch.
7. Define:· i)resonance ii) amplitude
8. Draw the sketch of vibration element system.
9. Why need of balancing?
10. Define:· i) frequency ii) resonance
11. what are the effects of unbalancing?
12. Explain dynamic balancing.
13. Define:· i) resonance ii) natural frequency
14. Explain static balancing in short.
15. short note on torsional vibration with sketch.

3 Marks:

1. Three masses m_1 m_2 m_3 are respectively 3kg 4 kg and 2 kg and rotating at radii of 30 mm 20 mm and 25 mm respectively. The position of the mass m_1 m_2 and m_3 with horizontal axis is at an angle 30°, 120° and 270° respectively. Find the balancing mass attached at the radius of 35mm from axis and its position with horizontal by analytical method.
2. Explain the balancing of single rotating mass by two masses rotating in different planes.
3. write down the causes of vibration and remedies to reduce the vibration.
4. Explain graphical method of balancing several mass by two masses rotating in different planes.
5. Three masses m_1 m_2 m_3 are respectively 5kg, 6 kg and 8 kg and rotating at radii of 0.12 m ; 0.10 m and 0.15 m respectively. The position of the mass m_1 m_2 and m_3 with horizontal axis is at an angle between 5kg and 6kg mass is 60°; 6kg and 8kg mass is 165° . Find the balancing mass attached at the radius of 0.14m from axis and its position with horizontal by graphical method.
6. Explain analytical method of balancing several mass by two masses rotating in different planes.
7. Three masses m_1 m_2 m_3 are respectively 5kg , 6 kg and 8 kg and rotating at radii of 0.12 m ; 0.10 m and 0.15 m respectively. The position of the mass m_1 m_2 and m_3 with horizontal axis is at an angle between 5kg and 6kg mass is 60° ; 6kg and 8kg mass is 165° . Find the balancing mass attached at the radius of 0.14m from axis and its position with horizontal by analytical method.
8. Explain static and dynamic balancing.
9. Explain graphical method of balancing several mass by two masses rotating in different planes.
10. Define vibration and explain different types of vibration.
11. Three masses m_1 m_2 m_3 are respectively 6kg , 4 kg and 8 kg and rotating at radii of 0.12 m ; 0.10 m and 0.15 m respectively. The position of the mass m_1 m_2 and m_3 with horizontal axis is at an

angle between 5kg and 6kg mass is 60° ; 6kg and 8kg mass is 165° . Find the balancing mass attached at the radius of 0.18m from axis and its position with horizontal graphical method.

12. Explain the sketch of vibration element system.
13. Explain the analytical method of balancing several masses revolving in same plane.
14. what are the causes of Vibration and also write remedies for that.
15. Three masses m_1 m_2 m_3 are respectively 6kg ,3 kg and 2 kg and rotating at radii of 30 mm 20 mm and 25 mm respectively. The position of the mass m_1 m_2 and m_3 with horizontal axis is at an angle 30° 120° and 270° respectively. Find the balancing mass attached at the radius of 35mm from axis and its position with horizontal by graphical method.
16. Explain the balancing of single rotating mass by two masses rotating in different planes.
17. Explain the analytical method of balancing several masses revolving in same plane.
18. State causes of vibration and remedies to reduce the vibration.