# INSTITUTE OF AERONAUTICAL ENGINEERING

**(Autonomous)**
Dundigal, Hyderabad -500 043

## MECHANICALENGINEERING

## TUTORIAL QUESTIONBANK

| | |
|---|---|
| **Course Name** | **KINEMATICS OF MACHINES** |
| **Course Code** | **AMEB10** |
| **Class** | IV Semester |
| **Branch** | MECHANICAL ENGINEERING |
| **Year** | 2019 – 2020 |
| **Course Faculty** | Mr. BVSN RAO, Associate Professor. |

### COURSE OBJECTIVES:

**The course should enable the students to:**

| | |
|---|---|
| I | Understand the basic principles of kinematics and the related terminology ofmachines. |
| II | Identify mobility; enumerate links and joints in themechanisms. |
| III | Explain the concept of analysis of differentmechanisms. |
| IV | Understand the working of various straight line mechanisms, gears, gear trains, steering gear mechanisms, cams and a Hooke'sjoint. |
| V | Determinethe mechanisms for displacement, velocity and acceleration of links in amachine. |

### COURSE OUTCOMES:

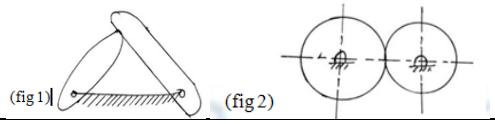
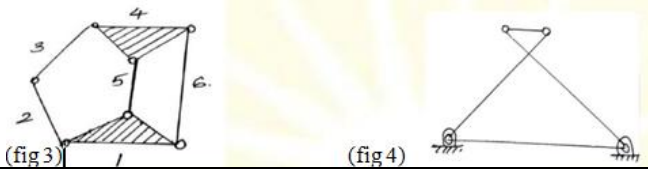
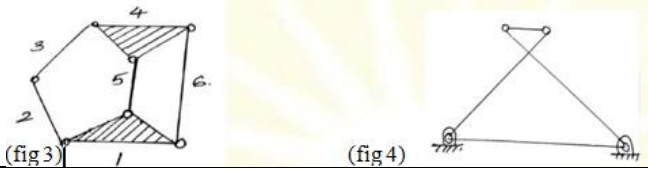
| | |
|---|---|
| CO 1 | Understand designing a suitable mechanism depending on application. |
| CO 2 | Understand displacement diagrams and cam profile diagram for followers executing different types of motions and various configurations of followers. |
| CO 3 | Visualize drawing velocity and acceleration diagrams for different mechanisms. |
| CO 4 | Select gear and gear train depending on application. |
| CO 5 | Explore the knowledge on differential gear design. |

### COURSE LEARNING OUTCOMES:

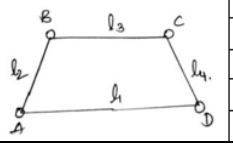
**Students, who complete the course, will have demonstrated the ability to do the following:**

| S. No. | Description |
|---|---|
| AMEB10.01 | Classifications of the kinematic links, kinematic pairs and formation of the kinematic chain. |
| AMEB10.02 | Distinguish between mechanism and machine. |
| AMEB10.03 | Design and develop inversions of quadric cycle chain. |
| AMEB10.04 | Design and develop inversions of slider crank mechanism. |
| AMEB10.05 | Construct Graphical methods of velocity and acceleration polygons for a given configuration diagram. |
| AMEB10.06 | Understand other methods of acceleration determination diagrams like Klien's construction. |
| AMEB10.07 | Develop acceleration component of Corioli's acceleration involving quick return mechanisms |

| | |
|---|---|
| AMEB10.08 | Alternative approach for determining velocity by using Instantaneous centers and relative velocity methods. |
| AMEB10.09 | Significance of exact and approximate straight line mechanisms. |
| AMEB10.10 | Application of straight line mechanism in engine indicators. |
| AMEB10.11 | Applications of Ackerman's and Davis steering mechanisms in automobiles. |
| AMEB10.12 | Develop the condition for exact steering. |
| AMEB10.13 | Develop the polar velocity diagram for a single Hook joint and develop condition for unity for higher and lower speeds. |
| AMEB10.14 | Study different displacement diagrams applicable in cams. |
| AMEB10.15 | Plot the displacement, velocity and acceleration diagrams with respect to time. |
| AMEB10.16 | Understand the geometry of gears and deduce the expression for arc of contact. |
| AMEB10.17 | Derive the expression for minimum number of teeth to avoid interference in case of pinion and gear. |

| MODULE – I | | | | |
|---|---|---|---|---|
| **MECHANISMS** | | | | |
| **PART - A (SHORT ANSWER QUESTIONS)** | | | | |
| **S. No** | **Question** | **Blooms Taxonomy Level** | **Course Outcomes** | **Course Learning Outcomes** |
| 1 | Understand different links in a mechanism. | Remember | CO 1 | AMEB10.01 |
| 2 | Remember the mobility in a mechanism. | Remember | CO 1 | AMEB10.02 |
| 3 | Analyze the quick return motion mechanism of crank and slotted lever. | Remember | CO 1 | AMEB10.03 |
| 4 | Analyze the Whit-worth quick return motion mechanism. | Remember | CO 1 | AMEB10.04 |
| 5 | Understand machine and structure. | Remember | CO 1 | AMEB10.01 |
| 6 | Create inversions of a mechanism. | Remember | CO 1 | AMEB10.02 |
| 7 | Understand Grubler's criterion. | Remember | CO 1 | AMEB10.03 |
| 8 | Evaluate the degrees of freedom of a mechanism. | Understand | CO 1 | AMEB10.01 |
| 9 | Remember the types of kinematic pairs. | Understand | CO 1 | AMEB10.02 |
| 10 | Understand the types of links with examples. | Remember | CO 1 | AMEB10.03 |
| 11 | Apply theGrashof's method for a linkage mechanism | Remember | CO 1 | AMEB10.04 |
| 12 | Analyze the crank mechanism in a four bar linkage andjustify your answer with a neat diagram | Understand | CO 1 | AMEB10.01 |
| 13 | Understand the classification of kinematic links. | Understand | CO 1 | AMEB10.02 |
| 14 | Remember the difference between Mechanism and machine. | Understand | CO 1 | AMEB10.03 |
| 15 | Evaluate Grublers criterion for the constrained motion of a planar mechanism with lower pairs. | Understand | CO 1 | AMEB10.01 |
| 16 | Evaluate the degrees of freedom of linkage shown in figure 1 and figure 2.   | Understand | CO 1 | AMEB10.01 |
| 17 | Analyze the degrees of freedom of linkage shown in figure 3 and figure 4.   | Understand | CO 1 | AMEB10.02 |
| 18 | Evaluate the degrees of freedom of linkage shown in figure 4.   | Understand | CO 1 | AMEB10.03 |
| 19 | Apply your answer for 1 spring pair =2 binary pairs | Remember | CO 1 | AMEB10.04 |
| 20 | Analyze that "Slider crank mechanism is an extension of four bar mechanism". | Remember | CO 1 | AMEB10.01 |

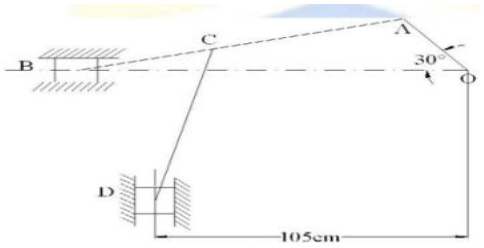
| PART - B (LONG ANSWER QUESTIONS) | | | | |
|---|---|---|---|---|
| 1 | a) Understand link and kinematic pair.<br>b) Create the inversions of double slider crank chain mechanism | Understand | CO 1 | AMEB10.01 |
| 2 | a) Understand machine and mechanism.<br>b) Create the inversions of single slider crank chain mechanism | Understand | CO 1 | AMEB10.01 |
| 3 | a) Understand the quick return motion mechanism of crank and slotted lever.<br>b) The length of the fixed link in a crank and slotted lever quick return mechanism is 300 mm and crank is 110 mm. Determine the inclination of the slotted lever with the vertical in the extreme position. | Understand | CO 1 | AMEB10.02 |
| 4 | a) Analyze the difference between a machine and a structure.<br>b) Understand different kinematic pairs. | Remember | CO 1 | AMEB10.03 |
| 5 | a) Understand the Whitworth quick return motion mechanism.<br>b) In a Whitworth quick return motion mechanism, the distance between the fixed centers is 50 mm and the length of the driving crank is 75 mm. The length of the slotted lever is 150 mm and the length of the connecting rod is 135 mm. Find the ratio of time of cutting and return strokes and also the effective stroke. | Remember | CO 1 | AMEB10.04 |
| 6 | a) Understand machine and structure.<br>b) Analyze different types of constrained motions. | Remember | CO 1 | AMEB10.01 |
| 7 | a) Understand the function of Oldham's coupling.<br>b) Evaluate that the elliptical trammel describes an ellipse. | Understand | CO 1 | AMEB10.02 |
| 8 | a) Understand inversion of a mechanism?<br>b) Create the inversions of a quadric cycle chain? | Understand | CO 1 | AMEB10.03 |
| 9 | a) Apply Grubler's criterion for a four bar mechanism.<br>b) Evaluate the degrees of freedom for four bar mechanism, slider crank mechanism and five bar mechanism. | Understand | CO 1 | AMEB10.04 |
| 10 | a) Understand degrees of freedom of a mechanism?<br>b) Analyze the applications of Kutzbach criterion to plane mechanisms. | Understand | CO 1 | AMEB10.01 |
| 11 | A crank and slotted lever mechanism used in a shaper has a centre distance of 300 mm between the centre of oscillation of the slotted lever and the centre of rotation of the crank. The radius of the crank is 120mm. Find the ratio of the time of cutting to the time of return stroke. | Remember | CO 1 | AMEB10.02 |
| 12 | The Whitworth quick return motion mechanism has the driving crank 150 mm long. The distance between fixed centres is 100 mm. The line of stroke of the ram passes through the centre of rotation of the slotted lever whose free end is connected to the ram by a connecting link. Find the ratio of time of cutting to time of return. | Remember | CO 1 | AMEB10.01 |

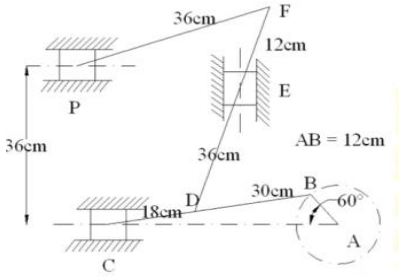
<table>
<tr><td>13</td><td>In a crank and slotted lever quick return mechanism, the distance between the fixed centers is 150 mm and the driving crank is 75 mm long. Determine the ratio of the time taken on the cutting and return Strokes</td><td>Understand</td><td>CO 1</td><td>AMEB10.02</td></tr>
<tr><td>14</td><td>In a crank and slotted lever quick return mechanism, the distance between the fixed centers is 150 mm and the driving crank is 75 mm long. Determine the ratio of the time taken on the cutting and return Strokes</td><td>Understand</td><td>CO 1</td><td>AMEB10.03</td></tr>
<tr><td>15</td><td>In a crank and slotted lever quick return motion mechanism, the distance between the fixed centre’s O and C is 200 mm. The driving crank CP is 75 mm long. The pin Q on the slotted lever, 360 mm from the fulcrum O, is connected by a link QR 100 mm long, to a pin R on the ram. The line of stroke of R is perpendicular to OC and intersects OC produced at a point 150 mm from C. Determine the ratio of times taken on the cutting and return strokes.</td><td>Remember</td><td>CO 1</td><td>AMEB10.01</td></tr>
<tr><td>16</td><td>In a crank and slotted lever quick return mechanism, the driving crank length is 30 mm and inclines at $30^0$ to the vertical. The distance between the fixed centre’s is 200 mm and the length of the slotted lever is 500mm. Find the ratio of the times taken on the cutting and idle strokes. Determine the effective stroke also.</td><td>Remember</td><td>CO 1</td><td>AMEB10.02</td></tr>
<tr><td>17</td><td>A Whitworth quick return motion mechanism, has the following particulars: Length of stroke = 150 mm ; Driving crank length = 40 mm; Time of cutting stroke= 2Time of return stroke. Find the lengths of connecting rod and slotted lever.</td><td>Remember</td><td>CO 1</td><td>AMEB10.03</td></tr>
<tr><td>18</td><td>A Four bar mechanism shown in fig foe each set of link proportions in the table below. Determine the mechanism described and draw the inversions of each mechanism.<br> 

<table>
<tr><th>Mechanism number</th><th>AD (cm) $l_1$</th><th>DC $l_2$</th><th>CB $l_3$</th><th>AB $l_4$</th></tr>
<tr><td>1</td><td>5</td><td>4</td><td>3.6</td><td>2.2</td></tr>
<tr><td>2</td><td>3</td><td>8.1</td><td>5.4</td><td>9</td></tr>
<tr><td>3</td><td>1</td><td>4.9</td><td>3</td><td>3.9</td></tr>
<tr><td>4</td><td>2.2</td><td>17</td><td>4.6</td><td>4</td></tr>
</table></td><td>Understand</td><td>CO 1</td><td>AMEB10.04</td></tr>
<tr><td>19</td><td>Explain the quick return motion mechanism of crank and slotted lever.</td><td>Understand</td><td>CO 1</td><td>AMEB10.01</td></tr>
<tr><td>20</td><td>Explain the whit-worth quick return motion mechanism.</td><td>Understand</td><td>CO 1</td><td>AMEB10.02</td></tr>
<tr><td colspan="5">PART - C (ANALYTICAL QUESTIONS)</td></tr>
<tr><td>1</td><td>The Whitworth quick return motion mechanism has the driving crank 150mm long. The distance between fixed centers is 100mm. The line of stroke of the ram passes through the center of rotation of the slotted lever whose free end is connected to the ram. Find the ratio of the time of cutting to the time of return.</td><td>Understand</td><td>CO 1</td><td>AMEB10.01</td></tr>
<tr><td>2</td><td>In the crank and slotted lever quick return mechanism, the distance between the fixed centers is 150 mm and the driving crank is 75mm long. Find the ratio of the time of cutting to the time of return.</td><td>Understand</td><td>CO 1</td><td>AMEB10.02</td></tr>
</table>

| | | | | |
|---|---|---|---|---|
| 3 | Sketch and explain any two inversions of a double slider crank chain. | Remember | CO 1 | AMEB10.03 |
| 4 | What is the difference between Whitworth quick return motion mechanism and Crank and Slotted lever mechanism. | Remember | CO 1 | AMEB10.04 |
| 5 | Sketch and explain the various inversions of a four bar chain. | Remember | CO 1 | AMEB10.01 |
| **MODULE-II** | | | | |
| **KINEMATICS, PLANE MOTION OF BODY, ANALYSIS OF MECHANISMS** | | | | |
| **PART - A (SHORT ANSWER QUESTIONS)** | | | | |
| 1 | Understand Instantaneous centre of a link. | Remember | CO 2 | AMEB10.05 |
| 2 | Apply the Kennedy's theorem to different mechanisms. | Remember | CO 2 | AMEB10.08 |
| 3 | Apply Klien's construction for determining acceleration of slider. | Remember | CO 2 | AMEB10.06 |
| 4 | Understand axode. | Understand | CO 2 | AMEB10.08 |
| 5 | Remember the acceleration image of a link. | Understand | CO 2 | AMEB10.06 |
| 6 | Understand relative velocity of a link. | Understand | CO 2 | AMEB10.06 |
| 7 | Remember instantaneous axis. | Understand | CO 2 | AMEB10.07 |
| 8 | Understand body centrode. | Understand | CO 2 | AMEB10.08 |
| 9 | Remember space centrode. | Understand | CO 2 | AMEB10.07 |
| 10 | Apply Coriolis component of acceleration for a mechanism. | Remember | CO 2 | AMEB10.06 |
| 11 | Remember rubbing velocity. | Remember | CO 2 | AMEB10.07 |
| 12 | Analyze sliding velocity. | Remember | CO 2 | AMEB10.07 |
| 13 | Create the space centrode and body centrode. | Remember | CO 2 | AMEB10.08 |
| 14 | Understand the various types of instantaneous centers. | Understand | CO 2 | AMEB10.07 |
| 15 | Apply the formula to calculate the number of instantaneous centers are in a mechanism? | Understand | CO 2 | AMEB10.07 |
| 16 | Evaluate the expression for radial and tangential component of acceleration? | Understand | CO 2 | AMEB10.07 |
| 17 | Understand the determination of the magnitude of Coriolis component of acceleration. | Understand | CO 2 | AMEB10.07 |
| 18 | Remember the direction of Coriolis component of acceleration | Remember | CO 2 | AMEB10.07 |
| 19 | Apply the properties of instantaneous centre method | Remember | CO 2 | AMEB10.07 |
| 20 | Understand velocity Image of a link. | Understand | CO 2 | AMEB10.06 |
| **PART - B (LONG ANSWER QUESTIONS)** | | | | |
| 1 | a) Remember different types of instantaneous centers.<br>b) Create the instantaneous centers for crank and slotted lever quick return mechanism? | Remember | CO 2 | AMEB10.07 |
| 2 | a) Understand Instantaneous center of a link in a mechanism.<br>b) Create all the Instantaneous centers of slider crank mechanism with crank length of 25mm rotating clockwise at a uniform speed of 100rpm. The crank makes $45^0$ with IDC and the connecting rod is 400mm long. Determine the velocity of the slider and the angular velocity of connecting rod? | Remember | CO 2 | AMEB10.07 |
| 3 | a) Analyze the Kennedy's theorem for a mechanism.<br>b) In a slider crank mechanism, the crank OA makes 400 | Understand | CO 2 | AMEB10.08 |

| | | | | |
|---|---|---|---|---|
| | rpm in the counter clockwise direction which is $60^0$ from IDC. The lengths of the links are OA= 60 mm, OB= 220 mm and BA= 280 mm. Determine the velocity and acceleration of the slider B? | | | |
| 4 | a) Understand Klien's construction for determining velocity and acceleration of slider crank mechanism.<br>b) Remember the method of determining the Coriolis component of acceleration in crank and slotted lever quick return mechanism? | Remember | CO 2 | AMEB10.08 |
| 5 | Evaluate the velocity and acceleration of the link QR and RS in a four bar mechanism in which PQRS is a four bar mechanism with fixed link PS. Crank PQ rotates uniformly and makes an angle of $60^o$ with PS in anti-clockwise direction.. The length of the links are PQ=62.5mm, QR= 175mm, RS= 112.5mm and PS= 200mm. Crank PQ rotates at 10 radians/ second? | Remember | CO 2 | AMEB10.06 |
| 6 | a) Understand centrode and axode.<br>b) Remember the analytical method of determination of velocity and acceleration for a slider crank mechanism? | Understand | CO 2 | AMEB10.06 |
| 7 | a) Analyze how the acceleration of a point in a link is determined when the acceleration of some other point on the same link is given in magnitude and direction.<br>b) Create the acceleration diagram of a slider crank mechanism. | Remember | CO 2 | AMEB10.06 |
| 8 | a ) Remember the acceleration image of a link.<br>b) Create and explain the velocity diagram of Whitworth quick return mechanism by assuming suitable proportions. | Remember | CO 2 | AMEB10.06 |
| 9 | Evaluate an expression for the magnitude of Coriolis component of acceleration. | Understand | CO 2 | AMEB10.07 |
| 10 | a) Analyze the practical significance of evaluating velocity and acceleration of members of a mechanism?<br>b) Evaluate the velocity and acceleration of a slider in Toggle mechanism assuming suitable proportions | Understand | CO 2 | AMEB10.06 |
| 11 | The Crank of a slider crank mechanisms rotates clockwise at a Constant speed of 600 r.p.m. The crank is 125 mm and connecting rod is 500 mm long. Determine 1. Linear velocity and acceleration of the mid Point 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. | Understand | CO 2 | AMEB10.06 |
| 12 | In a four link mechanism, the dimensions of the links are AB=200 mm, BC=400mm, CD=450 mm and AD=600mm. At the instant when DAB=90°, the link AB has angular velocity of 36 rad/s in the clockwise direction. Determine (i) The velocity of point C, (ii) The velocity of point E on the link BC When BE =200 mm (iii) the angular velocities of links BC and CD, iv) acceleration of link of link BC. | Remember | CO 2 | AMEB10.06 |

| | | | | |
|---|---|---|---|---|
| 13 | The dimensions of the various links of a mechanism, are as follows: OA=300 mm;AB=1200; BC=450 mm and CO=450 mm. if the crank OA rotates at 20 r.p.m. in the anticlockwise direction and gives motion to the mechanism, find, for given configuration: (1) Velocity of A and B (2) Angular velocity of AB (3) Linear acceleration of B. | Remember | CO 2 | AMEB10.06 |
| 14 | a) Evaluate the expressions for Velocity and acceleration of piston in reciprocating steam engine mechanism with a neat sketch<br>b) Analyze the expression for Coriolis component of acceleration with a neat sketch. | Understand | CO 2 | AMEB10.06 |
| 15 | In a slider crank mechanism, the length of the crank and the connecting rod are 100 mm and 400 mm respectively. The crank position is 45° from IDC and the crankshaft speed is 600 r.p.m. clockwise. Using analytical method Determine (1) Velocity and acceleration of the slider, and (2) Angular velocity and angular acceleration of the connecting rod. | Remember | CO 2 | AMEB10.06 |
| 16 | Create all instantaneous centers of the slider crank mechanism; the length of crank OB and Connecting rod AB are 125 mm and 500 mm respectively. The crank speed is 600 rpm clockwise. When the crank has turned 45° from the IDC. Determine (i) velocity of slider' A' (ii) Angular Velocity of connecting rod 'AB'. | Remember | CO 2 | AMEB10.06 |
| 17 | In the mechanism shown in figure , the crank OA rotates at 20rpm anticlockwise and gives motion of sliding blocks B and D. The dimensions of various links are OA = 300mm, AB = 1200mm, BC = 450mm and CD = 450 mm. For the given configuration determine<br>i) velocities of sliding at B and D,<br>ii) angular velocity of CD<br>iii) Linear acceleration of D and iv) angular acceleration of CD.<br>  | Understand | CO 2 | AMEB10.06 |
| 18 | The crank and connecting rod of a theoretical steam engine are 0.5 m and2m long respectively. The crank makes 180 rpm in the clockwise direction. When it has turned 450 from the inner dead centre position, determine : a) Velocity of piston b) Angular velocity of connecting rod. C) Velocity of point E on the connecting rod 1.5m from the gudgeon pin. D) velocity of rubbing at the pins of the crank shaft, crank and crank cross head when the diameters of their pins are 50mm and 60mm and 30mm respectively. | Remember | CO 2 | AMEB10.07 |

| | | | | |
|---|---|---|---|---|
| 19 | A four-bar mechanism has the following link length in mm. Input, A0A= 25, AB = 70, output $B_0B$ = 45 and frame $A_0B_0$ = 60. Coupler point Ais above and B is below the horizontal frame link $A_0B_0$, respectively. When the input link is in an angular position of $105^o$ counter clockwise from the frame link, draw the four bar mechanism and locate all the instantaneous centres. If the input link rotates with a constant angular velocity of 2.5 rad/sec clockwise, determine the linear velocity of B ofthe output link and the angular velocity of the output link. | Understand | CO 2 | AMEB10.07 |
| 20 | In a steam engine mechanism shown in figure a) the crank AB rotates at200 rpm. The dimensions of various links are AB = 12cm, BC = 48cm,CD = 18cm and DE =36cm, EF = 12 cm and FP = 36cm. Find thevelocities of C,D,E,F and P.   | Remember | CO 2 | AMEB10.07 |
| | **PART - C (ANALYTICAL QUESTIONS)** | | | |
| 1 | Create all instantaneous centers of the slider crank mechanism; the length of crank OB and Connecting rod AB are 125 mm and 500 mm respectively. The crank speed is 600 rpm clockwise. When the crank has turned 45° from the IDC. Determine (i) velocity of. slider' A' (ii)Angular Velocity of connecting rod 'AB | Remember | CO 2 | AMEB10.01 |
| 2 | Understand the procedure to determine the velocity and acceleration of a slider crank mechanism by Klein's construction. | Remember | CO 2 | AMEB10.02 |
| 3 | Create and explain Whit worth quick return motion mechanism | Remember | CO 2 | AMEB10.03 |
| 4 | A four-bar mechanism has the following link length in mm. Input, $A_0A$= 25, AB = 60, output $B_0B$ = 45 and frame $A_0B_0$ = 45. Coupler point Ais above and B is below the horizontal frame link $A_0B_0$, respectively. When the input link is in an angular position of $105^0$ counter clockwise from the frame link, draw the four bar mechanism and locate all the instantaneous centers. If the input link rotates with a constant angular velocity of 3 rad/sec clockwise, determine the linear velocity of B of the output link and the angular velocity of the output link. | Understand | CO 2 | AMEB10.04 |
| 5 | Evaluate the expression for Coriolis component of acceleration with a neat sketch. | Understand | CO 2 | AMEB10.01 |
| | **MODULE-III** | | | |
| | **STRAIGHT LINE MOTION MECHANISMS, STEERING GEARS, HOOKE'S JOINT** | | | |
| | **PART - A (SHORT ANSWER QUESTIONS)** | | | |
| 1 | Understand the principle of straight line mechanisms. | Understand | CO 3 | AMEB10.10 |
| 2 | Remember the application of Pantograph. | Understand | CO 3 | AMEB10.10 |

| | | | | |
|---|---|---|---|---|
| 3 | Create Ackerman steering gear mechanism | Remember | CO 3 | AMEB10.11 |
| 4 | Understand Hooke's joint in an automobile. | Remember | CO 3 | AMEB10.13 |
| 5 | Remember a Double Hooke's joint. | Remember | CO 3 | AMEB10.13 |
| 6 | Analyze a Davis steering gear mechanism. | Remember | CO 3 | AMEB10.11 |
| 7 | Remember the applications of Hooke's joint. | Understand | CO 3 | AMEB10.10 |
| 8 | Analyze the exact straight line mechanisms. | Understand | CO 3 | AMEB10.10 |
| 9 | Create the approximate straight line mechanisms. | Understand | CO 3 | AMEB10.10 |
| 10 | Remember copied straight line mechanism | Understand | CO 3 | AMEB10.10 |
| | | | | |
| 11 | Remember the use of pantograph. | Understand | CO 3 | AMEB10.10 |
| 12 | Create the Harts mechanism. | Understand | CO 3 | AMEB10.11 |
| 13 | Create the Peaucellier mechanism. | Understand | CO 3 | AMEB10.11 |
| 14 | Understand the Roberts mechanism. | Remember | CO 3 | AMEB10.11 |
| 15 | Remember the Scott Russell mechanism. | Remember | CO 3 | AMEB10.11 |
| 16 | Create the grass hoper mechanism. | Remember | CO 3 | AMEB10.11 |
| 17 | Understand the Tchebecheffs mechanism. | Understand | CO 3 | AMEB10.11 |
| 18 | Remember the Watt mechanism. | Understand | CO 3 | AMEB10.11 |
| 19 | Evaluate the ratios of links for Tchebecheffs mechanism. | Understand | CO 3 | AMEB10.11 |
| 20 | Analyze the ratios of links for Grasshoper mechanism. | Understand | CO 3 | AMEB10.11 |
| | **PART - B (LONG ANSWER QUESTIONS)** | | | |
| 1 | a)Understand straight line mechanisms?<br>b) Create any one mechanism having all turning pairs that generate anexact straight line. | Remember | CO 3 | AMEB10.10 |
| 2 | a) Understand the Peaucellier's straight line mechanism.<br>b) Remember the principle of generation of straight line. | Remember | CO 3 | AMEB10.10 |
| 3 | a) Create an approximate straight line mechanism?<br>b) Remember a mechanism which consists of a sliding pair. | Remember | CO 3 | AMEB10.10 |
| 4 | a) Create an exact straight line mechanism?<br>b) Analyze an exact straight line mechanism? | Remember | CO 3 | AMEB10.10 |
| 5 | a) Understand the Watt's mechanism for straight line motion.<br>b) Evaluate the condition for generating a straight line in Watt's mechanism? | Understand | CO 3 | AMEB10.11 |
| 6 | a) Understand a Pantograph and its application.<br>b) Create Scot Russel mechanism with a neat sketch andshow that it generates a straight line? | Understand | CO 3 | AMEB10.10 |
| 7 | a) Analyze the differences between Davi's and Ackerman steering gears.<br>b) In a Davi's steering gear, the distance between the pivots of the front axle is 1 meter and the wheel base is 2.5 meters. Find the inclination of the track arm to the longitudinal axis of the car when it is moving along a straight path? | Understand | CO 3 | AMEB10.10 |
| 8 | a) Understand the condition for correct steering?<br>b) Create the Ackerman's steering gear mechanism. | Understand | CO 3 | AMEB10.11 |
| 9 | a) Understand a Hooke's joint and its applications?<br>b) A Hooke's joint connects two shafts whose axes intersect at 1500.Thedriving shaft rotates uniformly at 120 rpm. The driven shaft operates against a steady torque of 150NM. And carries a flywheel whose mass is | Understand | CO 3 | AMEB10.11 |

| | | | | |
|---|---|---|---|---|
| | 45 kg and radius of gyration 150 mm. Find the maximum torque which will be exerted by the driving shaft. | | | |
| 10 | a) Understand a Double Hooke's joint?<br>b) Evaluate an expression for the ratio of shaft velocities in a Hooke's joint. | Understand | CO 3 | AMEB10.13 |
| | | | | |
| 11 | Create Scott Russel mechanism with a neat sketch and show that it generates a straight line? | Understand | CO 3 | AMEB10.13 |
| 12 | Differentiate between Davi's and Ackerman steering gears | Understand | CO 3 | AMEB10.11 |
| 13 | In a Davi's steering gear, the distance between the pivots of the front axle is 1 meter and the wheel base is 2.5 meters. Find the inclination of the track arm to the longitudinal axis of the car when it is moving along a straight path? | Remember | CO 3 | AMEB10.12 |
| 14 | Remember the condition for correct steering. | Remember | CO 3 | AMEB10.12 |
| 15 | Create the Ackerman's steering gear mechanism. | Remember | CO 3 | AMEB10.12 |
| 16 | Understand a Hooke's joint and its applications? | | CO 3 | AMEB10.12 |
| 17 | A Hooke's joint connects two shafts whose axes intersect at 1500.Thedriving shaft rotates uniformly at 120 rpm. The driven shaft operates against a steady torque of 150NM. And carries a flywheel whose mass is45 kg and radius of gyration 150 mm. Find the maximum torque which will be exerted by the driving shaft. | Understand | CO 3 | AMEB10.13 |
| 18 | Understand a Double Hooke's joint. | Understand | CO 3 | AMEB10.13 |
| 19 | Evaluate an expression for the ratio of shaft velocities in a Hooke's joint. | Understand | CO 3 | AMEB10.13 |
| 20 | Create the Davis's steering gear mechanism. | Understand | CO 3 | AMEB10.12 |
| | **PART - C (ANALYTICAL QUESTIONS)** | | | |
| 1 | The track arm of a Davis steering gear is at a distance of 185 mm from the front main axle whereas the difference between their lengths is 90 mm. If the distance between steering pivots of the main axle is 1.2 m, determine the length of the chassis between the front and the rear wheels. Also find the inclination of the track arms to the longitudinal axis of the vehicle | Remember | CO 3 | AMEB10.1 |
| 2 | The distance between the steering pivots of a Davis steering gear is 1.3 m. The wheel base is 2.75 m. what will be the inclination of the track arms to the longitudinal axis of the vehicle moving in a straight path. | Understand | CO 3 | AMEB10.1 |
| 3 | Give a neat sketch of the straight line motion 'Hart mechanism.' Prove that it produces an exact straight line motion. | Remember | CO 3 | AMEB10.1 |
| | | | | |
| 4 | The driving shaft of a double Hook's joint rotates at 400 rpm. The angle of driving and driven shaft with intermediate shaft is $20^0$. Determine the maximum and minimum velocities of the driven shaft. | Remember | CO 3 | AMEB10.1 |
| 5 | A hooks joint connects two shafts whose axes intersect at $25^0$. What will be the angle turned by the driven shaft when the velocity ratio is maximum, minimum and unity. | Understand | CO 3 | AMEB10.1 |
| | **MODULE– IV** | | | |
| | **CAMS, ANALYSIS OF MOTION OF FOLLOWERS** | | | |
| | **PART - A (SHORT ANSWER QUESTIONS)** | | | |
| 1 | Understand cams and followers.. | Remember | CO 4 | AMEB10.14 |
| 2 | Remember the angle of action in a cam. | Remember | CO 4 | AMEB10.14 |
| 3 | Create the displacement diagrams the UARM. | Remember | CO 4 | AMEB10.14 |

| | | | | |
|---|---|---|---|---|
| 4 | Remember the uses of cams and followers. | Remember | CO 4 | AMEB10.14 |
| 5 | Understand a tangent cam | Remember | CO 4 | AMEB10.14 |
| 6 | Remember the followers and applications | Remember | CO 4 | AMEB10.14 |
| 7 | Understand the classification of cams | Understand | CO 4 | AMEB10.14 |
| 8 | Create the different types of followers. | Understand | CO 4 | AMEB10.14 |
| 9 | Understand the angle of dwell in cams. | Understand | CO 4 | AMEB10.14 |
| 10 | Remember the pressure angle in cams. | Understand | CO 4 | AMEB10.15 |
| 11 | Understand the angle of ascend in the cams. | Understand | CO 4 | AMEB10.15 |
| 12 | Remember the angle of descend in cams | Understand | CO 4 | AMEB10.15 |
| 13 | Understand the application of cam. | Remember | CO 4 | AMEB10.15 |
| 14 | Remember the angle of action in cams. | Remember | CO 4 | AMEB10.14 |
| 15 | Understand dwell in the case of cams. | Remember | CO 4 | AMEB10.15 |
| 16 | Analyze the classifications of followers according to the path of motion. | Understand | CO 4 | AMEB10.15 |
| 17 | Understand the different follower motions. | Understand | CO 4 | AMEB10.15 |
| 18 | Create the necessary elements of a cam mechanism. | Understand | CO 4 | AMEB10.14 |
| 19 | Evaluate the formula for maximum velocity in cams. | Understand | CO 4 | AMEB10.15 |
| 20 | Analyze the classifications of follower according to the motion of the follower? | Understand | CO 4 | AMEB10.15 |
| **PART - B (LONG ANSWER QUESTIONS)** | | | | |
| 1 | a) Understand a cam and mention the types.<br>b) Analyze the various motions possible with cam and follower. | Remember | CO 4 | AMEB10.14 |
| 2 | a) Understand a follower and mention the types.<br>b) Create the displacement and velocity diagrams for uniform acceleration and retardation motion. | Remember | CO 4 | AMEB10.14 |
| 3 | a) Understand the following terms as applied to cams with neat sketch:<br>i) Base circle ii) pitch circle iii) pressure angle.<br>b) Create the profile of a cam with oscillating roller follower for the following motion: Follower to move outwards through an angular displacement of $20^0$ during $120^0$ of cam rotation, follower to dwell for $50^0$, follower to return to its initial position during $90^0$ of cam rotation with UARM, follower to dwell for the remaining period. | Remember | CO 4 | AMEB10.14 |
| 4 | a) Understand cams and followers.<br>b) Create a cam to raise a valve through a distance of 50 mm in 1/3 of revolution with SHM, keep it fully raised through 1/12 of revolution and lower it with harmonic motion in 1/6 of revolution. The valve remains closed during the rest of the revolution. The diameter of the roller is 20mm and the minimum radius of the cam is 25 mm. The axis of the valve rod passes through the axis of the cam shaft | Understand | CO 4 | AMEB10.15 |
| 5 | a) Create the displacement and velocity diagrams for Simple Harmonic motion.<br>b) Create the profile of a cam so that the follower is to move outwards through 30 mm during $160^0$ of cam rotation with Uniform velocity and dwell for $30^0$ of cam rotation followed by returning to initial position with Uniform acceleration and retardation during $110^0$ of cam rotation and dwell for the remaining period. The | Remember | CO 4 | AMEB10.15 |

| | | | | |
|---|---|---|---|---|
| | base circle diameter of cam is 28mm and the follower is a knife edge follower. The axis of the follower is offset by 6 mm. | | | |
| 6 | a) Remember angle of action, angle of dwell and pressure angle in cams.<br>b) Create the profile of a cam so that the follower is to move outwards through 30 mm during $180^0$ of cam rotation with SHM and dwell for $20^0$of cam rotation followed by returning to initial position with Uniform velocity during$160^0$ of cam rotation. The base circle diameter of cam is28 mm and the roller diameter is 8 mm. The axis of the follower is offset by 6 mm. | Remember | CO 4 | AMEB10.15 |
| 7 | a) Create the displacement, velocity and acceleration diagrams for a cam executing UARM.<br>b) A cam operating a knife edge follower has the following data:<br>Follower moves outward through 40 mm during $60^0$ of cam rotation with uniform velocity, follower dwells for the next $45^0$, follower returns to its original position during next $90^0$ with Uniform velocity and dwells for the remaining period. Draw the cam profile. | Understand | CO 4 | AMEB10.15 |
| 8 | a) Understand the uses of cams and followers.<br>b)A radial translating flat faced follower has a lift of 30 mm. The rise takes place with SHM during $180^0$ of cam rotation. The return also takes place with SHM during the next $180^0$ of cam rotation. Assume anti clockwise rotation of the cam. Draw the cam profile and determine the maximum velocity and acceleration values when the follower rises and the cam rotates at 50 rpm. | Remember | CO 4 | AMEB10.15 |
| 9 | a) Understand a roller follower preference to a knife edge follower.<br>b) Evaluate expressions for displacement, velocity and acceleration for a tangent cam operating a radial translating roller follower when the contact is on circular nose. | Remember | CO 4 | AMEB10.15 |
| 10 | a) Understand a tangent cam.<br>b) Evaluate an expression for the tangent cam when the follower is contacting the convex flanks. | Understand | CO 4 | AMEB10.15 |
| 11 | A cam is to give the following motion to a knife edged follower:<br>(a) Outstroke during 60° of cam rotation<br>(b) Dwell for the next 45° of cam rotation<br>(c) Return stroke during next 90° of cam rotation and<br>(d) Dwell for the remaining of cam rotation<br>The stroke of the follower is 40 mm and the minimum radius of the cam is 50 mm. The follower moves with uniform velocity during both the outstroke and return strokes. Draw the profile of the cam when (a) the axis of the follower passes through the axis of the camshaft, and (b) the axis of the follower is offset by 20 mm from the axis of the cam shaft. | Understand | CO 4 | AMEB10.15 |
| 12 | Create the profile of a cam operating a Knife-edge follower from the following data: (a) Follower to move outward through 40 mm during 60° of a cam rotation; (b) Follower to dwell for the next 45° (c) Follower to return its original position during next 90° (d)Follower to dwell for the rest of cam rotation. The displacement of the follower is to take place with simple harmonic motion during both the outward and return strokes. The | Remember | CO 4 | AMEB10.15 |

| | | | | |
|---|---|---|---|---|
| | least radius of the cam is 50mm. If the cam rotates at 300 rpm, determine the maximum velocity and acceleration of the follower during the outward stroke and return stroke. | | | |
| 13 | A cam, with a minimum radius of 50 mm, rotating clockwise at a uniform speed, is required to given a knife-edged follower the motion as described below: (a) To move outwards through 40 mm during 100° rotation of the cam; (b) to dwell for next 80° (c) To return to its starting position during next 90 ° and (d) To dwell for the rest period of revolution. Draw the profile of the cam (i) When the line of stroke of the follower passes through the centre of the cam shaft and (ii) When the line of stroke of the follower is to take place with Uniform acceleration and uniform retardation. Determine the maximum velocity and acceleration of the follower when the cam shaft rotates at 900 r.p.m. | Remember | CO 4 | AMEB10.15 |
| 14 | Create the profile of a cam operating a roller reciprocating follower and with the following data: Minimum radius of cam =25 mm; lift=30mm; Roller diameter= 15mm.The cam lifts the follower for 120° with SHM, followed by a dwell period of 30°. Then the follower lowers down during 150° of cam rotation with uniform acceleration and retardation followed by a dwell period. If the cam rotates at a uniform speed of 150 RPM. Calculate the maximum velocity and acceleration of follower during the descent period. | Remember | CO 4 | AMEB10.15 |
| 15 | It is required to set out the profile of a cam to give the following motion to the reciprocating follower with a flat mushroom contact surface: (i) Follower to have a stroke of 20 mm during 120° of cam rotation, (ii)Follower to dwell for 30° of cam rotation, (iii) Follower to return to its initial position during 120° of cam rotation, (iv) Follower to dwell for remaining 90° of cam rotation. The minimum radius of the cam is 25mm. The out stroke of the follower is performed with SHM and return stroke with equal uniform acceleration and retardation. | Understand | CO 4 | AMEB10.15 |
| 16 | A tangent cam to drive a roller follower through a total lift of 12.5 mm for a cam rotation of 75°.The cam speed is 600 rpm . The distance between cam centre and follower centre at full lift is 45 mm and the roller is 20 mm in diameter. Find the cam proportions and plot displacement, velocity and acceleration for one full cycle | Understand | CO 4 | AMEB10.15 |
| 17 | Create a tangent cam and mention the important terminologies on it. Also derive the expression for displacement, velocity, acceleration of a reciprocating roller follower when the roller has contact with the nose | Remember | CO 4 | AMEB10.15 |
| 18 | Create the profile of a cam operating a roller reciprocating follower for the following data. Lift of follower = 30mm; Angle during the follower rise period $=120^0$; angle during the follower after rise = $30^0$; angle during the follower return period = $150^0$. Angle during which follower dwell after return = $60^0$; minimum radius of cam = 25mm; Roller diameter 10mm. The motion of follower is uniform acceleration and deceleration during the rise and return period. | Remember | CO 4 | AMEB10.15 |

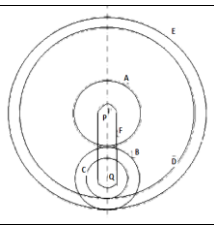
| | | | | |
|---|---|---|---|---|
| 19 | Design a cam to raise a valve with simple harmonic motion through15mm is 1/3rd of a revolution, keep it fully raised through 1/12th of revolution and to lower it with SHM in 1/6th of a revolution. The valve remains closed during the rest of the revolution. The diameter of the roller is 20mm and the minimum radius of the cam is 25mm. The axis of the valve rod passes through the axis of the cam shaft. If the cam shaft rotates at uniform speed of 100 rpm; find the maximum velocity and acceleration of the valve during raising and lowering. Also draw the profile of the cam. | Understand | CO 4 | AMEB10.15 |
| 20 | a) Create neat sketches of cam follower according to their shape, location and motion. State also their advantages, if any, with respect to other followers<br>b) Create the displacement, velocity and acceleration curves of a SHM motion of Follower. Why is it superior over other motion curves? | Understand | CO 4 | AMEB10.15 |
| | **PART - C (ANALYTICAL QUESTIONS)** | | | |
| 1 | Create the profile of a cam operating a Knife-edged follower from the following data:<br>(a) Follower to move outward through 40 mm during 60° of a cam rotation;<br>(b) Follower to dwell for the next 45°<br>(c) Follower to return its original position during next90°<br>(d) Follower to dwell for the rest of cam rotation. The displacement of the follower is to take place with simple harmonic motion during both the outward and return strokes. The least radius of the cam is 50mm. If the cam rotates at 300 r.p.m., determine the maximum velocity and acceleration of the follower during the outward stroke and return stroke. | Remember | CO 4 | AMEB10.17 |
| 2 | A cam is to give the following motion to a knife edged follower:<br>(a) Outstroke during 60° of cam rotation<br>(b) Dwell for the next 60° of cam rotation<br>(c) Return stroke during next 60° of cam rotation and<br>(d) Dwell for the remaining of cam rotation<br>The stroke of the follower is 80 mm and the minimum radius of the cam is 50 mm. The follower moves with uniform velocity during both the outstroke and return strokes. Draw the profile of the cam when (a) the axis of the follower passes through the axis of the cam shaft, and (b) the axis of the follower is offset by 10 mm from the axis of the cam shaft. | Remember | CO 4 | AMEB10.16 |
| 3 | Create the profile of a cam operating a Knife-edged follower from the following data: (a) Follower to move outward through 40 mm during 60° of a cam rotation; (b) Follower to dwell for the next 30° (c) Follower to return its original position during next 90° (d)Follower to dwell for the rest of cam rotation. The displacement of the follower is to take place with simple harmonic motion during both the outward and return strokes. The least radius of the cam is 50mm. If the cam rotates at 500 r.p.m., determine the | Understand | CO 4 | AMEB10.17 |

| | | | | |
|---|---|---|---|---|
| | maximum velocity and acceleration of the follower during the outward stroke and return stroke. | | | |
| 4 | A cam, with a minimum radius of 35 mm, rotating clockwise at a uniform speed, is required to given a knife-edged follower the motion as described below: (a) To move outwards through 40 mm during 90° rotation of the cam; (b) to dwell for next 90° (c) To return to its starting position during next 90 ° and (d) To dwell for the rest period of revolution. Draw the profile of the cam (i) When the line of stroke of the follower passes through the centre of the cam shaft and (ii) When the line of stroke of the follower is to take place with Uniform acceleration and uniform retardation. Determine the maximum velocity and acceleration of the follower when the cam shaft rotates at 600 r.p.m. | Understand | CO 4 | AMEB10.17 |
| 5 | Create the profile of a cam operating a roller reciprocating follower and with the following data: Minimum radius of cam =25 mm; lift=60mm; Roller diameter= 15mm.The cam lifts the follower for 180° with SHM, followed by a dwell period of 30°. Then the follower lowers down during 120° of cam rotation with uniform acceleration and retardation followed by a dwell period. If the cam rotates at a uniform speed of 150 RPM. Calculate the maximum velocity and acceleration of follower during the descent period. | Remember | CO 4 | AMEB10.18 |
| **MODULE– V** | | | | |
| **HIGHER PAIRS, GEAR TRAINS** | | | | |
| **PART - A (SHORT ANSWER QUESTIONS)** | | | | |
| 1 | Understand spur gears and their applications. | Remember | CO 5 | AMEB10.16 |
| 2 | Remember cycloidal gears. | Remember | CO 5 | AMEB10.16 |
| 3 | Understand the method of eliminating interference in gears | Remember | CO 5 | AMEB10.17 |
| 4 | Remember a gear train and list its types? | Remember | CO 5 | AMEB10.18 |
| 5 | Understand a Differential? | Remember | CO 5 | AMEB10.16 |
| 6 | Analyze helical gears. | Remember | CO 5 | AMEB10.16 |
| 7 | Remember bevel gears in a mechanism. | Understand | CO 5 | AMEB10.16 |
| 8 | Understand interference in gears. | Understand | CO 5 | AMEB10.16 |
| 9 | Create the involute profiles of gears. | Understand | CO 5 | AMEB10.17 |
| 10 | Understand pressure angle of gears. | Understand | CO 5 | AMEB10.17 |
| 11 | Evaluate addendum and dedendum of gears. | Understand | CO 5 | AMEB10.17 |
| 12 | Understand circular pitch of gears. | Remember | CO 5 | AMEB10.17 |
| 13 | Evaluate the length of path of contact. | Remember | CO 5 | AMEB10.16 |
| 14 | Analyze the length of path of contact. | Remember | CO 5 | AMEB10.17 |
| 15 | Understand the law of gearing. | Understand | CO 5 | AMEB10.17 |
| 16 | Remember the angle of approach. | Understand | CO 5 | AMEB10.17 |
| 17 | Understand the contact ratio of gears. | Understand | CO 5 | AMEB10.17 |
| 18 | Remember the helix angle of gears. | Understand | CO 5 | AMEB10.17 |
| 19 | Evaluate the gear ratio of gears. | Understand | CO 5 | AMEB10.17 |
| 20 | Understand epicyclic gear train. | Understand | CO 5 | AMEB10.18 |

| PART - B (LONG ANSWER QUESTIONS) | | | | |
|---|---|---|---|---|
| 1 | a) Understand spur, helical and bevel gears.<br>b) Evaluate an expression for the length of path of contact. | Understand | CO 5 | AMEB10.17 |
| 2 | a) Understand the terms module, pressure angle and addendum in gears.<br>b) Two mating gears have 29 and 40 involute teeth of module 10 mm and $20^0$ pressure angle. If the addendum on ach 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. | Understand | CO 5 | AMEB10.17 |
| 3 | a) Remember the terms gear ratio, angle of action and dedendum in gears.<br>b) Two gears have 30 and 42 involute teeth of module 8 mm and $20^0$ pressure angle. If the addendum on each wheel is 12mm find the dedendum for each gear wheel and contact ratio. | Remember | CO 5 | AMEB10.17 |
| 4 | a)Understand the method of eliminating interference in gears.<br>b)A pair of gears having 40 and 20 teeth respectively are rotating in mesh The speed of the smaller is 2000 rpm. Determine the velocity of sliding at the point of engagement, at the pitch point and at the point of disengagement. Assume that the gear teeth are200 involute, addendum is 5 mm and module is 5 mm. | Remember | CO 5 | AMEB10.17 |
| 5 | a) Evaluate an expression for the length of arc of contact.<br>b) The pitch circle diameter of the smaller of the two gears which mesh externally and have involute teeth is 100 mm. The number of teeth is 16 and 32. The pressure angle is 200. The addendum is 0.32 of the circular pitch. Find the length of path of contact of the pair of teeth. | Understand | CO 5 | AMEB10.17 |
| 6 | a) Evaluate an expression for the minimum number of teeth on pinion to avoid interference.<br>b) The pressure angle of two gears in mesh is 200 and have a module of 10 mm. The number of teeth on pinion are 24 and on gear 60. The addendum of pinion and gear is same and equal to one module. Determine the number of pairs of teeth in contact, the angle of action of pinion and gear, the ratio of sliding to rolling velocity at the beginning of contact, at pitch point and at the end of contact. | Remember | CO 5 | AMEB10.17 |
| 7 | a) Understand a gear train and its types.<br>b) The speed ratio of a reverted gear train is 12. The module pitch of gears A and B which are in mesh is 3.125 mm and of gears C and D which are in mesh is 2.5 mm. Calculate the suitable number of teeth for the gears. No gear is to have less than 20 teeth. B-C is a compound gear. | Remember | CO 5 | AMEB10.18 |
| 8 | a) Create a neat sketch of the sun and planet wheel.<br>b) In an epicyclic gear train, an arm carries two gears 1 and 2 having 40 and 50 teeth respectively. The arm rotates at 160 rpm counter clockwise about the centre of gear1, which is fixed. Determine the speed of gear2. | Understand | CO 5 | AMEB10.17 |
| 9 | a) Understand a Differential.<br>b) An internal wheel B with 80 teeth is keyed to a shaft F. A fixed internal wheel C with 82 teeth is concentric with B. A compound wheel D-E gears with two internal wheels. D has 28 teeth and gears with C while E gears with B. The compound wheels revolve freely on a pin which projects from | Remember | CO 5 | AMEB10.18 |

| | | | | |
|---|---|---|---|---|
| | a disc keyed to shaft A coaxial with F. If the wheels have the same pitch and the shaft rotates at 800 rpm what is the speed of the shaft F? Sketch the arrangement. | | | |
| 10 | In an epicyclic gear train, internal gear A is keyed to the driving shaft and has 30 teeth. Compound wheel CD of 20 and 22 teeth respectively are free to rotate on a pin fixed to the arm P which is rigidly connected to the driven shaft. Internal gear B which has 32 teeth is fixed. If the driving shaft runs at 60 rpm clock wise, determine the speed of the driven shaft. | Remember | CO 5 | AMEB10.18 |
| 11 | In a reverted epicyclic train, the arm F carries two wheels A and D and a compound wheel B-C. Wheel A meshes with wheel B and Wheel D meshes with wheel C. The number of teeth on wheel A, D and C are 80, 48, and 72. Find the speed and direction of wheel D , when wheel A is fixed and arm F makes 200 rpm clockwise. | Remember | CO 5 | AMEB10.17 |
| 12 | Two mating spur gear with module pitch of 6.5 mm have 19 ad 47 teeth of 20° pressure angle and 6.5 mm addendum. Determine the number of pair of teeth and angle turned through by the larger wheel for one pair of teeth in contact. Determine also the sliding velocity at the instant (i) engagement commences (ii) engagement terminates. When the pitch line velocity is 1.2 m/s. | Understand | CO 5 | AMEB10.17 |
| 13 | The number of teeth on each of the two spur gears in mesh is 40. The teeth have 20° involute profile and the module is 6mm. If the arc of contact is 1.75 times the circular pitch. Find the addendum. | Remember | CO 5 | AMEB10.17 |
| 14 | Two 20° involute spur gears have a module of 10 mm. The addendum is one module. The larger gear has 50 teeth and pinion 13 teeth. Does the interference occur? If it occurs, to what value should the pressure angle be changed to eliminate interference? | Remember | CO 5 | AMEB10.17 |
| 15 | Two mating involute spur gears 20° pressure angle have a gear ratio of 2. The number of teeth on the pinion is 20 and its speed is 250 rpm. The module pitch of the teeth is 12 mm. if the addendum on each wheel recess on each side are half the maximum possible length each, find (1) the addendum for pinion and gear wheel (2) the length of arc of contact (3 the maximum velocity of sliding during approach and recess. Assume pinion to be driver. | Remember | CO 5 | AMEB10.17 |
| 16 | A pair of spur gear with involute teeth is to give a gear ratio of 4:1. The arc of approach is not to be less than the circular pitch and the smaller wheel is the driver. The angle of pressure is 14.5 What is the least number of teeth can be used on each wheel? What is the addendum of the wheel in terms of circular pitch | Understand | CO 5 | AMEB10.17 |
| 17 | A pair 20° full depth involute spur gear having 30 and 50 teeth respectively module 4 mm arc in mesh, the smaller gear rotates at 1000 rpm. Determine (a) Sliding velocities at engagement and disengagement of a pair of teeth and (b) Contact ratio | Understand | CO 5 | AMEB10.17 |
| 18 | In an epicyclic gear train the internal wheels A and B and compound wheels C and D rotate independently about axis O. The wheels E and F rotate on pins fixed to the arm G. E gears with A and C . Wheel F gear with B and D. All the wheels have the same module and the number of teeth are: TC =28 TD=26; TE = TF=18. (1) Sketch the arrangement, (2) Find the | Understand | CO 5 | AMEB10.17 |

| | | | | |
|---|---|---|---|---|
| | number of teeth on A and B, (3)If the arm G makes 100 rpm clockwise and A is fixed, find the speed of B , and (4) If the arm G makes 100 rpm clockwise and wheel A makes 10 rpm counter clockwise; Find the speed of wheel B | | | |
| 19 | Two gear wheels mesh externally and are to give a velocity ratio of 3 to 1. The teeth are of involute form; module=6mm, addendum=one module, pressure angle= 20°. The pinion rotates at 90 rpm. 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. | Understand | CO 5 | AMEB10.17 |
| 20 | The arm of an epicyclic gear train rotates at 100 rpm in the anticlockwise direction. The arm carries two wheels A and B having 36 and 45 teeth respectively. The wheel A is fixed and the arm rotates about the centre of wheel A. Find the speed of wheel B. What will be the speed of B, if the wheel A instead of being fixed, makes 200 rpm (clockwise). | Understand | CO 5 | AMEB10.17 |
| **PART - C (ANALYTICAL QUESTIONS)** | | | | |
| 1 | Create the profile of a cam operating a roller reciprocating follower and with the following data: Minimum radius of cam =25 mm; lift=30mm; Roller diameter= 15mm. The cam lifts the follower for 120° with SHM, followed by a dwell period of 30°. Then the follower lowers down during 150° of cam rotation with uniform acceleration and retardation followed by a dwell period. If the cam rotates at a uniform speed of 150 RPM. Calculate the maximum velocity and acceleration of follower during the descent period. | Understand | CO 5 | AMEB10.17 |
| 2 | In a reverted epicyclic train, the arm F carries two wheels A and D and a compound wheel B-C. Wheel A meshes with wheel B and Wheel D meshes with wheel C. The number of teeth on wheel A, D and C is 80, 48, and 72. Find the speed and direction of wheel D , when wheel A is fixed and arm F makes 200 rpm clockwise | Remember | CO 5 | AMEB10.18 |
| 3 | Two Parallel shafts are connected by spur gearing. The distance between the shaft is 600mm. If one shaft runs at 120 rpm and the other at 360 rpm. Find the number of teeth on each wheel, if module is 8 mm. Also determine the exact center distance between the shafts. | Remember | CO 5 | AMEB10.17 |
| 4 | A compound epicyclic gear is shown in figure. The gears A, D and E are free to rotate on axis P. The compound gears B and C rotate together on the axis Q at the end of arm F. All the gears have equal pitch. The number of external teeth on gears, A B and C are 18, 45 and 21 respectively. The gears D and E are annulus gears. The gear A rotates at 100 rpm in anticlockwise direction and the gear D rotates at 450 rpm clockwise. Find the speed and direction of the arm and the gear E. | Remember | CO 5 | AMEB10.17 |

| | | | | |
|---|---|---|---|---|
| |  | | | |
| 5 | A compound train consists of six gears. The number of teeth on the gears are as follows :<br>Gear : A B C D E F<br>No. of teeth: 60 40 50 25 30 24<br>The gears Band *C* are on one shaft while the gears D and Eare on another shaft. The gear A drives gear B, gear C drives gear D and gear E drives gear F. If the gear *A* transmits 1.5 kW at 100 r.p.m. and the gear train has an efficiency of 80 percent, find the torque on gear F. | Understand | CO 5 | AMEB10.18 |

**Prepared by:**

Mr. B.V.S.N Rao,Associate Professor **HOD, ME**

\