



**SREENIVASA INSTITUTE OF TECHNOLOGY AND MANAGEMENT STUDIES
(AUTONOMOUS)**

QUESTION BANK

Year / Semester: II B.Tech IV Semester

Regulation: R23

Subject and Code: 23MEC242T

SYLLABUS

UNIT-1: BASICS OF MECHANISMS

Basics of kinematics – Types of motions – Kinematic links – Kinematic pairs – Kinematic chain – Types of joints in chains – Degree's of freedom – Application of plane mechanism – Inversion of mechanism – Inversions of quadric, single and double slider. **Straight Line Motion Mechanisms:** Exact and approximate copiers and generated types – Peaucellier, Hart's and Scott-Russell's mechanism – Grasshopper mechanism – Watt's-modified Scott- Russell mechanism – T.Chebicheff's and Robert mechanism – Pantograph.

UNIT-2: KINEMATICS OF LINKAGE MECHANISMS

Instantaneous Centre Method: Instantaneous center of rotation, centroids and axodes – Relative motion between two bodies – Three centers in-line theorem – Locating instantaneous centers for simple mechanisms and determination of angular velocity. **Relative Velocity Method:** Velocity and acceleration – Motion of link in machine – Determination of velocity and acceleration diagrams – Graphical method - Application of relative velocity method – Slider crank mechanism – Four bar mechanism. **Acceleration Method:** Acceleration diagrams for simple mechanisms, Coriolis acceleration and determination of Coriolis component of acceleration – Kleins construction – Analysis of slider crank mechanism for displacement, velocity and acceleration.

UNIT-3: STEERING MECHANISMS AND DRIVE SYSTEM

Steering Mechanisms: Conditions for correct steering – Davis steering gear – Ackerman's steering gear – Velocity ratio – Hooke's joint – Single and double Hooke's joint. **Drive Systems:** Belt, Rope and chain drives – Selection of belt drive – Types of belt drives – Materials used for belts and ropes – Velocity ratio of belt drives, slip of belt, creep of belt, tension for flat belt drive, angle of contact, centrifugal tension, maximum tension of belt. **Chains:** Length, angular speed ratio – Classification of chains (theory only).

UNIT-4: KINEMATICS OF CAM

Classification of cams and followers – Displacement diagrams – Uniform velocity, parabolic, simple harmonic and cycloidal motions – Derivatives of follower motions – Layout of plate cam profiles – Specified contour cams – Circular arc and tangent cams – Pressure angle and undercutting – sizing of cams.

UNIT-5: GEARS AND GEAR TRAINS

Gearing: Law of toothed gearing – Involute and cycloidal tooth profiles – Spur gear terminology – Gear tooth action – Contact ratio – Interference and undercutting – Helical, bevel, worm, rack and pinion gears. **Gear trains:** Gear trains – Speed ratio – Train value – Simple gear train – Compound and reverted gear train – Epicyclic gear trains.



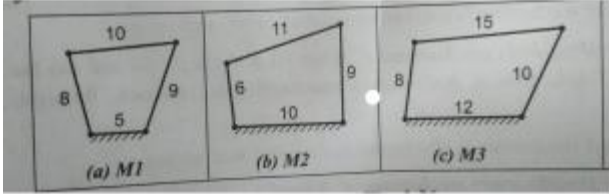
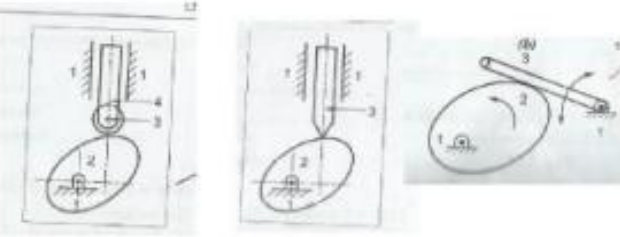
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Max Marks: **10**

S.No.	CO	Questions	BT
Unit I: (BASICS OF MECHANISMS)			
1	1	a. What is constrained motion and what are the different types of constrained motions? Give one example for each with suitable sketch b. Name the classification of the kinematics pairs with all the aspect	L2
2	1	a. Define the Grashof's law and identify the mechanism produced by the following linkage.  b. Explain about the Kutzbach criterion and why it is used? Show the proof?	L1
3	1	Define the term 'Degrees of Freedom'. And find the degrees of freedom for the following linkages. 	L3
4	1	a. Explain the working of beam engine with neat sketch b. Explain the working of Oscillating cylinder engine with neat sketch	L2
5	1	Explain the inversions of double slider crank chain with neat sketch and list out the practical applications of inversions.	L2
6	1	What are the practical applications of inversions of the 4 – bar linkage? Explain all with neat sketch	L2
7	1	Explain the inversions of single slider crank chain with neat sketch and list out the practical applications of inversions?	L2
8	1	Sketch and Describe the working of Harts mechanism	L3

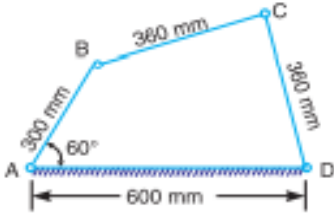
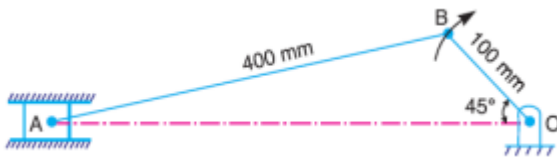
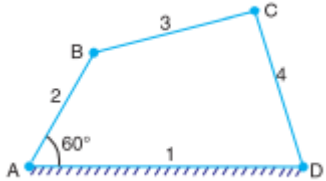


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9	1	Sketch and Describe the working of Peaucellier mechanism	L3
10	1	Sketch and Describe the Scott-Russell and Robert's straight-line motion mechanisms.	L3
Unit II: (KINEMATICS OF LINKAGE MECHANISMS)			
1	2	<p>In a pin jointed four bar mechanism, as shown in Fig. AB = 300 mm, BC = CD = 360 mm, and AD = 600 mm. The angle BAD = 60°. The crank AB rotates uniformly at 100 r.p.m. Locate all the instantaneous centres and find the angular velocity of the link BC</p> 	L4
2	2	<p>Locate all the instantaneous centres of the slider crank mechanism as shown in Fig. 6.12. The lengths of crank OB and connecting rod AB are 100 mm and 400 mm respectively. If the crank rotates clockwise with an angular velocity of 10 rad/s, find: 1. Velocity of the slider A, and 2. Angular velocity of the connecting rod AB</p> 	L4
3	2	<p>Locate all the instantaneous centres for a four bar mechanism as shown in Fig. 6.27. The lengths of various links are : AD = 125 mm ; AB = 62.5 mm ; BC = CD = 75 mm. If the link AB rotates at a uniform speed of 10 r.p.m. in the clockwise direction, find the angular velocity of the links BC and CD.</p> 	L4
4	2	<p>The mechanism of a wrapping machine, as shown in Fig. 6.18, has the following dimensions : O1A = 100 mm; AC = 700 mm; BC = 200 mm; O3C = 200 mm; O2E = 400 mm; O2D = 200 mm and BD = 150 mm. The crank O1A rotates at a uniform speed of 100 rad/s. Find the velocity of the point E of the bell crank lever by instantaneous centre method.</p>	L4



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5	2	<p>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 = 60°.</p>	L4
6	2	<p>In Fig. 7.9, 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 center 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</p>	L4
7	2	<p>a. What do you understand by the instantaneous centre of rotation in kinematic of machines? Answer briefly b. Explain the following terms: (a) Instantaneous center (b) Body center and space centre (c) Axode</p>	L2
8	2	<p>a. Explain with sketch the instantaneous centre method for determination of velocities of links and mechanisms b. Discuss the three types of instantaneous centres for a mechanism</p>	L2
9	2	<p>An engine mechanism is shown in Fig. The crank CB = 100 mm and the connecting rod BA = 300 mm with centre of gravity G, 100 mm from B. In the position shown, the crankshaft has a speed of 75 rad/s and an angular acceleration of 1200 rad/s². Find: 1. Velocity of G and angular velocity of AB, and 2. acceleration of G and angular acceleration of AB.</p>	L4



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10	2	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	L4
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Unit III: (STEERING MECHANISMS AND DRIVE SYSTEM)			
1	3	With neat sketch, explain the Ackerman steering gear of an automobile	L3
2	3	With neat sketch, explain the Davis steering gear of an automobile.	L3
3	3	What is the condition for correct steering ? Sketch and show the two main types of steering gears and discuss their relative advantages	L3
4	3	Derive an expression for the ratio of shafts velocities for Hooke's joint and draw the polar diagram depicting the salient features of driven shaft speed	L3
5	3	Two shafts with an included angle of 160° are connected by a Hooke's joint. The driving shaft runs at a uniform speed of 1500 r.p.m. The driven shaft carries a flywheel of mass 12 kg and 100 mm radius of gyration. Find the maximum angular acceleration of the driven shaft and the maximum torque required	L4
6	3	The angle between the axes of two shafts connected by Hooke's joint is 18° . Determine the angle turned through by the driving shaft when the velocity ratio is maximum and unity.	L4
7	3	An open belt 100 mm wide connects two pulleys mounted on parallel shafts with their centres 2.4 m apart. The diameter of the larger pulley is 450 mm and that of the smaller pulley 300 mm. The coefficient of friction between the belt and the pulley is 0.3 and the maximum stress in the belt is limited to 14 N/mm width. If the larger pulley rotates at 120 r.p.m., find the maximum power that can be transmitted.	L4
8	3	Obtain an expression for the length of a belt in a) an open belt drive ; and b) Cross belt drive.	L3



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9	3	Derive the condition for transmitting the maximum power in a flat belt drive.	L3
10	3	What are different types of chains? Explain, with neat sketches, the power transmission chains.	L3

S.No.	CO	Questions	BT
Unit IV: (KINEMATICS OF CAM)			
1	4	Use the following data in drawing the profile of a cam in which a knife-edged follower is raised with uniform acceleration and deceleration and is lowered with simple harmonic motion: Least radius of cam = 60 mm, Lift of follower = 42 mm, Angle of ascent = 60° Angle of dwell between ascent and descent = 40°, Angle of descent = 72°. If the cam rotates at 180 rpm, determine the maximum velocity and acceleration during ascent and descent.	L4
2	4	A cam is to give the following motion to a knife-edged follower : 1. Outstroke during 60° of cam rotation; 2. Dwell for the next 30° of cam rotation; 3. Return stroke during next 60° of cam rotation, and 4. Dwell for the remaining 210° of cam rotation. 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 the axis of the follower is offset by 20 mm from the axis of the cam shaft.	L4
3	4	A cam is to be designed for a knife edge follower with the following data: 1. Cam lift = 40 mm during 90° of cam rotation with simple harmonic motion. 2. Dwell for the next 30°. 3. During the next 60° of cam rotation, the follower returns to its original position with simple harmonic motion. 4. Dwell during the remaining 180°. Draw the profile of the cam when the line of stroke of the follower passes through the axis of the cam shaft. The radius of the base circle of the cam is 40 mm. Determine the maximum velocity and acceleration of the follower during its ascent and descent, if the cam rotates at 240 r.p.m.	L4
4	4	Explain with sketches the different types of followers. Write short notes on cams	L1
5	4	Define the following terms (i). Cam (ii). Follower (iii) Offset follower (iv) Radial follower (v) Mushroom follower	L2
6	4	Define the following terms as applied to cam with a neat sketch :- (a) Base circle, (b) Pitch circle, (c) Pressure angle, and (d) Stroke of the follower.	L2



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7	4	Draw the displacement, velocity and acceleration diagrams for a follower when it moves with simple harmonic motion. Derive the expression for velocity and acceleration during outstroke and return stroke of the follower	L2
8	4	A cam, with a minimum radius of 50 mm, rotating clockwise at a uniform speed, is required to give a knife edge follower the motion as described below : 1. To move outwards through 40 mm during 108° rotation of the cam; 2. To dwell for next 70°; 3. To return to its starting position during next 72°, and 4. To dwell for the rest period of a revolution i.e. 110°. Draw the profile of the cam, When the line of stroke of the follower is off-set by 15 mm right side of the cam axis. The displacement 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.	L4
9	4	A cam operating a knife-edged follower has the following data: a) Follower moves outwards through 40 mm during 60° of cam rotation. b) Follower dwells for the next 45°. c) Follower returns to its original position during next 90°. d) Follower dwells for the rest of the 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 50 mm. Draw the profile of the cam when the axis of the follower passes through the cam axis. If the cam rotates at 300 r.p.m., determine maximum velocity and acceleration of the follower during the outward stroke and the return stroke	L4
10	4	A cam, with a minimum radius of 25 mm, rotating clockwise at a uniform speed is to be designed to give a roller follower, at the end of a valve rod, motion described below : 1. To raise the valve through 50 mm during 120° rotation of the cam; 2. To keep the valve fully raised through next 30°; 3. To lower the valve during next 60°; and 4. To keep the valve closed during rest of the revolution i.e. 150°; The diameter of the roller is 20 mm and the diameter of the cam shaft is 25 mm. Draw the profile of the cam when the line of stroke of the valve rod passes through the axis of the cam shaft. The displacement of the valve, while being raised and lowered, is to take place with simple harmonic motion. Determine the maximum acceleration of the valve rod when the cam shaft rotates at 100 r.p.m	L4

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Unit V: (GEARS AND GEAR TRAINS)			
1	5	State and prove the law of gearing. Show that involute profile satisfies the conditions for correct gearing.	L2
2	5	Derive an expression for the velocity of sliding between a pair of involute teeth. State the advantages of involute profile as a gear tooth profile	L3



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3	5	A pinion having 30 teeth drives a gear having 80 teeth. The profile of the gear is involute with 20 degree pressure angle 12 mm module and 10 mm addendum. Find the length of path of contact, arc of contact and the contact ratio	L4
4	5	Derive an expression for the length of the arc of contact in a pair of meshed spur gears.	L2
5	5	Two involute gears of 20° pressure angle are in mesh. The number of teeth on pinion is 20 and the gear ratio is 2. If the pitch expressed in module is 5 mm and the pitch line speed is 1.2 m/s, assuming addendum as standard and equal to one module, find : 1. The angle turned through by pinion when one pair of teeth is in mesh ; and 2. The maximum velocity of sliding	L4
6	5	The number of teeth on each of the two equal spur gears in mesh is 40. The teeth have 20° involute profile and the module is 6 mm. If the arc of contact is 1.75 times the circular pitch, find the addendum.	L4
7	5	In a reverted epicyclic gear train, the arm A carries two gears B and C and a compound gear D - E. The gear B meshes with gear E and the gear C meshes with gear D. The number of teeth on gears B, C and D are 75, 30 and 90 respectively. Find the speed and direction of gear C when gear B is fixed and the arm A makes 100 r.p.m. clockwise.	L3
8	5	An epicyclic gear consists of three gears A, B and C as shown in Fig. 13.10. The gear A has 72 internal teeth and gear C has 32 external teeth. The gear B meshes with both A and C and is carried on an arm EF which rotates about the center of A at 18 r.p.m.. If the gear A is fixed, determine the speed of gears B and C	L3
9	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 center 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?	L3

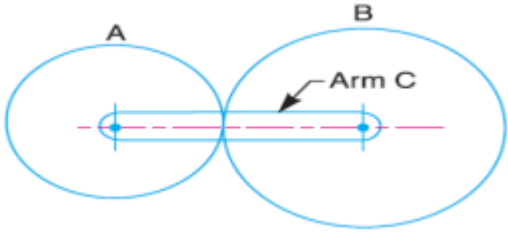
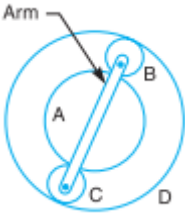


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10	5	<p>An epicyclic train of gears is arranged as shown in Fig.13.11. How many revolutions does the arm, to which the pinions B and C are attached, make : 1. when A makes one revolution clockwise and D makes half a revolution anticlockwise, and 2. when A makes one revolution clockwise and D is stationary ? The number of teeth on the gears A and D are 40 and 90 respectively.</p> 	L3

Note: L1-Remembering, L2-Understanding, L3-Applying, L4-Analyzing, L5-Evaluating, and L6-Creating

Instruction to Faculty Members:

The Six Levels of Bloom's Taxonomy:

1. **Remembering:** Retrieving, recognizing, and recalling relevant knowledge from long-term memory (e.g., list, define, name, locate).
2. **Understanding:** Constructing meaning, explaining ideas, or concepts (e.g., summarize, interpret, classify, compare).
3. **Applying:** Using information in new situations or implementing procedures to solve problems (e.g., solve, use, demonstrate, implement).
4. **Analyzing:** Breaking material into constituent parts, determining how the parts relate to one another and to an overall structure (e.g., contrast, categorize, distinguish, diagram).
5. **Evaluating:** Making judgments based on criteria and standards through checking and critiquing (e.g., judge, critique, justify, defend, argue).
6. **Creating:** Putting elements together to form a coherent or functional whole; reorganizing elements into a new pattern or structure (e.g., design, construct, develop, formulate).