KINEMATICS OF MACHINES

IV Semester: ME								
Course Code	**Category**		**Hours / Week**		**Credits**	**Maximum Marks**		
AMEB10	**CORE**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	1	-	4	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

COURSE OBJECTIVES:
The student will try to learn:

I. The basic concepts of Machine design to develop Mechanisms and Machines by using type synthesis , number synthesis and dimensional synthesis.
II. The Kinematics from the geometric point of view to determine mobility ,velocity and acceleration using graphical methods.
III. The Mechanisms with lower pairs to obtain steering, copying and straight line motions in automobiles and other allied applications.
IV. The Kinematic analysis and synthesis of cams (higher pairs) imparting motion to knife edged, roller and mushroom followers, Gears and Gear trains.

COURSE OUTCOMES :
After successful completion of the course, students will be able to:

CO 1   **List** the types of the kinematic synthesis for building a mechanism/Machine for mobility.

CO 2   **Identify** kinematic links , pairs and chains based on type, motion and mechanical constraint for designing mechanism and machine inversions using Grumbler's and Grashaf's criterion.

CO 3   **Explain** the performance of quadratic cycle chain, slider crank mechanism, and double slider crank mechanism and cross slider mechanism.

CO 4   **Interpret** link relative motion and apply Graphical methodsfor computing velocity and accelerations by drawing configuration diagrams in mechanisms.

CO 5   **Identify** the mechanisms like Pantograph, Paucellier, Hart, Scott-Russelfor copying and generating exact, approximate straight line motions using lower pairs.

CO 12   **Select** the condition for correct steering mechanisms I-centre method usedin Automobile applications.

CO 7   **Demonstrate** the polar velocity diagramfor determining velocity ratios of single and double Hooke's joint in automotive applications.

CO 8   **Develop** Cam profiles for different kinds displacement programs using various kinds of fallowers usedin machines and automotive applications.

CO 9   **Understand** the geometry of gears and deduce the conditionsfor meshing with minimum number of teeth

CO 10   **Classify** different gear trains for motion transmission and discuss design specific requirements.

CO 11   **Illustrate** the design function of planetary gear train system and its methods of evaluationfor train value.

CO 12   **Make use of** Epicyclic Gear trains including Automotive transmission, Humpy's reduction gear, Ferguson's paradox to determine speed reduction

CO 13   **Explain** the difference between Structure, Mechanism and Machine to eliminate redundant linkages

CO 14	**Demonstrate** mobility of mechanisms with lower and higher pairs using CAD simulation software.

Module-I	**MECHANISMS & MACHINES**

Mechanisms: Elements or links, classification, rigid link, flexible and fluid link, types of kinematic pairs types of constrained motion, kinematic chain, mechanism, machine, structure, inversion of mechanism, inversions of quadric cycle chain, single and double slider crank chains, mechanical advantage, Grubler's Criterion

Module-II	**KINEMATICS, PLANE MOTION OF BODY, ANALYSIS OF MECHANISMS**

Kinematics: Velocity and acceleration, motion of link in machine, determination of velocity and acceleration, Graphical method, application of relative velocity method, plane motion of body: Instantaneous center of rotation, centroids and axodes, three centers in line theorem, graphical determination of instantaneous center, determination of angular velocity of points and links by instantaneous center method. Klein's construction, Coriolis acceleration, determination of Coriolis component of acceleration; Analysis of mechanisms: Analysis of slider crank chain for displacement, velocity and acceleration of slider, acceleration diagram for a given mechanism.

Module-III	**STRAIGHT LINE MOTION MECHANISMS, STEERING GEARS, HOOKE'S JOINT**

Straight-line motion Mechanisms: Exact and approximate copied and generated types, Peaucellier, Hart and Scott Russel, Grasshopper, Watt, TChebicheff and Robert mechanisms, pantograph.

Steering gears: Conditions for correct steering, Davis Steering gear, Ackerman's steering gear, Hooke's joint: Single and double Hooke's joint, velocity ratio, application, problems.

Module-IV	**CAMS, ANALYSIS OF MOTION OF FOLLOWERS**

Cams: Definitions of cam and followers, their uses, types of followers and cams, terminology, types of follower motion, uniform velocity, simple harmonic motion and uniform acceleration; Maximum velocity and maximum acceleration during outward and return strokes in the above three cases; **Analysis of motion of followers**: Tangent cam with roller follower, circular arc cam with straight, concave and convex flanks

Module-V	**HIGHER PAIRS, GEAR TRAINS**

Higher Pairs: friction wheels and toothed gears, types, law of gearing, condition for constant velocity ratio for transmission of motion, velocity of sliding, form of teeth, cycloidal and involute profiles, phenomena of interferences, methods of interference; Condition for minimum number of teeth to avoid interference, expressions for arc of contact and path of contact of pinion and gear pinion and rack arrangements; Introduction to helical, bevel and worm gearing; Gear trains: Introduction, types, simple and reverted gear trains, epicyclic gear train; Methods of finding train value or velocity ratio of epicyclic gear trains, selection of gear box, differential gear for an automobile.

Text Books:

1. Amithab Ghosh, Asok Kumar Malik, "Theory of Mechanisms and machines", East West Press Pvt Ltd, 2001.
2. S.S Ratan, "Theory of Machines", Tata McGraw-Hill, 4th Edition,2014.
3. J. S. Rao, R.V. Dukkipati "Mechanism and Machine Theory / New Age Publications", 1996.
4. P. L. Ballaney, "Theory of Machines", Khanna Publishers, 3rd Edition, 2003

Reference Books:

1. Dr Jagdish Lal, J. M. Shaw "Theory of Machines", 1st Edition, 1985.
2. Abdulla Sharif, Dhanpat Rai, "Theory of Machines", 5th Edition, 1987,

3. Neil Sclater, P. Nicholas, Chironis "Mechanisms and Mechanical Devices Sourcebook", New York McGraw-Hill, publications, 3rd Edition.1963

4 J. E. Shigley, R. Charles, Mischke,"Mechanical engineering and design", TMH,1st Edition, 2003.

Web References:

1. https://en, wikipedia.org/wiki/Mechanism_(engineering)
2. https://en, wikipedia.org/wiki/Machine_(mechanical)
3. https://en, wikipedia.org/wiki/Crank_(mechanism)

E-Text Books:

1. https://engineeringstudymaterial.net/ebook/mechanisms-and-mechanical-devices-sourcebook/
2. https://accessengineeringlibrary.com/browse/mechanisms-and-mechanical-devices-sourcebook-fifth-edition
3. https://www,amazon,com/Mechanisms-Mechanical-Devices-Sourcebook-Fourth-ebook/dp/B0062Y 79H0#navbar/