

MECHANISM AND MACHINE DESIGN

V Semester: AE								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AAE523	Elective	L	T	P	C	CIA	SEE	Total
		3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

COURSE OBJECTIVES:
The course should enable the students to:

- Understand the basic principles of kinematics and the related terminology of machines.
- Discriminate mobility; enumerate links and joints in the mechanisms.
- Formulate the concept of analysis of different mechanisms.
- Understand the working of various straight line mechanisms, gears, gear trains, steering gear mechanisms, cams and a Hooke's joint.
- Analyze a mechanism for displacement, velocity and acceleration of links in a machine.

COURSE OUTCOMES (COs):

CO 1: Describe the concept of mechanisms and machines in which all the links and their mechanism studied.

CO 2: Determine the velocity and acceleration diagrams for different mechanisms using graphical methods.

CO 3: Understand the concept of plane motion of body and gyroscopic motion precession in which gyroscopic mechanism is studied.

CO 4: Explore the concept of cams and followers, steering gear mechanism to understand real time applications of mechanisms.

CO 5: Introduction to gears and gear mechanism where different tooth profiles of gear is designed.

COURSE LEARNING OUTCOMES (CLOs):

- Classifications of the kinematic links, kinematic pairs and formation of the kinematic chain.
- Distinguish between mechanism and machine.
- Design and develop inversions of quadratic cycle chain, slider crank mechanism, and double slider crank mechanism and cross slider mechanism.
- Demonstrate type synthesis, number synthesis and dimensional synthesis.
- Construct Graphical methods of velocity polygon and acceleration polygons for a given configuration diagram.
- Understand other methods of acceleration diagrams like Klien's construction.
- Develop secondary acceleration component i.e Correlli's component involving quick return mechanisms
- Alternative approach for determining velocity by using I centers and centroids methods.
- Significance of exact and approximate straight line mechanisms.
- Application of straight line mechanism in steam engine indicators.
- Applications of Ackerman's and Davi's steering mechanisms in automobiles.
- Develop the condition for exact steering.
- Develop the polar velocity diagram for a single hook joint and double hook joint and develop condition for unity for higher and lower speeds.
- Study different displacement profiles applicable in I.C engines cam shafts.

15.	Plot the displacement, velocity and acceleration profiles with respect to time.	
16.	Understand the geometry of gears and deduce the expression for arc of contact.	
17.	Derive the expression for minimum number of teeth to avoid interference in case of pinion and gear as well as rack and pinion.	
18.	Application of different gear trains including epi-cyclic and deduce the train value using tabular and relative velocity method.	
19.	Significance of differential gear box in an automobile while taking turn on the road.	
20.	Enable the students to understand the importance of theory of machines for lifelong learning, Higher Education and competitive exams.	
UNIT I	MECHANISMS & MACHINES	Classes: 09
Elements of links, classification, rigid link, flexible and fluid link, types of kinematic pairs, sliding, turning, rolling, screw and spherical pairs, lower and higher pairs, closed and open pairs, constrained motion, completely, partially or successfully constrained, and incompletely constrained, mechanism and machines, classification, kinematic chain, inversion of mechanism, inversion of quadratic cycle, chain, single and double slider crank chains; Exact and approximate straight line mechanisms: Paucellier, hart t, Chibichief, pantograph.		
UNIT II	KINEMATIC ANALYSIS OF MECHANISMS	Classes: 09
Velocity and acceleration, motion of link in machine, determination of velocity and acceleration diagrams, graphical method, application of relative velocity method for four bar chain, analysis of slider crank chain for displacement, velocity and acceleration of sliding, acceleration diagram for a given mechanism, Kleins construction, Coriolis acceleration, determination of Coriolis component of acceleration.		
UNIT III	PLANE MOTION OF BODY & GYROSCOPIC MOTION PRECESSION	Classes: 09
Instantaneous centre of rotation, centroids and axodes, relative motion between two bodies, three centres in line theorem, graphical determination of instantaneous centre, diagrams for simple mechanisms and determination of angular velocity of points and links. The gyroscope, free and restrained, working principle, the free gyro, rate gyro, integrating gyro as motion measuring instruments, effect of precession on the stability of vehicles, motorbikes, automobiles, airplanes and ships, static and dynamic forces generated due to in precession in rotating mechanisms.		
UNIT IV	CAMS AND FOLLOWERS, STEERING GEARS	Classes: 09
Cams and followers, definition uses, types, terminology, types of follower motion, uniform velocity, simple harmonic motion and uniform acceleration, maximum velocity and acceleration during outward and return strokes, roller follower, circular cam with straight, concave and convex flanks, condition for correct steering, Davis steering gear, Ackerman's steering gear, velocity ratio, hook's joint, single and double hooks joint, universal coupling, applications.		
UNIT V	GEARS AND GEAR TRAINS, DESIGN OF FOUR BAR MECHANISMS	Classes: 09
Introduction to gears: Types, law of gearing; Tooth profiles: Specifications, classification, helical, bevel and worm gears, simple and reverted gear train, epicyclic gear trains, velocity ratio or train value, four bar mechanism, Freudenstein equation, Precession point synthesis, Chebyshev's method, structural error.		
Text Books:		
1. Amithab Ghosh, Asok Kumar Malik, —Theory of Mechanisms and machines, East West Press Pvt Ltd, 2001. 2. J. S. Rao, R.V. Duddipati —Mechanism and Machine Theory / New Age Publications, 1996.		
Reference Books:		
1. Jagadish Lal, "Theory of Mechanisms and Machines", Metropolitan Book Company, 1 st Edition, 1978. 2. P. L. Ballaney, —Theory of Machines, Khanna Publishers, 3 rd Edition, 2003.		

Web References:
1. http://link.springer.com/book 2. http://www.sciencedirect.com/science 3. http://www.e-booksdirectory.com
E-Text Books:
1. https://www.sapnaonline.com/books/theory-of-mechanisms-machines-4838273 2. https://www.amazon.in/Mechanism-Machine-Theory-J-S-Rao/dp/812240426X 3. http://www.ieidurgapurlc.org/index.php/library-books/