MECHANISM AND MACHINE DESIGN

VI Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAEB43	Professional Elective	3	-	-	3	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 concepts on four bar, single and double slider mechanisms and their inversions in analyzing the relative motions of links for engineering applications.
II	The kinematic analysis of planar mechanisms using instantaneous and relative velocity methods for describing the position, velocity and acceleration of moving links.
III	The mechanisms of power transmission among the shafts using cams, belts, toothed gearing and Gear trains in aerospace and aligned engineering industries.
IV	The effects of gyroscopic couples and rotating masses in designing of aircraft and machine components

COURSE OUTCOMES :

CO 1	**Demonstrate** the principles of kinematic pairs, chains and their classification for planar mechanisms based on pairs and joints.
CO 2	**Identify** the mechanisms, inversions of kinematic chins and mobility of mechanisms using Grumbler's and Grashaf's criterion for engineering applications
CO 3	**Analyze** the planar mechanisms for position, velocity and acceleration using instantaneous center method and graphical approach.
CO 4	**Choose** the appropriate belt drives for power transmission between the shafts based on follower rotation for industrial needs.
CO 5	**Identify** the displacement diagram of follower and cam profile for the specified motions of the follower in aerospace and allied engineering fields using cam terminologies
CO 6	**Demonstrate** the gear tooth geometry for selection of appropriate gears for power transmission at desired speeds in engineering fields
CO 7	**Analyze** the speed and torque of simple, compound and epicyclic gear trains for designing gear boxes in real field applications
CO 8	**Make use of** the effect of gyroscopic couple for stabilization of ship, Aero-plane, two and four wheeler vehicles during steering, pitching and rolling
CO 9	**Demonstrate** the methods for reducing undesirable effects of unbalanced masse, when rotating same or different planes using graphical and analytical methods
CO 10	**Apply** the fundamentals of Mechanism and Machine design for real world problems in obtaining optimum solutions of aircraft design problems.

MODULE-I MECHANISMS & MACHINES

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;

MODULE-II	KINEMATIC ANALYSIS OF MECHANISMS

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.

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

MODULE-III	BELT DRIVES, AND CAMS AND FOLLOWERS

Belt Drives: Types of Belts, Material used for Belts, Types of Flat Belt Drives, Velocity Ratio of Belt Drive. Length of Open Belt Drive. Power Transmitted by a Belt. Ratio of Driving Tensions for Flat Belt Drive. Centrifugal Tension. Maximum Tension in the Belt. Initial Tension in the Belt.

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.

MODULE-IV	GEARS AND GEAR TRAINS

Gears And Gear Trains: 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.

Gear trains: Introduction, types, simple and reverted gear trains, epicyclic gear train; Methods of finding train value or velocity ratio of epicyclic gear trains

MODULE-V	GYROSCOPIC COUPLE AND PRECESSION MOTION AND BALANCING OF ROTATING MASSES

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

Introduction. Balancing of Rotating Masses; Balancing of a Single Rotating Mass By a Single Mass Rotating in the Same Plane; Balancing of a Single Rotating Mass By Two Masses Rotating in Different Planes; Balancing of Several Masses Rotating in the Same Plane; Balancing of Several Masses Rotating in Different Planes

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/B0062Y79H0#navbar/