INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

MECHANISM AND MACHINE DESIGN								
V Semester: AE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
AAED19	**Elective**	3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Mechanics of Solids								

I. COURSE OVERVIEW:

This is a basic course on modeling, design, integration and best practices for use of machine elements such as bearings, springs, gears, cams and mechanisms. Modeling and analysis of these elements is based upon extensive application of physics, mathematics and core mechanical engineering principles (solid mechanics, fluid mechanics, manufacturing, estimation, computer simulation, etc.). These principles are reinforced via laboratory experiences wherein students conduct experiments and disassemble machines and substantial design project wherein students' model, design, fabricate and characterize a mechanical system that is relevant to a real-world application.

II. COURSES OBJECTIVES:

The students will try to learn

I. The basic mechanism involved in machine design and basic relative kinematics relations of two moving point.
II. The individual links and categorize the type of the connection of the links (joints) for the mechanism of machines.
III. The fundamentals of specific link and joint combinations such as gyroscopic motion, followers, cam and gear systems.
IV. The kinematic analysis and develop analytical equations describing the relative position, velocity and acceleration of all moving links.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO 1 Summarize the various mechanisms like links, pairs, chains etc., for creating various combinations to be used in machines.
CO 2 Interpret the kinematics used in creating various mechanisms for understanding the resultant motion of the particular machine.
CO 3 Discover the use of belt drives used in machines and their conditions for transmitting power across machines.
CO 4 Employ the cam and follower mechanism for creating timed mechanisms in a machine for intermittent motions.
CO 5 Breakdown the use of gears and gear trains in machines for better transmissibility of power and work.
CO 6 Evaluate gyroscopic couple and principle of balancing masses to stabilize rotating masses to get precession motion.

IV. COURSE CONTENT:

MODULE-I: MECHANISMS & MACHINES (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.

MODULE-II: KINEMATIC ANALYSIS OF MECHANISMS (09)

Instantaneous centre of rotation, centroids and axodes, relative motion between two bodies, three centers 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: AXIAL FLOW COMPRESSORS AND TURBINES (09)

Belt Drives: Types of belts, material used for belts, types of flat belt drives, and 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 (09)

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 (09)

Angular Motion: Gyroscopes - Processional Angular Motion; Gyroscopic Couple; effect of precession motion on the stability of moving vehicles such as motorcycle - motorcar - aero planes and ships. 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.

V. 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.

VI. 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.

VII. ELECTRONICS RESOURCES:

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

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Tech talk topics
4. Open end experiments
5. Definitions and terminology
6. Assignments
7. Model question paper – I
8. Model question paper - II
9. Lecture notes
10. E-learning readiness videos (ELRV)
11. Power point presentation