Semester - V

THEORY OF MACHINES			
Course Code	21ME51	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2-2-0-0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course objectives:

- To understand the concept of machines, mechanisms and to analyze a mechanism for displacement, velocity and acceleration at any point in a moving link.
- To understand the force-motion relationship in components subjected to external forces and analysis of standard mechanisms
- To understand the theory of gears and gear trains.
- To understand the undesirable effects of unbalances resulting from prescribed motions in mechanism.
- To understand the principles in mechanisms used for speed control and stability control.
- To compute the natural and damped frequencies of free 1-DOF mechanical systems and to analyze the vibrational motion of 1-DOF mechanical systems under harmonic excitation conditions.

Teaching-Learning Process (General Instructions)

These are sample strategies, which teachers can use to accelerate the attainment of the various course outcomes.

➢ Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.

➢ Chalk and Talk method for Problem Solving.

➢ Adopt flipped classroom teaching method.

➢ Adopt collaborative (Group Learning) learning in the class.

➢ Adopt Problem Based Learning (PBL), which fosters students' analytical skills and develops thinking skills such as evaluating, generalizing, and analysing information.

Module-1
Introduction: Mechanisms and machines, Kinematic pairs-types, degree of freedom, Kinematic chains and their classification, Kinematic inversions,   **Velocity and Acceleration analysis of planar mechanisms Graphical method:** Velocity and Acceleration Analysis of Mechanisms Velocity and acceleration analysis of four bar mechanism, slider crank mechanism. Mechanism illustrating Corioli's component of acceleration. Angular velocity and angular acceleration of links, velocity of rubbing.   **Velocity and Acceleration Analysis of Mechanisms (Analytical Method):** Velocity and acceleration analysis of four bar mechanism, slider crank mechanism using complex algebra method.

Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board

Module-2
Static force analysis: Static equilibrium, analysis of four bar mechanism, slider crank mechanism.   **Dynamic force analysis:** D'Alembert's principle, analysis of four bar and slider crank mechanism.   **Flywheel:** Introduction to Flywheel and calculation of its size for simple machines like punching machine, shearing machine

Teaching-Learning Process	. 1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving./White board

Module-3

Spur Gears: Gear terminology, law of gearing, path of contact, arc of contact, contact ratio of spur gear. Interference in involute gears, methods of avoiding interference, condition and expressions for minimum number of teeth to avoid interference.

Gear Trains: Simple gear trains, compound gear trains. Epicyclic gear trains: Algebraic and tabular methods of finding velocity ratio of epicyclic gear trains, torque calculation in epicyclic gear trains. Discussions on applications of gear trains.

Teaching-Learning Process	1. Power-point Presentation,
	2. Video demonstration or Simulations,
	3. Chalk and Talk are used for Problem Solving./White board

Module-4

Balancing of Rotating Masses: Static and Dynamic Balancing, Balancing of single rotating mass by balancing masses in same plane and in different planes. Balancing of several rotating masses by balancing masses in same plane and in different planes. Discussions on applications.

Balancing of Reciprocating Masses: Inertia Effect of crank and connecting rod, Single cylinder Engine, Balancing in multi cylinder-inline engine (primary and secondary forces). Discussions on applications

Governors:Types of Governors; Force Analysis of Porter and Hartnell Governors. Controlling Force, Stability, Sensitiveness, Isochronism, Effort and Power. Discussion on applications.

Teaching-Learning Process	1. Power-point Presentation,
	2. Video demonstration or Simulations,
	3. Chalk and Talk are used for Problem Solving./White board

Module-5

Free vibrations: Basic elements of vibrating system, Types of free vibrations, Longitudinal vibrations- Equilibrium method, D'Alembert's principle, Determination of natural frequency of single degree freedom systems, Damped free vibrations: Under damped, over damped and critically damped systems. Logarithmic decrement.

Forced vibrations: Undamped forced vibration of spring mass system, Damped forced vibrations, Rotating unbalance, Reciprocating unbalance, Vibration isolation, Critical speed. Discussions on applications.

Teaching-Learning Process	1. Power-point Presentation,
	2. Video demonstration or Simulations,
	3. Chalk and Talk are used for Problem Solving./White board

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

- Knowledge of mechanisms and their motion and the inversions of mechanisms
- Analyse the velocity, acceleration of links and joints of mechanisms..
- Analyse the mechanisms for static and dynamic equilibrium.
- Carry out the balancing of rotating and reciprocating masses
- Analyse different types of governors used in real life situation.
- Analyze the free and forced vibration phenomenon.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour)**

➤ First test at the end of 5th week of the semester
➤ Second test at the end of the 10th week of the semester
➤ Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

➤ First assignment at the end of 4th week of the semester
➤ Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

➤ At the end of the 13th week of the semester
➤ The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject **(duration 03 hours)**

➤ The question paper will have ten questions. Each question is set for 20 marks.Marks scored shall be reduced proportionally to 50 marks
➤ There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

Suggested Learning Resources:

Books

1 Theory of Machines Kinematics and Dynamics Sadhu Singh Pearson Third edition 2019
2 Mechanism and Machine Theory G. Ambekar PHI 2009

Reference Books

1 Theory of Machines Rattan S.S Tata McGraw-Hill Publishing Company 2014
2 Mechanisms and Machines- Kinematics, Dynamics and Synthesis Michael M Stanisic Cengage Learning 2016

Web links and Video Lectures (e-Resources):

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Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

• Course Seminar
• Term project
• Assignment

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