NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. in Mechanical Engineering
Course Code:	2ME501
Course Title:	Theory of Machines
Course Type:	Core
Year of introduction:	2023-24

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Course Learning Outcomes (CLOs):

After successful completion of the course, student will be able to –

1 infer the concepts of machines and mechanisms, (BL2)
2 analyse the kinematics of planar mechanisms, (BL4)
3 solve the static and dynamic forces in planar mechanisms, (BL3)
4 appraise various motion transmission elements such as gears, gear trains and cams. (BL5)

Syllabus: **Total Teaching Hours: 30**

Unit	Syllabus	Teaching Hours
Unit I	**Links & Mechanism** Links- kinematics pairs, Higher and lower pairs, Constraints, Degrees of freedom of mechanism, Four-bar chain and slider-crank chain mechanism and their inversions, Straight line motion mechanism, Steering gear mechanisms, Condition for correct steering, Davis and Ackermann steering gears.	**07**
Unit II	**Motion analysis** Velocity and acceleration in machine parts, Instantaneous centre method, Centrode and its laws, Velocity and acceleration diagrams for simple kinematic mechanisms (vector and graphical approach), Computer aided kinematic analysis of mechanism like slider-crank mechanism and four-bar mechanism.	**08**
Unit III	**Gears, Cams and Gyroscope** Classification of gears, Terminology, Law of gearing, Forms of teeth, Path of contact of gears, Arc of contact of gears, Contact ratio, Interference in involute gears, Minimum number of teeth required in gears, Undercutting, Simple gear train, Compound gear trains, Reverted gear trains, Epicyclic gear trains, Analysis of epicyclic gear train, Types of cams and followers and related terminology, Follower displacement diagram, Derivatives of follower motion, Layout of cam	**06**

profile, Analysis of an elastic cam system, Gyroscopic couple, Gyroscopic effect on aeroplanes and naval ships, Stability of an automobile (two-wheeler)

Unit IV **Static and Dynamic force analysis** **09**

Static equilibrium of two force and three force members, Members with two force and a torque, Free body diagrams, Superposition, Principle of virtual work, D' Alembert's principle, Equivalent offset inertial force, Dynamic analysis of four bar chain and slider crank mechanism, Turning moments of crankshaft, Dynamically equivalent systems, Inertia of connecting rod, Inertia forces in reciprocating engines, Fluctuation of energy, Flywheels

Self – Study: The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory Work: Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated

Suggested Readings/References:

1. Rattan S. S., Theory of Machines, Tata McGraw Hill Education
2. Norton R. L., Kinematics and Dynamics of Machinery, Tata McGraw Hill Education
3. Ambekar A. G., Mechanism and Machine Theory, PHI Learning Private Ltd.
4. Ghosh Amitabha & Mallik Ashok Kumar, Theory of Mechanisms and Machines, East West Press.
5. Uicker J.J., Pennock G.R., Shigley J.E., Theory of Machines and Mechanisms, Oxford University Press.
6. Rao J.S and Dukkipati R.V., Mechanism and Machine Theory, Wiley-Eastern Ltd., New Delhi.
7. Hannah John and Stephens R.C, Mechanics of Machines, Edward Arnold

Suggested list of experiments: (not restricted to the following)

Sr. No.	Title	Hours
1.	Static force analysis of planner mechanism – graphical method	2
2.	Static force analysis of planner mechanism using superposition method – graphical method	2
3.	Static force analysis of planner mechanism – analytical approach	2
4.	Dynamic force analysis of planner mechanism – graphical method	2
5.	Dynamic force analysis of planner mechanism – analytical approach	2
6.	Development of cam profile	4
7.	Estimation of cam jump speed	2
8.	Study of the simple, compound, and reverted gear trains	2
9.	Velocity analysis of epicyclic gear trains	2
10.	Determine the gyroscopic couple	2
11.	Estimation of degrees of freedom of planner mechanism	2
12.	Velocity analysis of planner mechanism using graphical approach	2
13.	Acceleration analysis of planner mechanism using graphical approach	2