Course Code	Course Name	Credits
MEC403	**Kinematics of Machinery**	**03**

Objectives:

1. To acquaint with basic concept of kinematics and kinetics of machine elements
2. To familiarize with basic and special mechanisms
3. To study functioning of motion and power transmission machine elements

Outcomes: Learner will be able to…

1. Identify various components of mechanisms
2. Develop mechanisms to provide specific motion
3. Draw velocity and acceleration diagrams of various mechanisms
4. Choose a cam profile for the specific follower motion
5. Predict condition for maximum power transmission in the case of a belt drive
6. Illustrate requirements for an interference-free gear pair

Module	Content	Hrs.
1	**1.1 Kinetics of Rigid Bodies** Concept of mass moment of inertia and its application to standard objects. Kinetics of rigid bodies: Work and energy Kinetic energy in translating motion, Rotation about fixed axis and in general plane motion, Work energy principle and Conservation of energy **1.2 Basic Kinematics** Structure, Machine, Mechanism, Kinematic link & its types, Kinematic pairs, Types of constrained motions, Types of Kinematic pairs, Kinematic chains, Types of joints, Degree of freedom (mobility), Kutzbach mobility criterion, Grűbler's criterion & its limitations Four bar chain and its inversions, Grashoff's law, Slider crank chain and its inversions, Double slider crank chain and its inversions	**07**
2	**Special Mechanisms** (No problems on this module) **2.1 Straight line generating mechanisms:** Introduction to Exact straight line generating mechanisms - Peaucillier's and Hart's Mechanisms, Introduction to Approximate Straight line generating mechanisms- Watt's, Grasshopper mechanism, Tchebicheff's mechanisms **2.2 Offset slider crank mechanisms** - Pantograph, Hook-joint (single and double). **2.3 Steering Gear Mechanism** - Ackerman, Davis steering gears	**04**
3	**3.1 Velocity Analysis of Mechanisms (mechanisms up to 6 links)** Velocity analysis by instantaneous centre of rotation method (Graphical approach), Velocity analysis by relative velocity method (Graphical approach) **3.2 Acceleration Analysis of Mechanisms (mechanisms up to 6 links)** Acceleration analysis by relative method including pairs involving Coriolis acceleration (Graphical approach)	**10**
4	**Cam and Follower Mechanism** 4.1 Cam and its Classification based on shape, follower movement, and manner of constraint of follower; Followers and its Classification based on shape, movement, and location of line of movement; Cam and follower terminology; 4.2 Motions of the follower: SHM, Constant acceleration and deceleration (parabolic), Constant velocity, Cycloidal; Introduction to cam profiles (No problems on this point)	**04**

5	**Belts, Chains and Brakes:** **5.1 Belts**: Introduction, Types and all other fundamentals of belting, Dynamic analysis –belt tensions, condition of maximum power transmission **5.2 Chains** (No problems)**:** types of chains, chordal action, variation in velocity ratio, length of chain (No problems) **5.3 Brakes** (No problems)**:** Introduction, types and working principles, Introduction to braking of vehicles	**04**
6	**Gears and Gear Trains:** **6.1 Gears**- Introduction, Types, Law of gearing, Forms of teeth, Details of gear terminology, Path of contact, Arc of contact, Contact ratio, Interference in involutes gears, Minimum number of teeth for interference free motion, Methods to control interference in involutes gears, Static force analysis in gears - spur, helical, bevel, worm & worm wheel (No problems on this point) **6.2 Gear Trains:** Kinematics and dynamic analysis of simple and compound gear trains, reverted gear trains, epi-cycle gear trains with spur or bevel gear combination	**10**

Assessment:

Internal Assessment for 20 marks: Consisting Two Compulsory Class Tests First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour.

End Semester Examination: Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

Text Books:

1. S.S. Ratan, “Theory of Machines”, Tata McGraw Hill
2. Ghosh and A.K. Mallik, “Theory of Mechanisms and Machines”, East-West Press

References:

1. J.J. Uicker, G.R. Pennock, and J.E. Shigley, “Theory of Machines and Mechanism”, Oxford Higher Education
2. P.L. Ballaney, “Theory of Machines”, Khanna Publishers
3. M.A. Mostafa, “Mechanics of Machinery”, CRC Press
4. R.L. Norton, “Kinematics and Dynamics of Machinery”, McGraw Hill
5. A.G. Erdman, G.N. Sander, and S. Kota, “Mechanism Design: Analysis and Synthesis Vol I”, Pearson

Links for online NPTEL/SWAYAM courses:

1. https://nptel.ac.in/courses/112/105/112105268/
2. https://www.youtube.com/playlist?list=PLYRGB44zNZWVibVLmWANp-7obQzOhJLRt
3. http://www.nptelvideos.in/2012/12/kinematics-of-machines.html