SCHEME OF COURSE WORK

Course Details:

Course Title	**:KINEMATICS OF MECHANISMS**		
Course Code	**:** 22ME1112	**L T P C**	**:3 0 0 3**
Program:	**: B.Tech**		
Specialization :	**: Mechanical Engineering(Robotics)**		
Semester	**:IV**		

Course Outcomes (COs): At the end of the course, the student will able to

CO-1	Describe different mechanisms and their inversions
CO-2	Calculate velocity and acceleration of different points and links in a mechanism
CO-3	Explain the working of straight line motion mechanisms, steering gears and Hooke's joint
CO-4	Describe cam terminology and sketch cam profiles for given follower motions
CO-5	Differentiate gears, analyze gear performance and determine torque transmission in gear trains

Program Outcomes (POs): A graduate of mechanical engineering will be able to

PO-1	Apply the knowledge of mathematics, science, engineering fundamentals to solve complex mechanical engineering problems including robotics applications.
PO-2	Attain the capability to identify, formulate and analyze problems related to mechanical and robotics engineering.
PO-3	Design solutions for mechanical and robotics system components and processes that meet the specified needs with appropriate consideration for public health and safety.
PO-4	Perform analysis, conduct experiments and interpret data by using research methods such as design of experiments to synthesize the information and to provide valid conclusion.
PO-5	Select and apply appropriate techniques and modern engineering software tools including prediction and modeling to complex mechanical and robotics systems.
PO-6	Carry out their professional practice in mechanical engineering in particular robotics area by appropriately considering the issues related to society.
PO-7	Understand the impact of the professional engineering solutions on environmental safety and legal issues.
PO-8	Transform into responsible citizens by resorting to professional ethics and norms of the engineering practice.
PO-9	Function effectively in individual capacity as well as a member in diverse teams and in multidisciplinary streams.
PO-10	Communicate fluently with the engineering community and society; prepare reports; and make presentations effectively.
PO-11	Apply knowledge of the engineering and management principles to deal with projects and their finance in multidisciplinary environments.
PO-12	Engage themselves in independent and life-long learning for continuing professional practice in their specialized areas of mechanical and robotics engineering.

Course Outcome versus Program Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	3	3	2									1
CO-2	3	3	2									1
CO-3	3	3	2									1
CO-4	3	3	2									1
CO-5	3	3	2									1

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

Program Specific Objectives (PSOs):

The student must attain the knowledge and skills to

PSO-1	Design, analyze and develop mechanical and robotic systems that are cost effective and environment friendly using advanced tools and techniques.
PSO-2	Model, program and control safe and productive automation systems using various software tools and algorithms.
PSO-3	Apply domain knowledge of mechanical and robotics to provide solutions in interdisciplinary areas to meet current industrial and societal challenges.

Course Outcome versus Program Specific Outcomes:

COs	PSO1	PSO2	PSO3
CO-1	3		
CO-2	3		
CO-3	3		
CO-4	3		
CO-5	3		

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

Assessment Methods :	Assignment / Quiz / Seminar / Case Study / Mid-Test / End Exam

Teaching-Learning and Evaluation

Week	Contents	Course Outcomes	Sample questions	Teaching-Learning Strategy	Assessment Method & Schedule
1	Introduction, analysis and synthesis, the science of mechanics, terminology, definitions and assumptions, planar, spherical, and spatial mechanisms, mobility, classification of mechanisms, kinematic inversion.	CO-1	1). Sketch and explain prismatic, revolute, screw, cylindrical, and spherical pairs. 2). What do you understand by degree of freedom? For a planer mechanism derive Grubler's equation.	Lecture Animations	Mid-1 Quiz-1 Assignment-1
2	Inversions of four bar or quadric cycle chain – single slider crank chain – double slider crank chain, mechanical advantage	CO-1	Sketch and explain any two inversions of the double slider crank chain.	Lecture Animations/Model	Mid-1 Quiz-1 Assignment-1
3	Relative velocity method – velocity of point on a link- application of relative velocity method to four bar mechanism and slider crank mechanism – rubbing velocity of a joint	CO-2	In a slider crank mechanism, the length of crank and connecting rod are 125mm and 500mm respectively. The crank speed is 600rpm clockwise. When the crank has turned $45^0$from IDC, determine the velocity of the slider	Lecture Problem Solving Drawing practice	Mid-1 Quiz-1 Assignment-1
4	Velocity of point on a link by instant centre method, location of instant centre – Kennedy-Arnhold theorem and its application to simple mechanisms.	CO-2	State and prove Kennedy's theorem of three instance centers. While find ω_{out} of 4-bar mechanism	Lecture Problem Solving Drawing practice	Mid-1 Quiz-1 Assignment-1
5	Acceleration diagram of a link - acceleration diagram for a four bar mechanism, acceleration of intermediate and offset points and slider crank mechanism.	CO-2	Derive an expression for tangential acceleration and centripetal acceleration when a body moving along a circular path.	Lecture Problem Solving. Drawing practice	Mid-1 Quiz-1 Assignment-1

6	Coriolis component of acceleration - acceleration diagram for crank and slotted lever quick-return mechanism. Analytical expressions for displacement, velocity and acceleration of slider crank mechanism.	CO-2	Derive an expression for displacement, velocity and acceleration of a four-bar mechanism using analytical method.	Lecture Problem solving	Mid-1 Quiz-1 Assignment-1
7	Pantograph – straight line motion mechanisms – exact straight line motion mechanisms made of turning pairs – Peaucellier mechanism, Hart‘s mechanism exact straight line motion consisting of one sliding pair - Scott Russel mechanism.	CO-3	Sketch peaucellier mechanism. Show that it can be used to trace a straight line.	Lecture Animations/Model	Mid-2 Quiz-2 Assignment-2
8	Approximate straight line motion mechanisms - Grass hopper – Watt – Chebyschev–Robertmechanism- steering mechanism - condition for correct steering Davis steering gear- Ackerman steering gear.	CO-3	State and prove the condition for correct steering.	Lecture Animations/Model	Mid-2 Quiz-2 Assignment-2
9	**Mid Test– I**				
10	Hooke’s joint – ratio ofshaft velocities – maximum and minimum speed of driven shaft –condition for equal speeds – Angular acceleration of driven shaft – Double Hooke’s joint.	CO-3	The angle between the axes of two shafts connected by Hooke’s joint is 18^0.Determine the angle turned by the driving shaft when the velocity ratio is maximum and unity.	Lecture Problem Solving	Mid-2 Quiz-2 Assignment-2
11	Classification of followers and cams – terms used in radial cams – displacement, velocity and acceleration diagrams when the follower moves with uniform acceleration and retardation, simple harmonic motion and cycloidal motion	CO-4	Draw the displacement, velocity and acceleration diagrams for a follower when it moves with uniform and equal acceleration and retardation.	Lecture Problem Solving Drawing practice	Mid-2 Quiz-2 Assignment-2
12	Motion of the follower, line of stroke of the follower passes through the centre of cam shaft, off set of cam shaft. Layout of cam profiles for knife edge follower.	CO-4	Draw the cam profile for knife edge when the axis of the follower passes through the centre of cam shaft.	Lecture Problem Solving Drawing practice	Mid-2 Quiz-2 Assignment-2
13	Layout of cam profiles for roller follower, flat faced follower.	CO-4	Draw the cam profile for roller follower when the axis of the follower passes through the centre of cam shaft.	Lecture Problem Solving Drawing practice	Mid-2 Quiz-2 Assignment-2

14	Analysis of cams with specified contours- circular arc cam operating a reciprocating flat faced follower.	CO-4	Derive relations for velocity and acceleration for a covex cam with flat-faced follower.	Lecture Problem Solving Drawing practice	Mid-2 Quiz-2 Assignment-2
15	Classification of toothed wheels – terms used in gears - law of gearing – velocity of sliding of teeth – forms of teeth – cycloidal and involute teeth – standard proportions of gear teeth	CO-5	Differentiate between cycloidal and involute tooth profiles of gear.	Lecture Problem solving	Mid-2 Quiz-2 Assignment-2
16	path of contact, arc of contact – contact ratio Interference in involute teeth - minimum number of teeth to avoid interference.	CO-5	Two 20°involute spur gears having a velocity ratio of 2.5 mesh externally. Module is 4 mm and the addendum is equal to 1.23 module. Pinion rotates at 150 rpm. Find (i) the minimum number of teeth on each wheel to avoid interference. (ii) the number of pairs of teeth in contact.	Lecture Animations/Model Problem Solving	Mid-2 Quiz-2 Assignment-2
17	Simple, compound and reverted gear trains – epicyclic gear train – velocity ratio of epicyclic gear train — sun and planet wheels – torques in epicyclic gear trains	CO-5	Sketch and explain reverted gear train and write its applications.	Lecture Animations/Model Problem solving	Mid-2 Quiz-2 Assignment-2
18	**Mid Test– II**				