GUJARAT TECHNOLOGICAL UNIVERSITY

MECHANICAL (MACHINE DESIGN) (09)

ADVANCED MECHANISM DESIGN

SUBJECT CODE: 2720910

SEMESTER: II

Type of course: Engineering Science

Prerequisite: Zeal to learn the subject

Rationale: In this course, advanced topics in kinematics with a focus of mechanism synthesis techniques are to be discussed. The course will primarily focus on planar mechanism, but will also treat spherical and spatial mechanisms.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks		Practical Marks				
L	T	P	C	ESE (E)	PA (M)	ESE (V)		PA (I)		
						ESE	OEP	PA	RP	
3	0	2#	4	70	30	20	10	10	10	150

Contents:

Sr. No	Topic	Lectures	Weightage
1	**Introduction:** Introduction to kinematics and mechanisms, Kinematics diagram, Degrees of freedom, Formation of one D.O.F, multi loop kinematic chains, Mechanism design philosophy, design categories and mechanism parameters, Network formula, Gross motion concepts.	**4**	**10%**
2	**Kinematic Analysis:** Position Analysis, Vector loop equations and Analytical methods for four bar, Slider crank, Inverted slider, crank - Geared five bar, Analytical methods for velocity and acceleration Analysis, Graphical synthesis - Displacement – Velocity and acceleration analysis of simple mechanisms, Goodman analysis, Auxiliary point method.	**7**	**15%**
3	**Path Curvature Theory:** Fixed and moving centrodes, inflection points and inflection circle, Euler Savary equation, Bobillier's construction, Hartmann's construction, Graphical constructions, Cubic of stationary curvature.	**6**	**15%**
4	**Synthesis of Mechanisms:** Type synthesis, Number synthesis, Associated Linkage Concept, Dimensional synthesis, Motion generation., Path generation, Chebychev Spacing, Function generation, Cognate linkages, Coupler curve synthesis, Design of six-bar mechanisms, Algebraic methods, Application of instant center in linkage design.	**9**	**20%**
5	**Analytical Linkage Synthesis:** Two-Position Motion Generation, Three-Position Motion Generation,	**8**	**20%**

	Synthesis for a Specified Fixed Pivot Location, Analytical Synthesis of a Path Generator with Prescribed Timing, Analytical Synthesis of a Fourbar Function Generator.		
6	**Kinematics of Spatial Mechanisms and Robotics:** Introduction, topology arrangements of robotics arms, Kinematic analysis of spatial RSSR mechanism, Denavit - Hartenberg parameters, Forward and inverse kinematics of robotic manipulators. Study and use of Mechanism using Simulation Soft-ware packages.	**8**	**20%**

References Books:

1. Theory of Machines and Mechanisms, J. J.Uicker, G. R. Pennock and J.E.Shigley, Oxford University Press.
2. Kinematics and Dynamics of Machines, R. L. Nortron , McGraw Hill.
3. Advanced Mechanism Design, Vol. 2, N. G. Sandor and G. A. Erdman, Prentice Hall.
4. Advanced Mechanism Design, Vol. 1, N.G. Sandor, G.A. Erdman, and S. Kota, Prentice Hall.
5. Theory of Mechanism and Machines, A Ghosh and A K Mallik, EWLP, Delhi.
6. Kinematics and Dynamics of Machinery, C E Wilson, Pearson.
7. Kinematics, Dynamics and Design of Machinery, K. J. Waldron, & G.L. Kinzel, John Wiley.
8. Kinematic Analysis and Synthesis of Mechanisms, A. K. Mallik, A Ghosh, G. Dittrich, CRC.

Course Outcome:

After learning the course the students should be able to:

1. Gain a theoretical background in kinematics and in the analysis and synthesis of mechanisms.
2. Become familiar with basic and advanced tools for the analysis and design of linkages.
3. Apply theory and the use of engineering tools in a substantial mechanism design project.

List of Experiments

1. Graphical position, velocity and acceleration analyses of slotted crank-lever mechanism
2. Position, velocity and acceleration analysie of slotted crank-lever mechanism using MATLAB/Scilab.
3. Analysis of Klann and Theo Janson mechanisms using Mechanism Analysis Software.
4. Problems on Bobillier's and Hartmann's construction
5. Number synthesis of a 2-DOF system up to 10 links
6. Graphical two and three position synthesis with and without specified fixed pivot.
7. Graphical function generation
8. Analytical path and motion generation
9. Analytical function generation
10. Analysis and simulation of RSSR mechanism using MATLAB/Scilab.

Design based Problems (DP)/Open Ended Problem:

1. Study an existing mechanism car window closer and develop an alternative mechanism.
2. Create a mechanism for a required volume.

Major Equipment:

1. Computational facility.
2. Matlab / Scilab.

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for

seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website