

KIEMATICS OF MACHINES

IV Semester: ME								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AME009	Core	L	T	P	C	CIA	SEE	Total
		3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil			Total Classes: 60			
OBJECTIVES: The course should enable the students to: I. Understand the basic principles of kinematics and the related terminology of machines. II. Identify mobility; enumerate links and joints in the mechanisms. III. Explain the concept of analysis of different mechanisms. IV. Understand the working of various straight line mechanisms, gears, gear trains, steering gear mechanisms, cams and a Hooke's joint. V. Determine the mechanisms for displacement, velocity and acceleration of links in a machine.								
COURSE LEARNING OUTCOMES (CLOs): 1. Classifications of the kinematic links, kinematic pairs and formation of the kinematic chain. 2. Distinguish between mechanism and machine 3. Design and develop inversions of quadratic cycle chain, slider crank mechanism, double slider crank mechanism and cross slider mechanism. 4. Demonstrate type synthesis, number synthesis and dimensional synthesis 5. Construct Graphical methods of velocity polygon and acceleration polygons for a given configuration diagram. 6. Understand other methods of acceleration diagrams like Klien's construction. 7. Develop secondary acceleration component i.e Correlli's component involving quick return mechanisms. 8. Alternative approach for determining velocity by using I centres and centriods methods. 9. Significance of exact and approximate straight line mechanisms. 10. Application of straight line mechanism in steam engine indicators. 11. Applications of Ackerman's and Davi's steering mechanisms in automobiles. 12. Develop the condition for exact steering. 13. Develop the polar velocity diagram for a single hook joint and double hook joint and develop condition for unity for higher and lower speeds. 14. Study different displacement profiles applicable in I.C engines cam shafts. 15. Plot the displacement, velocity and acceleration profiles with respect to time. 16. Understand the geometry of gears and deduce the expression for arc of contact. 17. Derive the expression for minimum number of teeth to avoid interference in case of pinion and gear as well as rack and pinion. 18. Application of different gear trains including epicyclic and deduce the train value using tabular and relative velocity method. 19. Significance of differential gear box in an automobile while taking turn on the road. 20. Enable the students to understand the importance of theory of machines for lifelong learning, Higher Education and competitive exams.								
UNIT I	MECHANISMS						Classes: 09	
Mechanisms: Elements or links, classification, rigid link, flexible and fluid link, types of kinematic pairs types of constrained motion, kinematic chain, mechanism, machine, structure, inversion of mechanism, inversions of quadric cycle chain, single and double slider crank chains, mechanical advantage, Grubler's Criterion.								

UNIT II	KINEMATICS, PLANE MOTION OF BODY, ANALYSIS OF MECHANISMS	Classes: 09
Kinematics: Velocity and acceleration, motion of link in machine, determination of velocity and acceleration, Graphical method, application of relative velocity method, plane motion of body: Instantaneous center of rotation, centroids and axodes, three centers in line theorem, graphical determination of instantaneous center, determination of angular velocity of points and links by instantaneous center method. Klein's construction, Coriolis acceleration, determination of Coriolis component of acceleration; Analysis of mechanisms: Analysis of slider crank chain for displacement, velocity and acceleration of slider, acceleration diagram for a given mechanism.		
UNIT III	STRAIGHT LINE MOTION MECHANISMS, STEERING GEARS, HOOKE'S JOINT	Classes: 09
Straight-line motion Mechanisms: Exact and approximate copied and generated types, Peaucellier, Hart and Scott Russel, Grasshopper, Watt, Tchebicheff and Robert mechanisms, pantograph. Steering gears: Conditions for correct steering, Davis Steering gear, Ackerman's steering gear, Hooke's joint: Single and double Hooke's joint, velocity ratio, application, problems.		
UNIT IV	CAMS, ANALYSIS OF MOTION OF FOLLOWERS	Classes: 09
Cams: Definitions of cam and followers, their uses, types of followers and cams, terminology, types of follower motion, uniform velocity, simple harmonic motion and uniform acceleration; Maximum velocity and maximum acceleration during outward and return strokes in the above three cases; Analysis of motion of followers: Tangent cam with roller follower, circular arc cam with straight, concave and convex flanks.		
UNIT V	HIGHER PAIRS, GEAR TRAINS	Classes: 09
Higher Pairs: friction wheels and toothed gears, types, law of gearing, condition for constant velocity ratio for transmission of motion, velocity of sliding, form of teeth, cycloidal and involute profiles, phenomena of interferences, methods of interference; Condition for minimum number of teeth to avoid interference, expressions for arc of contact and path of contact of pinion and gear pinion and rack arrangements; Introduction to helical, bevel and worm gearing; Gear trains: Introduction, types, simple and reverted gear trains, epicyclic gear train; Methods of finding train value or velocity ratio of epicyclic gear trains, selection of gear box, differential gear for an automobile.		
Text Books:		
1. Joseph E. Shigley, "Theory of Machines and Mechanisms", Oxford University Press, 4 th Edition, 2010. 2. Thomas Bevan, "Theory of Machines", Pearson, 3 rd Edition, 2009.		
Reference Books:		
1. Jagadish Lal, "Theory of Mechanisms and Machines", Metropolitan Book Company, 8 th Edition, 2016. 2. S.S. Rattan, "Theory of Machines", Tata McGraw-Hill Education, 1 st Edition, 2009.. 3. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 3 rd Edition, 2008. 4. Sadhu Singh, "Theory of Machines", Pearson, 2 nd Edition, 2006 5. J. S Rao, R. V Duggipati, "Mechanisms and Machine Theory", New Age Publishers, 2 nd Edition, 2008. 6. R. K. Bansal, "Theory of Machines", Lakshmi Publications, 1 st Edition, 2013.		
Web References:		
1. http://www.uobabylon.edu.iq/uobColeges/ad_downloads/4_1293_515.pdf 2. http://ebooks.library.cornell.edu/k/kmoddl/toc_hartenberg1.html		
E-Text Books:		
1. https://drive.google.com/file/d/0B7raaoEF40D7eEJIR1VoODJodFE/edit . 2. http://royalmechanicalbuzz.blogspot.in/2015/04/theory-of-machines-by-rs-khurmi-ebook-pdf.html . 3. https://docs.google.com/file/d/0B5dLUIzfysmqMXBhakRyODhublU/edit . 4. https://archive.org/details/theoryofmachines00mckarich .		