

KINEMATICS OF MACHINES

| IV Semester: ME | | | | | | | | |
|---|---|--|---|-------------------------------|---------|---------------|--------------------------|-------|
| Course Code | Category | Hours / Week | | | Credits | Maximum Marks | | |
| AMEB10 | 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 | |
| I. COURSE OVERVIEW: | | | | | | | | |
| <p>Mechanical devices are designed to have mobility to perform certain functions. The theory behind the study of Kinematics of Machine leads us to design machines by understanding the relationship between the geometry and the motion of various parts of machine. This course will provide the knowledge on how to analyze the motions of mechanisms and design synthesis mechanisms to give required mobility. This includes relative motion analysis and design of gears, gear trains, cams, linkages and steering mechanism gears by adopting simultaneously both graphical and analytical approaches to estimate displacement, velocity and acceleration of links in a machine.</p> | | | | | | | | |
| II. OBJECTIVES: | | | | | | | | |
| The course should enable the students to: | | | | | | | | |
| <p>I The basic concepts of Machine design to develop Mechanisms and Machines by using type synthesis, number synthesis and dimensional synthesis.</p> <p>II The Kinematics from the geometric point of view to determine mobility, velocity and acceleration using graphical methods.</p> <p>III The Mechanisms with lower pairs to obtain steering, copying and straight line motions in automobiles and other allied applications.</p> <p>IV The Kinematic analysis and synthesis of cams imparting motion to knife edged, roller and mushroom followers, Gears and Gear trains..</p> | | | | | | | | |
| III. COURSE OUTCOMES: | | | | | | | | |
| After successful completion of the course, students should be able to: | | | | | | | | |
| CO 1 | | Discuss the types of the kinematic synthesis for building a mechanism/Machine for mobility. | | | | | Understand | |
| CO 2 | | Illustrate the velocity and acceleration analysis of various mechanisms by relative velocity method and I Center method. | | | | | Understand | |
| CO 3 | | Identify the various mechanisms for the approximate straight line motions. | | | | | Apply | |
| CO 4 | | Justify the importance of steering gear mechanisms for optimum operation of automobile vehicles. | | | | | Evaluate | |
| CO 5 | | Develop the Cam profiles for different motions of various followers. | | | | | Evaluate | |
| CO 6 | | Illustrate the design function of planetary gear train system and its methods of evaluation for gear train value. | | | | | Understand | |
| IV. SYLLABUS: | | | | | | | | |
| MODULE-I | MECHANISMS | | | | | | Classes: 09 | |
| <p>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.</p> | | | | | | | | |
| MODULE -II | KINEMATICS, PLANE MOTION OF BODY, ANALYSIS OF MECHANISMS | | | | | | Classes: 09 | |
| <p>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.</p> | | | | | | | | |

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| MODULE-III | STRAIGHT LINE MOTION MECHANISMS, STEERING GEARS, HOOKE'S JOINT | Classes: 09 |
| <p>Straight-line motion Mechanisms: Exact and approximate copied and generated types, Peaucellier, Hart and Scott Russul, Grasshopper, Watt, Tchebicheff and Robert mechanisms, pantograph.</p> <p>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.</p> | | |
| MODULE-IV | CAMS, ANALYSIS OF MOTION OF FOLLOWERS | Classes: 09 |
| <p>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.</p> | | |
| MODULE -V | HIGHER PAIRS, GEAR TRAINS | Classes: 09 |
| <p>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.</p> | | |
| Text Books: | | |
| <ol style="list-style-type: none"> 1. Mallik, A. K., Ghosh, A., & Dittrich, G. Kinematic analysis and synthesis of mechanisms: CRC Press. , 10th Edition, 2008. 2. Uicker, J. J., Pennock, G. R., & Shigley, J. E. Theory of machines and mechanisms: OUP. , 2nd Edition, 2008. 3. Norton, R. L. Design of machinery: An Introduction to the Synthesis and Analysis of Mechanisms and Machines: McGrawHill, 2nd Edition, 2008. 4. Rattan.S.S. Theory of Machines: McGraw-Hill Education (India) Pvt Ltd, , 6th Edition, 2013. 5. Rao, J. S. The Theory Of Machines Through Solved Problems: New Age International, 2nd Edition, 2008. | | |
| References | | |
| <ol style="list-style-type: none"> 1. Bevan, T. The theory of machines: A Text-Book for Engineering Students: Pearson Education, 4th Edition, 2013. 2. Vinogradov, O. G. Fundamentals of kinematics and dynamics of machines and mechanisms: CRC Press, 2nd Edition, 2014. 3. Ballaney PL, Theory of Machines and Mechanisms, Khanna Publications, 5th Edition, 2012. | | |
| Web References | | |
| <ol style="list-style-type: none"> 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 | | |
| <ol style="list-style-type: none"> 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/0B5dLUIZfysmqMXBhakRyODhubIU/edit 4. https://archive.org/details/theoryofmachines00mckarich | | |