New Jersey Institute of Technology - Mechanical Engineering Program

ME-637
KINEMATICS OF PLANAR AND SPATIAL MECHANISMS

Dr. Fischer

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Open to mechanical-engineering graduate students.

Prerequisites: Knowledge of matrix algebra, undergraduate dynamics. Previous study of kinematics or robot mechanics would be helpful but is not necessary.

Primary Reference (not required) Ian S. Fischer Dual-Number Methods in Kinematics, Statics and Dynamics CRC Press LLC, Boca Raton FL, 1999, ISBN 0-8493-9115-6

Additional References
Beggs: *Kinematics*
Bottema & Roth: *Theoretical Kinematics*
Craig: *Introduction of Robotics, Mechanics and Controls*
Duffy: *Analysis of Mechanisms and Robot Manipulators*
Hartenberg & Denavit: *Kinematic Synthesis of Linkages*
Hunt: *Kinematic Geometry of Mechanisms*
McCarthy: *Introduction to Theoretical Kinematics* Paul: *Robot Manipulators*
Sandor & Erdman: *Advanced Mechanism Design*
Erdman: *Modern Kinematics, Kinematics in the Last Forty Years*

Definitions of the dual number, dual angle, dual vector, dual velocity and dual force.
Coordinate transformations and Euler angles
Matrix modeling of links and joints
Displacement analysis of mechanisms
- Application to planar four-bar, spherical four-bar, Cardan joint, general spatial four-bar, robotic manipulators
- Numerical methods - dual-number Newton-Raphson method

Origin displacement equation
- Calculation of translational displacements

Velocity analysis (dual velocity)
- Application to planar four-bar, general spatial four-bar, generalized slider-crank, planar slider-crank, robotic manipulators

Midterm examination
Static force analysis (dual force)
- Application to general spatial four-bar, planar four-bar, planar slider-crank, robotic manipulators

Dynamic force analysis (dual momentum)
- Application to general spatial four-bar, planar slider-crank

Final examination

(Applications include RCCC, RSSR, RSSP, robotic manipulators, etc.)

This course is basically concerned with the dual-number coordinate-transformation matrix modeling of spatial mechanisms such as shaft couplings, spatial four-bars, spatial slider cranks and robotic manipulators.