AE6263 FLEXIBLE MULTI-BODY DYNAMICS

Topics

1. Rigid body kinematics. The representation of finite rotations: Generalized finite rotation parameters, the rotation vector, the conformal rotation vector. (4 hours)

2. Equations of motion for rigid body dynamics. (3 hours)

3. Constraint equations in multibody dynamics, prescribed motions. Holonomic and non-holonomic constraints, Lagrange multipliers. Formulation and classification of joints in mechanics analysis; modeling of lower and higher pairs. Relative motions at joints. Modeling of actuators. Flexibility in joints. (6 hours)

4. Methods for enforcing kinematic constraints: the coordinates partitioning method, the penalty function method, the Baumgarte method, the Lagrange multiplier technique, the augmented Lagrangian method, the singular value decomposition approach. (6 hours)

5. Formulation of flexible bodies in multibody dynamics. Geometrically exact cable, beams and plate formulations. Linearization and modal analysis. (9 hours)

6. Finite element modeling of geometrically exact formulation of flexible elements. Computational aspects in the representation of finite rotations. (6 hours)

7. Numerical stability of the dynamic simulation of constrained multibody systems. The Hilber-Hughes-Taylor scheme. Computational schemes for the stability of nonlinear problems. (6 hours)

8. Impact and contact problems in multi-body dynamics: kinematic conditions for contact, contact forces, friction and normal forces. Numerical aspects of the problem. (5 hours)

Reference books.

The following reference text books are a good souce of information for the class.

1. Meirovitch L.: *Methods of Analytical Dynamics*. McGraw -Hill, New-York, 1970.
2. Haug, E. J.: *Intermediate Dynamics*. Prentice Hall, Inc., 1992. (TJ170.H386)
3. Amirouche F.M.L.: *Computational Methods in Multi-body Dynamics*. Prentice Hall, Inc., 1992. (QA845.A53).
4. Robertson, R.E., and Schewtassek, R.: *Dynamics of Multibody Systems*. Springer-Verlag, 1988,
5. Pfeiffer, F., and Glocker, C.: *Multibody Dynamics with Unilateral Contacts***.** Wiley series in Nonlinear Sciences, John Wiley & Sons, 1996.(TJ173.P48)