Course Title: Applied Mathematics for Electrical Engineers

Credits: 3:0

Syllabus:

Solving linear equations Ax=b, row reduced echelon form and Gauss elimination. Vector space, linear independence, basis, dimension, rank-nullity theorem, orthogonality, the four fundamental subspaces, positive definiteness, singular value decomposition, pseudo inverse. Linear programming (LP) (min $C^T x$, Ax=b, x>=0), simplex method, duality. Linear dynamical systems of the form dx/dt=Ax, eigen decomposition and Jordon form. Stability.

Numerical solution of f(x)=0, root-finding algorithms such as Newton's method. Unconstrained nonlinear optimization (min f(x)), first and second-order necessary conditions, steepest descent, and Newton's algorithm. Constrained optimization (min f(x), h(x)=0, g(x)=<0), necessary conditions, Lagrange multipliers. Penalty, barrier, and constrained steepest descent algorithms. Sequential linear programming and quadratic programming. Nonlinear dynamical systems of the form dx/dt=f(x), existence and uniqueness of solutions, stability of equilibrium points-Lyapunov's method, gradient and Hamiltonian systems, limit cycles: Poincaré Bendixson theorem. Numerical solution of dx/dt=f(x), Euler and Runge-Kutta methods. Accuracy, stability, and convergence time.

Notes:

Instead of a theorem-proof approach, the focus will be on developing mathematical structures and techniques to solve a certain class of problems. Implementing the methods taught in MATLAB will form a significant component of this course. Examples will be drawn from different areas of science and technology with an emphasis on Electrical Engineering. A few proofs that require results from real analysis can be excluded.

Prerequisite: BTech Engineering Mathematics.

References:

1. Linear Algebra and Its Applications by Gilbert Strang.
2. Applied Linear Algebra by Peter J Oliver and, Chehrzad Shakiban.
3. Linear and Nonlinear Programming by David G Luenberger and, Yinyu Ye.
4. Differential Equations, Dynamical Systems, and an Introduction to Chaos by Morris W. Hirsch, Stephen Smale and, Robert L. Devaney.
5. Introductory Methods of Numerical Analysis by SS Sastry.
6. Numerical Analysis by Richard L. Burden and, J. Douglas Faires