

Syllabus for MATH 603

Title: Methods of Applied Mathematics II

Prerequisites: MATH308 and MATH311, or MATH601, or permission of instructor

1.0 Introduction to Vector Spaces (9 hrs):

Basic definitions-basis, dimension, subspaces, norm, inner product; Gram-Schmidt orthonormalization; basic topology-open, closed, compact, completeness, convergence, Cauchy sequences, Schauder basis.

2.0 Matrix and Tensor Algebra (9 hrs):

Matrices and tensors as linear maps, domain and range, tensor product; characteristic polynomial, eigenvalues and eigenvectors, Cayley Hamilton Theorem; canonical forms-spectral representation of self-adjoint matrices, Jordan normal form, meromorphic functions of matrices; quadratic forms; decomposition theorems-LU, QR, SVD, Polar decompositions with applications to least square solutions.

3.0 Vector and Tensor Analysis (15 hrs):

Limit, continuity, derivative of scalar, vector and tensor valued functions on finite dimensional vector spaces; coordinate independent definitions of gradient, divergence, curl; Divergence, Green, Stokes Theorems; Frechet derivative and applications to the calculus of variations (Euler equations, Lagrange multipliers); orthogonal curvilinear coordinates.

4.0 Introduction to Linear Partial Differential Operators (9 hrs):

Second order linear partial differential operators arising in applied mechanics-elliptic, hyperbolic, parabolic operators; D'Alembert's solution; separation of variables and eigenvalue problems; Sturm-Liouville problems and complete orthogonal families of eigenfunctions.

Suggested References:

James P. Keener, *Principles of Applied Mathematics*, Addison-Wesley, New York, 1988.
Roger A. Horn & Charles R. Johnson, *Matrix Analysis*, Cambridge University Press, 1985. Ray M. Bowen & C. C. Wang, *Introduction to Vectors and Tensors*, Plenum Press, 1976. James G. Simmonds, *A Brief on Tensor Analysis*, Springer-Verlag, 1982.
Gilber Strang, *Linear Algebra and Its Applications*, Harcourt, Brace, Jovanovich, 1988. Morton E. Gurtin, *An Introduction to Continuum Mechanics*, Academic Press, 1981.
J. David Logan, *Applied Partial Differential Equations*, Springer, 1988. Peter V. O'Neil, *Beginning Partial Differential Equations*, Wiley, X999. John Ockendon, *Applied Partial Differential Equations*, Oxford University Press, 1999. J. Kevorkian, *Partial Differential Equations*, Springer, 2000.