Math 301 **FUNCTIONAL ANALYSIS**

Unit-I

Normed linear spaces, Banach spaces and examples, quotient space of normed linear spaces and its completeness, convex sets and convex functional, lower semi-continuous and upper semi-continuous functions.

Unit-II

Equivalent norms, Riesz lemma, basic properties of finite dimensional normed linear spaces and compactness.Normed linear spaces of bounded linear transformations, dual spaces with examples.

Unit-III

Uniform boundedness theorem and some of its consequences, Open mapping and closed graph theorems, Hahn-Banach theorem for real linear spaces and complex linear spaces.

Unit-IV

Reflexive spaces, Reflexivity of Hilbert spaces, Inner product spaces, Hilbert spaces, Orthonormal sets, Bessel's inequality, Complete orthonormal sets and Parseval's identity, Structure of Hilbert Spaces, Projection theorem.

Unit-V

Riesz representation theorem, Adjoint of an operator on a Hilbert space, Self- adjoint operators, Positive, Projection, normal and unitary operators, Introduction to Sobolev spaces, Fundamental theorem of variational calculus, bilinear forms,

Text Books:

1. Functional Analysis with Applications by A. H. Siddique, Tata McGraw Hill Publishing Company Ltd. New Delhi.
2. Introductory Functional analysis with Applications by Kreyszig, John Wiley and Sons, New York.

Reference Books:

1. Real Analysis by H.L. Royden, Macmillan Publishing Co. Inc., New York, 4th Edition, 1993.
2. Functional Analysis by B.V. Limaye, Wiley Eastern Ltd.

Math 203 INTEGRAL EQUATIONS AND BOUNDARY VALUE PROBLEMS

Unit-I

Definitions of integral equations and their classification, solution of integral equation, Fredholm integral equations of second kind with separable kernels, solution of Fredholm integral equation with separable kernel, method of successive approximations.

Unit-II

Method of successive substitutions, Iterative scheme for Fredholm integral equations of the second kind, resolvent kernel and its results, application of iterative scheme to Volterra integral equations of the second kind.

Unit-III

Conversion of initial value problem to volterra integral equation and conversion of boundary value problem to Fredholm integral equation. Conversion of Fredholm integral equation to boundary value problems and conversion of Volterra integral equation to initial value problem.

Unit-IV

Orthonormal system of functions, symmetric kernels, fundamental properties of Eigen values and Eigen functions Green's function, for symmetric kernels, Hilbert Schmidt theory and solutions of Fredholm integral equations with symmetric kernels.

Unit-V

Definition of a boundary value problem for an ordinary differential equation of the second order, Dirac delta function, Green's function, Green's function approach to reduce boundary value problems of a differential equation with homogeneous boundary conditions to integral equations.

Text Books:

1. Linear Integral Equation Theory and Techniques by R.P. Kanwal, Academic Press, New York, 1971.
2. Linear Integral Equation (translated from Russian) by S.G. Mikhlin, Hindustan book Agency, 1960.

Reference Books:

1. Boundary value problems of Mathematical Physics by I. Stakgold, Vol.I, II, Mac Millan, 1969.

Math 303 **OPERATIONS RESEARCH**

Unit-I

Introduction, Nature and Meaning of O.R. Modelling in operations Research, Features of Operation research, scope of operations research Linear Programming Problem: formulation of L.P.P. solution of L.P.P. Graphical Method, Simplex Methods in Duality, Integer Programming.

Unit-II

Assignment problems: Mathematical formulation, reduction theorem, unbalanced assignment problem, Transportation problem formulation, basic feasible solution – North-West-corner method, Least cost method, Vogel's Approximation method, Optimum solution: MODI method.

Unit-III

Job sequencing: Processing n jobs through 2 machines, Processing n jobs through 3 machines, Processing 2 Jobs through m machines, Replacement problems: Replacement policy for items whose maintenance cost increase with time and money value is constant, Money value changes with constant rate.

Unit-IV

Project management: Introduction, network diagram representation, time estimates and critical path with saddle point, rectangular game with out saddle point, Principle of dominance, Graphical method.

Unit-V

Queuing Theory: Introduction, queuing system Transient and steady traffic inlets, Distribution of arrival distribution of departure, M/M/I: ∞/ FCFS model nonlinear programming: Kuhn-Tucker conditions.

Text Books:

1. Linear Programming by G. Hadley, Narosa Publishing House, 1995.
2. Operations Research by R.K. Gupta.

Reference Books:

1. Introduction to Operations Research (Sixth Edition) by F.S. Hillier and G.J. Lieberman Mc Graw Hill International Edition, Industrial Engineering Series, 1995.
2. Operations Research by S.D. Sharma.

Math 304 **MATHEMATICAL BIOLOGY**

Unit-I

Continuous Growth Models, Delay Models, Linear Analysis of Delay Population Models, Harvesting a Single Natural population, population Model with Age Structure, Fishery Management model.

Unit-II

Predator- Prey models, Lotka- Volterra Systems, Competition Models, Principle of competitive exclusion, Mutualism or Symbiosis, Stability analysis of Predator- Prey Models, Stability – Analysis of Competition Models.

Unit-III

Epidemic models and the dynamics of infectious diseases: Simple epidemic models, SIS, SIR and SIRS Epidemic Models, Modelling Venereal Diseases, Multi- group Model for Gonorrhea, AIDS: Modelling the Transmission Dynamics of HIV.

Unit-IV

Introduction to Compartment models, Discrete and continuous transfers, Discrete population Models for a single species, Discrete logistic model, Discrete delay models for single species, solution by eigen value analysis

Unit-V

Introduction to tracer methods in physiology, Bath-tub models, Continuous infusion into a compartment, Elementary pharmacokinetics, Parameter Estimation in Two-Compartment models, The homogeneous and Non-homogeneous cases.

Text Books:

1. Mathematical Biology (Biomathematics, Volume 19) by J.D. Murray, Springer verlag.
2. Linear Models in Biology by M.R. Cullen, Ellis Horwood Ltd.

Reference Books:

1. Mathematical Models in Biology and Medicines by J.N. Kapur.
2. Introduction to Mathematical Biology by S.I. Rubinow, John Wiley & Sons. 1975.