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Ph.D. Course
RESEARCH METHODOLOGY
BMA 701/702 | 751/752

UNIT I: **(08)**

Defining research and research problems, classification of research; Scientific explanation and social science/ management research; Review of Literature. Research questions; Research framework; Hypotheses formulation, Research Variables

UNIT II: **(08)**

Research design formulations; Classification of research design – exploratory research design; descriptive research design, Causal & experimental research design. **Measurement and scaling**; Scales of measurements, Comparative and non-comparative scaling techniques; research framework; hypothesis formulation, sample research proposal preparation/case studies.

UNIT III: **(08)**

Tools of data collection; Questionnaire design- process and structure; Reliability and validity. Sampling design and procedure; Classification of sampling techniques, Sample size.

UNIT IV: **(08)**

Overview of statistical techniques for data analysis- descriptive statistics, theoretical distributions, central limit theorem, testing of hypothesis, regression analysis, correlation analysis, inferencing, non-parametric statistics and tests, analysis of variance (ANOVA), experimental design, response surface methodology, uni-variate and multi-variate analysis of statistical data.

UNIT V : **(08)**

Ethical issues in Research: Academic Integrity, Report writing and use of plagiarism check, citation ethics etc.
Use of Computer software for Data Analysis & Reporting: Report compilation, Overview of Softwares like MS Word, MS Excel, MS Power point, Latex, SPSS etc.

Reference books:

1. Research Methodology by C.R. Kothari, New age International, New Delhi. (Major contents of unit I- IV available)
2. Statistical Methods by S. P. Gupta, S. Chand & Sons.
3. Fundamentals of Statistics by D. N. Elhance, KITAB MAHAL ALLAHABAD.
4. Fundamentals of applied statistics by S.C. Gupta & V.K. Kapoor, S. Chand & Sons.
5. Research Methodology by R. Paneer shelvam, PHI publications.
6. Research Methodology: A step by step Guide for Beginners by Ranjit Kumar, Sage Publication (I) P. Ltd- New Delhi 4th edition.
7. Internet sources & Lecture notes.

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Ph.D. Course

NUMERICAL TECHNIQUES FOR BOUNDARY VALUE PROBLEMS

BMA- 703 | 753

Detailed Syllabus:

Unit-I: System of Equations: [8]

Linear systems: Conditioned linear systems of equations, Over view of direct methods. Iterative methods and their convergence analysis. Special system of equations, Thomas Algorithm. Bounds on eigen values and various methods for solving eigen value problems.
Nonlinear systems: Newton's Raphson method and General iterative method.

Unit-II: Ordinary Differential Equations: [8]

Initial value problems: Runge-Kutta methods of various orders, Predictor and corrector methods. Boundary value problems: Shooting method and Finite difference methods. Stability, Convergence and Error analysis.

Unit-III: Partial Differential Equations : Finite Difference Methods [8]

Physical classification, Well posed problems, Dirichlet-, Neumann- and Mixed boundary value problems. Various Explicit and Implicit finite difference methods. Consistency, Stability and Convergence analysis, ADI and ADE methods.

Unit-IV: Weighted Residual Methods: Boundary Value Problems [8]

Variational Principles and Methods, Formulation of variational problems, Ritz method, Least squares method, collocation method, Galerkin method, Petrov-Galerkin method, Generalized Galerkin method.

Unit-V: Finite Element Method: [8]

Introduction to finite element analysis, Hermite families of elements, Isoperimetric elements. Finite elements for higher order problems, Axisymmetric problems. Ritz finite element method, Galerkin's finite element method and various other finite element methods.
Softwares used: Matlab, Mathematica-7.0, Maples, C/C++ Programming, Micro Visuals Basics 6.0.

Books Recommended:

1. M.K. Jain, S.R.K Iyenger and R.K. Jain: Numerical Methods for Scientific and Engineering Computations, New Age International Publication 5th Edition (2003).
2. C.T. John, A.A. Dale and H.P. Richard: Computational Fluid Mechanics and Heat Transfer, Taylor & Francis Publication 2nd Edition (1997).
3. J.N. Reddi: An Introduction to the Finite Element Method, Tata Mcgrah-Hill Edition, 3rd Edition (2006).
4. W.Y. Yang, W. Cao, T.S. Chung, and J. Morris: Applied Numerical Methods using Matlab, Wiley Student Edition, (2007).

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Ph.D. Course

THEORY OF ADVANCED DIFFERENTIAL EQUATIONS

BMA-704 754

Unit-I Theoretical consideration of Differential Equations [8]

Existence and uniqueness of solution of initial value problems for first order ODEs, singular solutions of first order ODEs, system of first order ODEs. Introduction, definition of stability, linear systems, almost linear systems, conditional stability. Adjoint and Self-Adjoint differential equations, Sturm-Liouville problem, eigen values and eigen functions, Singular Sturm-Liouville problems, orthogonally of eigen functions and eigen functions expansion.

Unit-II Partial Differential Equations [8]

Non-linear partial differential equations, compatible system of first order equations, Cauchy's method of characteristics, Higher order linear homogenous and non-homogenous partial differential equations with constant coefficients. Classification and canonical transformation of second order linear partial differential equations.

Unit-III Boundary Value Problems: Parabolic Equations [8]

Method of separation of variables for linear partial differential equations; D'Alembert's solution, vibrations of an infinite string and a semi-infinite string. Vibrations of string of finite length (separation method), Parabolic Equations: Method of separation of variables: heat equation, heat conduction problem for an infinite rod, a finite rod in higher dimensions, Duhamel's principle for parabolic equations.

Unit-IV Boundary Value Problems: Elliptic Equations [8]

Elliptic Equations: Boundary value problems: Dirichlet, Neumann, Cauchy boundary conditions. Maximum and minimum principles, Dirichlet and Neumann problems for a rectangle (separation of variables), theory of Green's function for Laplace equation.

Unit-V Boundary Value Problems: Hyperbolic Equations [8]

Hyperbolic Equations: quasi linear equations and the methods of charecterisatics conservation laws and shock waves, kinematic waves and specific Real-world nonlinear problems, introduction, kinematic waves, traffic flow problems, Flood waves in long rivers, Riemanns problem.

Text Book:

1. I. N. Sneddon: Elements of Partial Differential Equations, McGraw-Hill, 3rd edition (2006).
2. Richard C. DiPrima and William E. Boyce: Ordinary Differential Equations and Boundary Value Problems, John Willey, 11th edition (2017).
3. T. Amaranath: An Elementry Course in Partial differential equations, Narosa Publishing House, 2nd edition (2014).
4. S. L. Ross: Differential Equations, Wiley, 4th edition (1989).

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5. K. Sankara Rao: Introduction to Partial Differential Equations, PHI Learning, 5th edition (1995).

Reference books:

1. Walter A. Strauss: An Introduction to Partial Differential Equation, Wiley, 2nd edition (2007).
2. Lawrence. C. Evans: Partial Differential Equations, American Mathematical Society, 2nd Edition (1998).

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Ph.D. Course
OPERATIONS RESEARCH
(BMA-705) 755

Detailed Syllabus:

Unit-I Linear Programing Problems [8]

Definition and scope of operational research, different types of models, Linear Programming Problems (LPP), Optimality conditions, solution by various methods.

Unit-II Inventory Control [8]

Inventory problems and their analytical structure, simple deterministic inventory model. Stochastic demand inventory control. The concept of deterioration, inflation, time value of money and shortages.

Unit-III Sequencing and Replacement Models [8]

Sequencing: Basic assumptions, Johnson's algorithm, sequencing 'n' jobs on single machine using priority rules, sequencing using Johnson's rule-'n' jobs on 2 machines, 'n' jobs on 3 machines, 'n' jobs on 'm' machines. Sequencing of 2 jobs on 'm' machines using graphical method.

Replacement Problems: Optimal age of equipment replacement, capital equipment discounting cost, Replacement of items that fail, Individual and group replacement policies.

Unit-IV Queuing Theory [8]

Queuing Theory: Queuing systems and their characteristics, Pure-birth and Pure-death models (only equations), Kendall & Lee's notation of Queuing, empirical queuing models – Numerical on M/M/1 and M/M/C Queuing models.

Unit-V Network: CPM/PERT [8]

Network models and simulation. Network models for project analysis CPM; Network construction and time analysis; cost time trade off, PERT – problems. The comparisons between CPM and PERT.

Text Books:

1. J. K. Sharma, Operations Research: Theory and Applications, Macmillan, 12th edition (1997).

References:

1. Humdy A. Taha, Operations Research - An Introduction, Prentice Hall of India, New Delhi, 2nd edition 1999.
2. S.D. Sharma, Operation Research, Kedar Nath Ram Nath, 3rd edition (2008).

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Ph.D. Course
APPLIED STOCHASTIC PROCESSES
(BMA-706) 1756

UNIT-1 Probability Distributions:
Expectation and its properties, various transforms and important distributions, sum of (a fixed number of) random variables, conditional distribution and conditional expectation, sum of a random number of random variables, conditioning.

UNIT-II Stochastic Processes:
Definition, applications, classification, random walk, martingales, renewal process, branching process, Markov process, statistics of stochastic processes, stationary processes, ergodic process, systems with stochastic inputs, power spectrum, Wiener-Khinchin theorem.
Bernoulli process and Poisson process: properties, related distributions, splitting and merging.

UNIT-III Discrete-Parameter Markov Chains:
Definition, transition probabilities, Chapman-Kolmogorov equation, classification of states and chains, stationary behavior, ergodicity, convergence theorem, discrete-parameter birth-death processes, absorption probabilities and expected time to absorption.

UNIT-IV Continuous-Parameter Markov Chains:
Definition, transition probabilities, Chapman-Kolmogorov equations, state classification and limiting distributions, continuous-parameter birth death processes, applications in queuing systems: M/M/1, M/M/r, M/M/r/r, M/M/r/m, M/M/1/m, M/M/∞, M/G/1, GI/M/1, GI/M/r/r, $M/E_m/1$, M/D/1 etc., finite state space, machine repairman model, pure birth process, pure death process, Markov chains with absorbing states.

UNIT-V Markov Processes with Continuous State Space:
Brownian motion, Wiener process, differential equations for a Wiener process, Chapman-Kolmogorov equation, First passage time distributions for Wiener process.

Text Book:

1. J.Medhi. Stochastic Processes, Wiley Eastern Limited, 2nd edition (1994).

Reference Books:

1. U.N. Bhatt. Elements of Applied Stochastic Processes. Wiley, New York (1984).
2. S.M. Ross. Stochastic Processes, Wiley, New York (1983).
3. K.S. Trivedi, Probability and Statistics with Reliability, Queuing and Computer Science Applications, Prentice-Hall of India, Private Limited, New Delhi (1984).
4. Mingliao: Applied Stochastic Processes, CRC Press, 1st Edition (1973).

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