Master of Science - Applied Mathematics

Syllabus - First Semester

COMPUTER MATHEMATICS AND 'C' LANGUAGE

Course Code: MTH4105 **Credit Units: 03**

Course Objective:
The objective of this course module is to acquaint the students with the mathematics involved in basics of computers system, its components, data representation inside computer and to get them familiar with variousimportant features of a procedure oriented programming language i.e. C.

Course Contents:

Module-I: Data representation: number systems, character representation codes, binary, octal, hexadecimaland their inter conversions, binary arithmetic, floating point arithmetic, header files, static variables,register variables, declaration of variable names, data types and sizes, constants, format specifier, storageclass, scope.

Module-II: Arithmetic operators, relational and logical operators, type conversions, increment and decrementoperators, bit-wise operators, assignment operators and expressions, conditional expressions; precedenceand order of evaluation. if else, nested if.

Module-III: Loop- Switch. While and For, Do-while. Break and Continue, Go to and Lables, Character InputOutput Arrays, Character Arrays. Multi-Dimensional Arrays, Basics of Structures, Arrays of Structures,Unions.

Module-IV: Basics of functions, functions arguments block structures, recursion, pointers, function arguments,call by value, call by reference pointers and arrays functions, pointer arrays, pointers to pointers, commandline arguments, strings operation.

Examination Scheme

Components	A	CT	HA	EE
Weightage (%)	5	15	10	70

A: Attendance, CT: Class Test, HA: Home Assignment, Seminar, or Quiz, EE: End Semester Exam

References

- Rajaraman, V., Computer Programming in C" , Prentice Hall of India, 1995.
- Schildt, H., C: The complete reference", Osbourne Mcgraw Hill, 4th Edition, 2002.
- Kanetkar, Y., Let us C", BPB Publications, 14th Edition, 2016.
- Kernighan & Ritchie, C Programming Language", The (Ansi C Version), Prentice Hall India Learning Private Limited; 2 edition (1990).

COMPUTER MATHEMATICS AND 'C' LANGUAGE LAB

Course Code: MTH4106 **Credit Units: 01**

Software Required: Turbo C

Course Contents:

1. Some basic programs to understand the working of C language.
2. Programs involving conditional operator like if-end, else if-end
3. Programs involving nested if-else-end
4. Programs involving multiple selections using switch statement
5. Programs involving loops like while and do while.
6. Programs involving for loops.
7. Programs involving user defined function calls.
8. Programs involving arrays and matrices
9. Programs involving strings
10. Programs involving structures
11. Programs involving Unions
12. Programs involving pointers, and solving various problems with the help of those.
13. Programs involving file handling

Examination Scheme

Internal Assessment

Components	Attnd.	Performance	Lab Record	Viva
Weightage (%)	5	10	10	5

End-Term Exam

Components	Performance	Viva
Weightage (%)	35	35

References

- Rajaraman, V., Computer Programming in C" , Prentice Hall of India, 1995.
- Schildt, H., C: The complete reference", Osbourne Mcgraw Hill, 4th Edition, 2002.
- Kanetkar, Y., Let us C", BPB Publications, 14th Edition, 2016.
- Kernighan & Ritchie, C Programming Language", The (Ansi C Version), Prentice Hall India Learning Private Limited; 2 edition (1990).

Syllabus - Second Semester

OPTIMIZATION TECHNIQUES

Course Code: MTH4203 **Credit Units: 04**

Course Objective:
The problems in optimization are the most common applications of mathematics. The main aim of this courseis to present different methods of solving optimization problems in the areas of linear programming, non linear programming, and integer linear programming. In addition to theoretical treatments, there will be someintroduction to numerical methods for optimization problems.

Course Contents:

Module-I:**Review** Linear programming problem and its formulation, convex sets and their properties, graphical method, basic feasible solution, simplex method, big-M and two phase methods; infeasible and unbounded LPPs, alternate optima; Dual problem and duality theorems, dual simplex method and its application in post optimality analysis; Balanced and unbalanced transportation problems, Vogelsapprox-imation method for solving transportation problems; Hungarian method for solving assignment problems.

Module-II:Dynamic Programming Bellman's Principle of optimality of Dynamic Programming, Multi-stage decision problem and its solution by Dynamic Programming with finite number of stages, Solution of linear programming problems as a Dynamic Programming problem.

Module-III:Integer Linear Programming Problems: Integer Linear Programming Problems, Mixed Integer Linear Programming Problems, Cutting Plane Method, Branch and Bound method.

Module-IV:PERT and CPM: Basic idea of PERT & CPM, Difference between PERT & CPM, PERT/CPMnetwork components and precedence, Relationship critical path analysis, Project Scheduling, Project TimeCost, Trade Off, Resource allocation.

Examination Scheme:

Components	A	CT	HA	EE
Weightage (%)	5	15	10	70

A: Attendance, CT: Class Test, HA: Home Assignment, Seminar, or Quiz, EE: End Semester Exam

References:

- Taha, H.A., Operations Research: An Introduction", MacMillan Pub Co., NY, 9th Ed. (Reprint), 2013.
- Mohan, C. and Deep, K., Optimization Techniques", New Age India Pvt. Ltd, New Delhi, 2009.
- Ravindran, A., Phillips, D.T. and Solberg, J.J., Operations Research: Principles and Practice", JohnWiley and Sons, NY, 2nd Ed. (Reprint), 2012.
- Hillier, F. S., and G. J. Lieberman, Introduction to Operations Research", 2nd ed., Holden-Day, SanFrancisco, 1974.
- KanthiSwarup, P.K.Gupta and Man Mohan, \Operations Research". Sultan Chand and Sons New Delhi,Fourteenth Edition -2008

STATISTICS BASED LAB

Course Code: MTH4206 **Credit Units: 01**

Course Objective:
The objective of this Lab work is to acquaint students to use statistical software in computation and interpretation of various statistical results.

Course Contents:

Fundamentals of R, and SPSS software or Turbo C and their application in computation of:
1. Measurement of Central Tendencies
2. Measurement of Dispersion
3. Measurement of Skewness & Kurtosis
4. Analysis of Correlation & Regression
5. Sampling from discrete and continuous Probability Distribution (Binomial, Poisson, Geometric, NegativeBinomial, Exponential, Gamma, Normal)
6. Test of Significance (Chi-square Test, F-test, Analysis of Variance)
7. Solution of Linear Equations
8. Calculating Eigenvalues and Eigenvectors of a matix
9. Testing and Evaluation of nature of Quadratic forms (+ve definite, -ve definite, Indefinite)

Examination Scheme:

Internal Assessment

Components	Attnd.	Performance	Lab Record	Viva
Weightage (%)	5	10	10	5

End-Term Exam

Components	Performance	Viva
Weightage (%)	35	35

References

- V. K. Rohatgi and A. K. Md. E. Saleh, An Introduction to Probability and Statistics, 2nd Edn., Wiley, 2001.
- W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Edn., Wiley, 1968.
- Miller, I. and Miller, M:Freunds Mathematical Statistics with Applications, 7th edition,Prentice Hall.
- Hogg, R., Mckean, J. and Craig, A.:Introduction to Mathematical Statistics, 7th edition, Pearson Education

PRACTICAL INTRODUCTION TO MATLAB

Course Code: MTH4215 **Credit Units: 03**

Course Objective:
The main objective of the course is to familiarize the students with the main features of the MATLAB integrateddesign environment. Students will learn concepts related to programming in MATLAB and they will also getto the exposure to use few builtin functions to solve many practical problems.

Course Contents:

Module-I:Introduction to MATLAB and Plotting: vector and matrix generation, subscripting and the colon notation, matrix and array operations and their manipulations, introduction to some inbuilt functions. Two & three-dimensional graphics: basic plots, change in axes and annotation in a figure, multiple plots in a figure, saving and printing figures, mesh plots, surface plots and their variants.

Module-II: **m-files**: scripts and user defined functions, calling functions into a script file, subfunctions, andnested functions, concept of local and global variable, few examples of in-built functions, editing, savingm-files.

Module-III:Loops and Conditional statements: Flow control using various statements and loops including For-End and While-End loops with Break commands. Conditional Statements: If-End statement,If-Else-End statement, nested If-Else-End statements.

Module-IV:Applications of MATLAB: Solving a linear system of equations including overdetermined andsystem with infinitely many solutions. Calculus of polynomials using inbuilt functions, Solving equationsin one variable, Solving IVPs using inbuilt functions.

Examination Scheme:

Components	**A**	**CT**	**HA**	**EE**
Weightage (%)	5	15	10	70

A: Attendance, CT: Class Test, HA: Home Assignment, Seminar, or Quiz, EE: End Semester Exam

Reference Books:

- Applied Numerical Methods with Matlab for Engineers and Scientists by Steven Chapra, McGraw Hill,2008.
- MATLAB: An introduction with applications: Amos Gilat, 5th Edition, Wiley India, 2014.
- Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers by RudraPratap,Oxford University Press, 2016.

LAB BASED ON MATLAB

Course Code: MTH4216 **Credit Units: 01**

Course Objective:
MATLAB is a scientific computing tool which covers almost all area of science and engineering. Students willbe using MATLAB environment to solve various types of mathematical problems.

Course Contents:
Fundamentals of Linear Algebra, Numerical Analysis, Differential Equations and their application using MATLAB :

1. Generating arrays and matrices and their manipulations
2. Eigenvalues & Eigenvectors of various type of matrices
3. Using builtin functions to solve system of equations
4. Functions related to plotting 2D and 3D plots
5. Introducing builtin functions for numerical approximations
6. Annotation of Plots
7. Writing m files including script and function files
8. Introducing notion of sub-functions and nested functions
9. Solving IVPs using ode45 and other solvers
10. Solving system of equations of IVPs

Examination Scheme

Internal Assessment

Components	Attnd.	Performance	Lab Record	Viva
Weightage (%)	5	10	10	5

End-Term Exam

Components	Performance	Viva
Weightage (%)	35	35

Reference Books:

- Applied Numerical Methods with Matlab for Engineers and Scientists by Steven Chapra, McGraw Hill,2008.
- MATLAB: An introduction with applications: Amos Gilat, 5th Edition, Wiley India, 2014.
- Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers by RudraPratap,Oxford University Press, 2016.

Syllabus - Third Semester

NUMERICAL ANALYSIS

Course Code: MTH4325 **Credit Units: 03**

Course Objective:
The objective of this course is to introduce some advanced numerical methods, commonly used in research to thepost graduate students. Student will be introduced to numerical techniques for solving algebraic and transcendental equation, Interpolation of polynomial, Differentiation, Integration and ordinary differential equations.

Course Contents:
Module-I:Solution of Algebraic and Transcendental Equations: Bisection method, Regula-Falsi method,Iteration method, Newton Raphson method, Newton Raphson method for multiple roots, Secant methodas an improvement on Newton Raphson method, and Muller's method, Graeffe's Root Square Method.Convergence and error analysis of these methods.

Module-II: Finite differences, interpolation and approximation: Finite difference operators, their properties and their interrelations, problems based on finite difference tables, Newton's forward and Newton'sbackward interpolation formula, various central difference formulae including Stirling's formula, Bessel'sformula. Divided differences: Operators and difference table, Newton's divided difference formula, Lagrange's interpolation formula. Cubic Spline and least square approximation using Chebychev Polynomial.

Module-III:Solution of system of linear equations:
1. Direct methods: Cramers rule, Matrix inverse method, Gauss elimination and Gauss-Jordan method, LU decomposition method.
2. Iterative methods: Jacobis method, Gauss-Seidal method. Their convergence criterion.
Concept of ill-conditioning, and condition number for system of equations.

Module-IV:Numerical Differentiation and Integration: Numerical differentiation using Newtons forward and backward formula, order of leading error terms. Newton-Cotes quadrature formula - derivations & comparison of Trapezoidal rule, Simpsons 1/3 and 3/8 rules. Error analysis of these methods. Numerical solution of first order differential equations: Euler's method, modified Euler's method, Predictor -Corrector Method, Runge-KuttaIInd order and IVth order methods, their derivations and their extension to solve system of IVPs.

Examination Scheme:

Components	A	CT	HA	EE
Weightage (%)	5	15	10	70

A: Attendance, CT: Class Test, HA: Home Assignment, Seminar, or Quiz, EE: End Semester Exam

References:

- Gerald, C. F. &Wheatly P. O., Applied Numerical Analysis", 6th Ed., Addison-Wesley Publishing, 2002.
- Fausett, L. V., Applied Numerical Analysis", Prentice Hall, 2nd Ed. 2007
- Froberg, C. E., "Introduction to Numerical Analysis", 2nd Ed., Addison Wesley., 2004
- E. Scheid, Numerical Analysis", Mc Graw Hill 1988.
- Jain, M.K., S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computations", New Age International, New Delhi, 2003.

NUMERICAL ANALYSIS LAB WITH C / MATLAB

Course Code: MTH4327 **Credit Units: 01**

Course Objective:
The objective of the course is to explain the most common numerical methods used in engineering analysis,when to use each method, and how to implement basic methods in a structured manner using MATLAB'sprogramming language.

Course Contents:
Module-I: Roots of Transcendental Equations: Programs for Initial approximation for roots, Bisection method,Regula-Falsi method, Iterative method, Newton Raphson method, Secant method. Comparison of thesemethods. How to use builtin functions to find the roots of Transcendental Equations.

Module-II: System of Linear Equations: Programs for Jacobi method, Gauss-Seidal method, their comparativestudy using various stopping criterion. Programs for forward and back substitution, LU decompositionmethod, and using built in functions for system of equations.

Module-III: Programs for Numerical Differentiation, Programs for trapezoidal rule, Simpson's 1/3 and 3/8rule and their comparison. Using builtin functions for both numerical differentiation and numerical integration.

Module-IV: Programs for solving IVPs for Euler's method and its variants. How to use built in functions forsolving IVPs and how to extend the code for solving system of IVPs.

Examination Scheme

Internal Assessment

Components	Attnd.	Performance	Lab Record	Viva
Weightage (%)	5	10	10	5

End-Term Exam

Components	Performance	Viva
Weightage (%)	35	35

Reference Books:

- Applied Numerical Methods with Matlab for Engineers and Scientists by Steven Chapra, McGraw Hill.
- MATLAB: An introduction with applications: Amos Gilat, 5th Edition, Wiley India.
- Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers by RudraPratap,Oxford University Press.

NUMBER THEORY & CRYPTOGRAPHY

Course Code: MTH4329 **Credit Units: 04**

Course Objective:
The course provides an introduction to basic number theory, where the focus is on computational aspects withapplications in cryptography. Moreover, the course provides an introduction to some basic cryptographic techniques to understand fundamental mathematical concepts underlying digital signatures, public key encryption,and key establishment protocols.

Course Contents:
Module-I: Euclid's division lemma, Divisibility, The Linear Diophantine Equation, The fundamental theoremof Arithmetic, Fermat's Little theorem, Wilson's Theorem, Generating functions. Congruences, ResidueSystems, The Theorems of Fermat and Wilson Revisited, The Chinese Remainder Theorem.

Module-II: Combinatorial Study of $\phi(n)$, Formulae for $d(n)$ and $\sigma(n)$, Multiplicative Arithmetic Functions,The Mobius Inversion Formula, Primitive Roots Modulo p, Tchebychev's Theorem. Euler's Criterion, theLegendre Symbol, The Quadratic Reciprocity Law, Consecutive Residues and Non-residues.

Module-III: Cryptographic Hash Functions Hash functions and data integrity, security of Hash functions, Therandom oracle model, algorithms in random oracle model, comparison of security criteria, Compressionfunctions from encryption functions, Hash functions from compression functions.

Module-IV: Public Key Cryptography and Discrete Logrithms Finite fields, construction, The Elgamal crypto system, RSA public key crypto system, algorithms for discrete logarithm problems, Shanks Baby step Giant step algorithms, The pollard algorithm, factoring algorithms, attacks on RSA, security of Elgamal system, The Deffe Hellman key exchange problems, Digital signature algorithms using RSA, secrete key sharing principles, The Shamir Secret sharing protocol.

Examination Scheme:

Components	A	CT	HA	EE
Weightage (%)	5	15	10	70

A: Attendance, CT: Class Test, HA: Home Assignment, Seminar, or Quiz, EE: End Semester Exam

References

- Niven, I., Zuckerman, S.H., Montgomery, L.H., An Introduction to the Theory of Numbers, John Wiley and Sons. New York, 1991
- Dan Flath, Introduction to Number Theory, Wiley, 1988)
- K. Ireland, M. Rosen. A Classical Introduction to Modern Number Theory, Springer Verlage, 1990.
- Douglas R. S. Cryptography Theory and Practice, Third edition, Chaman& Hall/CRC, 2005
- Johannes Buchmann. Introduction to Cryptography, Second edition, Springer, 2004.
- N. Koblitz. Course in Number Theory and Cryptography, Springer, 1994.
- A. J. Menezes, P.C. Van Oorschot and S.A. Vanstone. Handbook of Applied Cryptography, CRC Press, Boca Raton, 1997.

STATISTICAL METHODS

Course Code: MTH4341 **Credit Units: 04**

Course Objective:
The course aims to equip the students with statistical tools and concepts that help them in decision making.

Course Contents:
Module-I: Multivariate Probability Distributions Random vectors, joint, marginal and conditional distributions, conditional expectations,Moment generating functions,Multinomial and Bivariate Normal Distributions,Chi square,t and F Distributions and their properties.

Module-II: Sampling Theory Random sampling with and without replacement, stratified sampling, clustersampling, systematic sampling etc. Distribution of sample mean and variance

Module-III: Estimation and Testing Basic concept of estimation,definition of a statistic, properties of a good estimator unbiasedness,efficiency,consistency and sufficiency, MVUE Estimator, Cramer Rao Inequality and applications,Maximum Likelihood Estimators.
Testing: Null and Alternative Hypothesis,Type 1 and Type 2 Error, Z-test,t test, Chi-square, F-test and Analysis of Variance one way classification and two way classification

Module-IV: Correlation and Regression Types, importance, methods of measuring correlation-scatter diagram, Karl Pearsons and SpearmansRank Correlation. Regression lines, Difference between regression and correlation, Meaning of Regression,Standard error of estimate,Partial and Multiple correlation coefficients.

Examination Scheme

Components	A	CT	HA	EE
Weightage (%)	5	15	10	70

A: Attendance, CT: Class Test, HA: Home Assignment, Seminar, or Quiz, EE: End Semester Exam

References:

- Miller,I. and Miller, M:Freunds Mathematical Statistics with Aplications,7th edition, Prentice Hall.
- Biswas and Srivastava- A Textbook, Mathematical Statistics, Narosa Publishing House, New Delhi.
- Mood, A.M., Graybill, F.A. and Boes, D.C.(1974): Introduction to the Theory of Statistics, McGraw Hill.
- Des Raj &Chandak (1998): Sampling Theory, Narosa Publishing House.
- Mathematical Statistics by Gupta and Kapoor, Sultan Chand and Sons

Syllabus - Fourth Semester

MATHEMATICAL MODELING

Course Code: MTH4411 **Credit Units: 04**

Course Objective:
Mathematical modeling is a process of creating a mathematical representation of some phenomenon in orderto gain a better understanding of that phenomenon. The main goal of this course is to learn how to make acreative use of some mathematical tools such as difference equations, ordinary and partial differential equations,Numerical analysis to build a mathematical description of some physical problems.

Course Contents:
Module-I: Mathematical modelling through Ordinary Differential Equations and Systems of Oridnary Equations of First Order : Linear Growth and Decay Models, Non-linear growth and Decay models, Compartment models, Mathematical Modelling in Population Dynamics, Mathematical modeling of Epidemics,Mathematical modeling in medicine, arms race battles and international trade, Mathematical modelingin dynamics.

Module-II: Modeling with difference equations, overview of basic concepts concerning matrices, eigenvaluesand eigenvectors, The Harrod Model, the cobweb model, Samuelsons interaction model, application toActuarial Science, Application to population dynamics and genetics.

Module-III: Queuing models: Poisson Process, Pure birth death process M/M/1, M/M/c, M/Ek/1 queuing models, steady state probabilities, waiting time distribution. Cost consideration in network models.

Module-IV: Mathematical modeling through mathematical programming maximum principle: Linear programming models in harvesting of animal populations, forest management, transportation and assignmentmodels, Non-linear programming models in optimal portfolio selection, information theory, non-linearprogramming models arising from pollution control, Pontryagins maximum principle, solution of a simpletime-optimal problem, optimal harvesting of animal populations

Examination Scheme

Components	A	CT	HA	EE
Weightage (%)	5	15	10	70

A: Attendance, CT: Class Test, HA: Home Assignment, Seminar, or Quiz, EE: End Semester Exam

References:

- J N Kapur, Mathematical Modeling", New Age International (P) Ltd., Publishers, New Delhi, 2005
- Barnes, B. and Fulford, G. R., Mathematical Modelling with Case Studies", CRC Press, Taylor andFrancis Group, 2009
- Edsberg, L., Introduction to Computation and Modeling for Differential Equations", John Wiley andSons, 2008
- F R Giordano, M D Weir, and W P Fox, A First Course in Mathematical Modeling", Cengage Learning;4th edition, 2008
- M M Gibbons, A Concrete Approach to Mathematical Modeling", John Wiley and Sons, 2007.
- P.E. Wellstead, Introduction to Physical System Modeling", Academic Press, 1977.

CODING THEORY

Course Code: MTH4413 **Credit Units: 04**

Course Objective:
The objectives of the course are to teach the students how to produce algebraic codes based on the methods ofgroups and finite fields and to make the students familiar with some of the most widely used codes and theirapplications. After learning this course, students will be able to understand and implement the most widelyused algebraic codes, write programs coding and decoding messages.

Course Contents:
Module-I: The Communication Channel, the coding problem, types of codes, Error Detecting and Error Correcting Codes, linear Codes. The Hemming metric, description of Linear Block Codes by matrices.

Module-II: Dual Codes, Standard Array Syndrome, Step by Step Decoding Modular Representation, ErrorCorrection Capabilities of linear codes, Bounds of Minimum Distance for Block Codes, Plotkin Bound,Hamming sphere packing bound bounds for Burst Error Detecting and Correcting Codes.

Module-III: Important linear Block Codes, Hamming Codes, Golay Codes, Perfect Codes, Quasi perfect Codes, Reed Muller Codes, Codes derived by Hadamard Matrices, Product Codes. Concatenated codes.

Module-IV: A double-error correcting decimal Code and an introduction to BCH Codes, BCH bounds, CyclicCodes, Matrix representation of Cyclic Codes, Hamming and Golay Codes as Cyclic Codes, Error detectionwith Cyclic codes, MDS Codes.

Examination Scheme

Components	**A**	**CT**	**HA**	**EE**
Weightage (%)	5	15	10	70

A: Attendance, CT: Class Test, HA: Home Assignment, Seminar, or Quiz, EE: End Semester Exam

References

- J H Van Lint, Introduction To Coding Theory, Springer Verlag, Heidelberg, 1998
- V. Pless, Introduction to the theory of Error Correcting Codes (3rd Ed.), Wiley Interscience, New York,1998
- V. Pless and W C Huffman, Fundamentals of Error Correcting Codes, Cambridge University Press, 2003.
- R. Hill, A first course in Coding Theory, Oxford University Press, 1986.
- M. Y. Rhee, Error Correcting Coding Theory, McGraw Hill Inc., 1989

STOCHASTIC PROCESSES

Course Code: MTH4414 **Credit Units: 04**

Course Objective:
To introduce the basic concepts of stochastic processes.

Course Contents:
Module-I: Poisson Process: Interarrival and waiting time distributions, conditional distributions of the arrival times, nonhomogeneous Poisson process, compound Poisson random variables and Poisson processes,conditional Poisson processes.

Module-II: Markov Chains: Introduction and examples, Chapman-Kolmogorov equations and classificationof states, limit theorems, transitions among classes, the Gamblers ruin problem, mean time in transientstates, branching processes, applications of Markov chain, time reversible Markov chains, semi Markovprocesses.

Module-III: Continuous-Time Markov Chains: Introduction, continuous time Markov chains, birth and death processes, The Kolmogorov differential equations, limiting probabilities, time reversibility, applications of reversed chain to queueing theory.

Module-IV: Brownian Motion and other Markov Processes: Introduction, hitting time, maximumvariable, Arc sine laws, variations on Brownian motion, Brownian motion with drift, backward and forwarddiffusion equations.

Examination Scheme

Components	**A**	**CT**	**HA**	**EE**
Weightage (%)	5	15	10	70

A: Attendance, CT: Class Test, HA: Home Assignment, Seminar, or Quiz, EE: End Semester Exam

References

- Ross, S. M., Stochastic Processes" Wiley India Pvt. Ltd., 2nd Ed. 2008.
- Brzezniak, Z. and Zastawniak, T., Basic Stochastic Processes: A Course through Exercises", Springer,1992.
- Medhi, J., Stochastic Processes", New Age Science, 2009.
- Resnick, S.I., Adventures in Stochastic Processes", Birkhauser, 1999.
- Hoel, P.G. and Stone, C.J., \Introduction to Stochastic Processes", Waveland Press, 1986

STATISTICAL INFERENCE

Course Code: MTH4415 **Credit Units: 04**

Course Objective:
To introduce the concepts of statistical inference.

Course Contents:
Module-I: Point estimation. Characteristics of a good estimator: Unbiasedness, consistency, sufficiency andefficiency. Method of maximum likelihood and properties of maximum likelihood estimators (withoutproof). Method of minimum Chi-square. Method of Least squares and method of moments for estimationof parameters. Problems and examples.

Module-II: Sufficient Statistics, Cramer-Rao inequality and its use in finding MVU estimators. Statistical Hypothesis (simple and composite). Testing of hypothesis. Type I and Type II errors, significance level, p-values, power of a test. Definitions of Most Powerful (MP), Uniformly Most Powerful (UMP) and Uniformly Most Powerful Unbiased (UMPU) tests.

Module-III: Neyman-Pearsonslemma and its applications for finding most powerful tests for simple hypothesisagainst simple alternative. Tests based on t, F and X^2 distributions.

Module-IV: Likelihood ratio tests and their reduction to standard tests. Large sample tests. Interval estimation, Pivotal quantity and its use in finding confidence intervals, concept of best confidence intervals.

Examination Scheme:

Components	A	CT	HA	EE
Weightage (%)	5	15	10	70

A: Attendance, CT: Class Test, HA: Home Assignment, Seminar, or Quiz, EE: End Semester Exam

References

- Hogg & Craig, Introduction to Mathematical Statistics", Pearson Education, 2005.
- Miller, I. and Miller, M., Freunds Mathematical Statistics with Applications", Prentice Hall PTR, 7thedition, 2006.
- Lehman, E.L., Testing of Statistical Hypothesis", Wiley Eastern Ltd, 1959
- G. Casella, R. L. Berger, \Statistical Inference", Duxbury Press, 2002.
- Rohatgi, V.K., Statistical Inference", Dover Publications, 2011.

NUMERICAL SOLUTION TO ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS

Course Code: MTH4416 **Credit Units: 04**

Course Objective:
The course covers few classical and contemporary methods for solving initial and boundary value problems.Finite difference operators and their application to solve various types of PDEs shall be introduced in thecourse.

Course Contents:
Module-I: Iterative solvers for nonlinear equations and system of linear equations: Iterative method and Newtons method for system of nonlinear equations; Iterative methods to solve system of linear equations including Gauss-Seidal and Jacobis method with pivoting; Concept of norms and condition number; Application of these methods for test problems using MATLAB codes.

Module-II: Initial value Problems Single-step methods: General definitions and Lipschitz condition, Derivationsand stability analysis for Taylor series method, Eulers method and its variants, RungeKutta second orderand fourth order methods; Implementation of these methods for various test problems using MATLAB.

Module-III: Initial value Problems Multi-step methods: General definitions and derivations of Adams Bash-forth, Adams Moulton methods, Predictor-corrector method; stability analysis of these methods and application of these methods for some test problems using MATLAB.

Module-IV: Introduction to Finite difference methods General concepts of truncation error and stability fora finite difference scheme; Numerical solution of one-dimensional heat equation, including Explicit Euler,Backward Euler, Crank-Nicolson schemes with various type of boundary and initial conditions; LaplaceEquations and Poissons equations with different type of boundary and initial conditions.

Examination Scheme

Components	A	CT	HA	EE
Weightage (%)	5	15	10	70

A: Attendance, CT: Class Test, HA: Home Assignment, Seminar, or Quiz, EE: End Semester Exam

Recommended Books:
- Numerical Methods in Engineering and Science by B. S. Grewal, Khanna Publishers, 2014
- Numerical Methods for Scientific and Engineering Computation by Jain,Iyengar, Jain, New Age International Publishers, 1996
- Elements of Numerical Analysis by Radhey S Gupta, Macmillan India Ltd, 2008.