Bachelor of Science - Mathematics (Honors)

Syllabus - First Semester

STATISTICS

Course Code: MTH2109 **Credit Units: 04**

Course Objective:
To introduce the fundamentals of probability theory and random processes. The main objective of this courseis to acquaint students with some basic concepts in Statistics. They will be introduced to some elementarystatistical methods of analysis of data.

Course Contents:

Module-I: Measures of Central Tendency Arithmetic Mean (A.M.) Definition,Mode, Median,Partition Values:Quartiles, Deciles and Percentiles, Box Plot, Percentile ranks.Means of transformed data , Geometric Mean(G.M.) Definition, merits and demerits, Harmonic Mean (H.M.), Weighted Mean: Weighted A.M., G.M.and H.M. Measures of Dispersion, Range, Mean deviation Mean square deviation, Variance and standardDeviation, Combined variance (derivation for 2 groups), Combined standard deviation, generalization forn groups. Moments.

Module-II: Skewness and Kurtosis, Bowley's coefficient of skewness, Karl Pearson's coefficient of skewness,Measures of skewness based on moments, Concepts of kurtosis, leptokurtic, mesokurtic and platykurticfrequency distributions.Measures of kurtosis based on moments, Correlation Covariance between two variables, Karl Pearson's coefficient of correlation (r), Spearman's rank correlation coefficient, Spearman'srank correlation coefficient (derivation of formula in caseof without ties). Regression, fitting of lines ofregression by the least squares method.

Module-III: Probability Theory: Random experiments, sample point and sample space, event, algebra of events. Definition of Probability classical and relative frequency approach to probability; probability axioms, real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments, moment generating function, characteristicfunction.

Module-IV: Special Discrete and Continuous Distributions: Introduction Binomial, Poisson distributionsNormal distribution.

Examination Scheme

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	15	5	5	70

A: Attendance, CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz,
EE: End Semester Exam

Recommended Books:

- S. C. Gupta & V. K. Kapoor, Fundamental of Mathematical Statistics, 9 th Edition, Sultan Chand &Sons, New Delhi, 1994.
- P. R. Vittal, Mathematical Statistics, Margham Publications, Chennai, 2002
- Sheldon Ross, Introduction to Probability Models (9th Edition), AcademicPress, Indian Reprint, 2007.

Syllabus - Second Semester

INTRODUCTION TO C PROGRAMMING

Course Code: MTH2318 **Credit Units: 03**

Course Objective:
The objective of this course is to acquaint the students with the basics of computers system, its components,data representation inside computer and to get them familiar with various important features of C programming.

Course Contents:

Module-I: Computers fundamentals:- definition, block diagram, diagram with components and characteristics,classification of computers History of C: Introduction of C, Basic structure of C program, Concept ofproblem solving, program design, debugging, Types of errors in programming, Number systems, Binary,octal, hexadecimal and their inter conversions.

Module-II: Element used in C, Header file, key words, identifiers, concept of variables, constants and datatypes in C, Input/output function, arithmetic, relational and bitwise operator, increment and decrementoperator, unary operator, type casting, operator hierarchy, Conditional operator

Module-III: Decision making with if statement, else statement, if-else statement, nesting if, switch and break,go to statement. Decision making statement concepts of loops like while loop, do while loop, for loop,nested for loops, jumps in loop.

Module-IV: Functions: - use of inbuilt function, user defined functions, arrays:- one dimensional and n dimensional array, initialization of array, iterative programs using arrays, uses of array with combination ofdecision making operator, Function prototype, Return values and their types, function argument, recursion, Strings, array of strings.

Examination Scheme

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	15	5	5	70

A: Attendance, CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz,
EE: End Semester Exam

Recommended Books:

- E Balagurusamy, ANSI C, McGraw Hill Education India Private Limited; Seventh edition (2017).
- YashwantKanetkar, Let us C, BPB Publications, 2nd Edition, 2001.
- Herbert Schildt, C: The complete reference, Osbourne Mcgraw Hill, 4th Edition, 2002.
- V. RajaRaman, Computer Programming in C, Prentice Hall of India, 1995.
- Kernighan & Ritchie, C Programming Language, The (Ansi C Version), PHI, 2nd Edition.

INTRODUCTION TO C PROGRAMMING LAB

Course Code: MTH2319 **Credit Units: 01**

Software Required: Turbo C

Course Contents:

- Basic programming to understand the working of C
- Programs using if, else if statements
- Programs using nested if-else statements
- Programs using switch case
- Programs using loops like while and do while
- Pattern programs using loops and multiple loops
- Simple programs with the help of function
- Simple programs involving array and strings

Examination Scheme

Internal Assessment

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

End-Term Exam

Components	Performance	Viva
Weightage (%)	35	35

Recommended Books:

- E Balagurusamy, ANSI C, McGraw Hill Education India Private Limited; Seventh edition (2017).
- YashwantKanetkar, Let us C, BPB Publications, 2nd Edition, 2001.
- Herbert Schildt, C: The complete reference, Osbourne Mcgraw Hill, 4th Edition, 2002.
- V. RajaRaman, Computer Programming in C, Prentice Hall of India, 1995.
- Kernighan & Ritchie, C Programming Language, The (Ansi C Version), PHI, 2nd Edition.

Syllabus - Fourth Semester

NUMERICAL METHODS

Course Code: MTH2413 **Credit Units: 03**

Course Objective:
This course aims to introduce various techniques for finding approximate numerical solutions to mathematicalproblems for which exact or analytical solutions are either unavailable or practically inappropriate to use.

Course Contents:

Module-I: Solution of system of linear equations:
Direct methods: Cramer's rule, Matrix inverse method, Gauss elimination and Gauss-Jordan method
Iterative methods: Jacobi's method, Gauss-Seidal method

Module-II: Solution of Transcendental equations: Initial approximation of the roots, Bisection method, Method of false position, secant method, iteration method, Newton-Raphson method and its convergence.

Module-III: Finite differences and interpolation:finite difference operators, their properties and their interrelations, finite difference tables, Newton's forward and Newton's backward interpolation formula, various central difference formulae including Stirling's formula, Bessel's formula. Divided differences: Operators and difference table, Newton's divided difference formula, Lagrange's interpolation formula.

Module-IV: Numerical differentiation and integration: Differentiation using Newtons forward and backward formula, Newton-Cotes quadrature formula - derivations & comparison of Trapezoidal rule, Simpsons1/3 and 3/8 rules. Numerical solution of first order differential equations: Euler's method, modified Euler'smethod, Runge-KuttaIInd order and IVth order methods.

Examination Scheme

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	15	5	5	70

A: Attendance, CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz,
EE: End Semester Exam

Recommended Books:

- An Introduction to Numerical Analysis by EndreSuli, David F. Mayers, Cambridge University Press, 2003
- Applied Numerical Analysis by C. F. Gerald, Pearson Education, 2009
- Elements of Numerical Analysis by R. S. Gupta, Macmillan India Ltd, 2009
- Numerical methods in Engineering & Science by B. S. Grewal, Khanna Publishers, 2013
- Numerical methods for Scientific and Engineering Computation by Jain, Iyengar, Jain, New Age International Publishers, 2004

NUMERICAL METHODS LAB

Course Code: MTH2414 **Credit Units: 01**

Course Objective:
To understand the implementation of methods learnt in the course Numerical Methods using C programming.

Course Contents:

1. Write a program to solve the system of equations $Ax = b$ using Gauss elimination method.
2. Write a program to solve the system of equations $Ax = b$ using Jacobi Iteration method.
3. Write a program to solve the system of equations $Ax = b$ using Gauss-Seidel method.
4. Write a program to find an initial approximation to solve transcendental equation of the form $f(x) = 0$.
5. Write a program to find the roots of an equation $f(x) = 0$ using Bisection method.
6. Write a program to find the roots of an equation $f(x) = 0$ using Iteration method.
7. Write a program to find the roots of f (x) = 0 using Newton Raphson method.
8. Write a program to find the roots of f(x) = 0 using Secant method.
9. Write a program to find the integral of a function using Trapezoidal rule.
10. Write a program to find the integral of a function using Simpson's 1/3rd and 3/8th rule.

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 - Fifth Semester

OPERATIONS RESEARCH

Course Code: MTH2504 **Credit Units: 04**

Course Objective:
Operations research has many applications in science, engineering, economics, and industry. The goal of thecourse is to teach how to formulate, analyze, and solve mathematical models using appropriate optimizationtools.

Course Contents:
Module-I: Basic Deification, Nature and Significance of OR, feature of OR Approach Application and Scopeof OR, Linear Programming problems, mathematical formulation of LPP, case studies, Advantages andLimitations of Linear Programming, Application Areas of Linear Programming, definition of feasible,Infeasible Solution, Basic feasible solution. Solution of LPP by Graphical methods, unbounded, alternativeand no feasible solution, convex set, convex hull, examples on convex sets, fundamental theorem of LPP.

Module-II: Standard form of LPP, slack & surplus variable, Simplex methods, Big M Method, Two phasemethod, solved problems on unbounded, alternative and no feasible solution, degeneracy. Duality inLinear Programming Problem, importance of duality, formulation of dual problems, theorems on Duality,Sensitivity Analysis.

Module-III: Assignment Problems, Hungarian method for optimal solution, solving unbalance problems, travelling salesman problems. Transportation Problem, formulation, finding basic feasible solution by-Northwest Corner Method, Least Cost Method and by Vogels Approximation Method, Optimality test: MODI method, Unbalanced Supply and Demand, Degeneracy Problem, Alternative Optional Solution, Maximization Transportation Problem.

Module-IV Sequencing problem, solution of sequencing problems, processing n jobs through 2 machines,processing n-jobs through 3 machines, processing 2-jobs through m-machine, Game theory: Competitivegame, rectangular game, saddle points, minimax (maximin) method of optimal solution, value of game,Solution of game with saddle point. Rectangular games without saddle point, mixed strategy for 2 x 2 games.

Examination Scheme

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	15	5	5	70

A: Attendance, CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/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

PRACTICAL INTRODUCTION TO MATLAB

Course Code: MTH2516 **Credit Units: 03**

Course Objective:
MATLAB is a scientific computing tool which can be used to solve many real life problems coming from various areas of science and engineering. The course introduces the basics of MATLAB; how to effectively usefew commonly used builtin functions; hands on experience on MATLAB programming and its applications tovarious practical problems.

Course Contents:

Module-I: Introduction to MATLAB: vector and matrix generation, subscripting and the colon notation, matrix and array operations and their manipulations, introduction to some inbuilt functions. m-files: scripts and functions, editing, saving m-files.

Module-II: Two & three-dimensional graphics: basic plots, change in axes and annotation in a figure, multipleplots in a figure, saving and printing figures, mesh plots, surface plots and their variants.

Module-III: Relational and logical operators: flow control using various statements and loops including If-End statement, If-Else-End statement, nested If-Else-End statement, For-End and While-End loops withBreak commands.

Module-IV: Applications of MATLAB: Solving a linear system of equations, calculus of polynomials usinginbuilt functions, solving equations in one variable, solving ordinary differential equations using inbuiltfunctions.

Examination Scheme

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	15	5	5	70

A: Attendance, CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/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: MTH2517 **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. Introduction on few builtin functions
3. 2D and 3D plots, multiple plots using figure and subplot commands
4. Annotation of plots
5. Simple script files and editing them
6. Introduction of function files
7. Introducing notion of sub-functions and nested functions
8. Solving IVPs using ode45 and other solvers
9. Solving system of linear equations using builtin functions

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.

MATHEMATICAL MODELLING

Course Code: MTH2515 **Credit Units: 03**

Course Objective:
Mathematical modeling is a process of formulating a real world problem into mathematical terms and analyzethem. The course is designed to learn mathematical tools such as difference equations, differential equations,concepts from probability theory to formulate and analyze real world problems.

Course Contents:

Module-I: Linear Growth and Decay Models Non-Linear Growth and Decay Models Compartment ModelsDynamic problems Geometrical problems.

Module-II: Population Dynamics Epidemics Compartment Models Economics Medicine, Arms Race, Battlesand International TradeDynamics.

Module-III: Planetary Motions Circular Motion and Motion of Satellites Mathematical Modelling throughLinear Differential Equations of Second Order Miscellaneous Mathematical Models.

Module-IV: Simple Models Basic Theory of Linear Difference Equations with Constant Coefficients Economics and Finance Population Dynamics and Genetics - Probability Theory.

Examination Scheme

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	15	5	5	70

A: Attendance, CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz,
EE: End Semester Exam

References

- Mathematical Modeling, J.N. Kapur, Wiley Eastern Limited, New Delhi, 1988.
- J.N. Kapur, Mathematical Models in biology and Medicine, EWP, New Delhi, 1985.
- M.M Gibbons, A Concrete Approach to Mathematical Modelling, John Wiley and Sons

R PROGRAMMING AND SAS

Course Code:MTH2519 **Credit Units: 03**

Course Objective:
To introduce programming concepts of R-programming, and how to use R for effective data analysis. Studentswill also get an exposure to SAS, a software commonly used by statisticians.

Course Contents:

Module-I: Overview of R, R data types and objects, reading and writing data, accessing R packages, writingR functions, debugging, profiling R code, and commenting R code.

Module-II: Control structures, functions, scoping rules, dates and times, Loop functions, organizing R code.

Module-III: SAS: Introduction to SAS System & Architecture, import and export raw data _les, manipulateand transform data, combine SAS data sets, create basic detail and summary reports using SAS proceduresidentify and correct data.

Module-IV: Leave and Continue Statements, Where Statement, If Then Else statement; Goto, Stop and Error statements; Output statement, Put statement; Do Loops; modifying and combining data sets; updating master data set; display manager commands; SAS functions; an introduction to arrays and array processing; overview of methods for combining SAS data sets.

Examination Scheme

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	15	5	5	70

A: Attendance, CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz,
EE: End Semester Exam

References

- Grolemund, Garrett, Hands-On Programming with R, Shroff Publishers & Distributers Private Limited Mumbai (2014)
- Mark Gardener, Beginning R: The Statistical Programming Language, Wiley (2013).
- Andrie de Vries, JorisMeys, R Programming For Dummies, Wiley Second edition (2016)
- Lora D. Delwiche, Susan J. Slaughter, The Little SAS Book: A Primer, SAS Institute; 4th edition, 2008.
- Ron P. Cody, Jeffrey K. Smith, Applied Statistics and the SAS Programming Language, Pearson; 5edition, 2005.

Syllabus - Sixth Semester

FINANCIAL MATHEMATICS

Course Code: MTH2603 **Credit Units: 04**

Course Objective:
The course introduces fundamental concepts of Financial Mathematics such as cash flows, present value, futurevalue, yield and probability that form the basis for further advanced learning.

Course Contents:

Module-I: Random Variable Discrete and Continuous, Probability Distributions Binomial, Poisson and Normal, Basics of Stochastic Process, Markov Process, Martingales.

Module-II: Derivative Securities, time value of money, Cash flow, money market, coupon bonds, Money market account.

Module-III: Forward and futures contracts Forward price formula, value of a forward contract,. Futures contract, Futures pricing. Swaps, value of commodity swaps.

Module-IV: Theory of option pricing Put-Call parity, behaviour of option prices with respect to variables,Pay-off curves, Single period and multi period binomial lattice model for option pricing, existence of riskneutral probability measure, pricing American options: A binomial lattice model, notion of complete markets, the CRR model, Black-Scholes formula for dividend paying stock, the Greeks. Portfolio optimizationRisk and return of an asset, two assets portfolio optimization, multi asset portfolio optimization, CapitalAsset Pricing Model (CAPM) as a pricing formula, as a factor model.

Examination Scheme

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	15	5	5	70

A: Attendance, CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz,
EE: End Semester Exam

References

- S. Chandra, S. Dharmaraja, Aparna Mehra, R. Khemchandani, An Introduction to Financial Mathematics,Narosa Publishing House Pvt. Ltd, 2013.
- Financial Economics: Advanced Financial Mathematics, Louis J. Lombardi, 2008.
- M. Baxter, A. Rennie, Financial Calculus. An Introduction to derivative pricing" Cambridge UniversityPress, 1996.
- J. Cvitanic and F. Zapatero, Introduction to the Economics and Mathematics of Financial Markets, MITPress, 2003.
- J. Medi, Stochastic processes, New Age International, 1994.

NUMBER THEORY

Course Code: MTH2611 **Credit Units: 04**

Course Objective:
Elementary Number Theory is the study of the basic structure and properties of integers. Learning Number Theory helps improving one's ability of mathematical thinking. The course is designed to introduce thefundamentals of number theory.

Course Contents:

Module-I: Divisibility, Euclidean algorithm, Linear Diophantine equations, Prime numbers, Fundamental theorem of arithmetic, Prime number theorem (statement only).

Module-II: Congruences, solutions of linear congruences, Chinese Remainder Theorem, Eulers totient function, Euler-Fermat theorem, Wilson's theorem, non-linear congruences, Hensel's lemma, primitive rootsand power residues.

Module-III: Quadratic residues, quadratic reciprocity, the Jacobi symbols. The greatest integer function, Arithmetic functions, Mobius function and Mobius inversion formula.

Module-IV: Finite continued fractions, infinite continued fractions, approximation to irrational numbers. Introduction to cryptography, public key cryptography, RSA.

Examination Scheme

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	15	5	5	70

A: Attendance, CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz,
EE: End Semester Exam

References

- Niven, I., Zuckerman, S.H., Montgomery, L.H., An Introduction to the Theory of Numbers, John Wileyand 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.
- N. Koblitz. Course in Number Theory and Cryptography, Springer, 1994.