FYUP Course Outline for Semester III

S. No.	Course Code	Course Title	Credits	Category
1	MTHS250MJ	Real Analysis	4	Major
2	MTHS251MJ	Differential Equations	4	Major
3	MTHS252MJ	Statistics	4	Major
4	MTHS253MJ	Operations Research	4	Major
5	DOMS250MV	Python	4	Minor Vocational

B.Sc. Mathematical Sciences- FYUGP

Course Title : **Real Analysis** **Semester: 4th**
Course Code : MTHS250MJ **Category: Major**

Credit hrs. : 4

Course Objectives: To develop a deep understanding of the real number system and its properties, as well as mastering the techniques and concepts used in rigorous mathematical proofs.

Course Outcomes:

1. Develop a rigorous understanding of the real number system
2. Study the convergence and divergence of sequences and series
3. Explore the concepts of limits and continuity of real-valued functions
4. Study Riemann integration and develop techniques for computing definite and indefinite integrals
5. Investigate the convergence properties of sequences and series of functions

Unit I: Real numbers; ordered sets; bounded and unbounded sets; supremum and infimum of a set, **o**rdered fields; completeness of the set of real numbers.

Unit II: Limits of functions, continuity, uniform continuity; sequences; limits of sequences and limit theorems; bounded and monotone sequences; Cauchy sequences; Bolzano-Weistrass Theorem;

Unit III: Riemann integrals, upper and lower sums; integrability of continuous and monotone functions; fundamental theorem of integral calculus, mean value theorems of integral calculus; improper integrals and their convergence

Unit IV: Limit, continuity and differentiability of real-values functions of two variables; partial derivatives; changing the order of derivation; change of variables, Jacobians

Text Books:

- An Introduction to Real Analysis by Bartle and Sherbert (Wiley & Sons).

Supplementary books:

- Mathematical Analysis by Tom Apostol
- Principles of Mathematical Analysis by Walter Rudin
- An Introduction to Analysis by William Wade
- A Course in Real Analysis by Shanti Narayan
- Real Analysis by R.R. Goldberg
- Undergraduate Analysis by Serge Lang
- Real Analysis by Terence Tao, Hindustan Book Agency (TRIM Series)

B.Sc. Mathematical Sciences- FYUGP

Course Title : **Differential Equations** **Semester: 4th**
Course Code : MTHS251MJ **Category: Major**

Credit hrs. : 4

Course Objective: Introduces students the concrete concept of differential equations and their applications in mathematical modeling, shell theory, informatics, and oscillation theory.

Course Outcomes: After the completion of paper student will able to:

1. Students will learn about differential equations in depth covering first and second order differential equations, linear and nonlinear equations and differential equation systems.
2. Students will learn how to solve differential equations using various approaches such as variable separation, integrating factors, characteristic equations, and Laplace transforms, hence improving their analytical and computational abilities.
3. Students will be able to use differential equations to model and solve real-world issues in physics, engineering, biology and other subjects demonstrating the concepts practical relevance and usefulness.

Unit I: Some basic differential equations; classification of differential equations; first order differential equations; linear equations and method of integrating factors; separable equations; modeling with first order equations; exact equations; numerical approximation and Euler's method

Unit II: Second order differential equations, homogeneous and non-homogeneous equations; fundamental solutions; linear independence and Wronskian; complex roots of the characteristics equation; higher order equations

Unit III: Series solutions of differential equations, Bessel and Legendre equations; series solutions near an ordinary point; regular singular points, Euler equations

Unit IV: Laplace transform; Laplace transforms of common functions, inverse transform and transforms of derivatives; Dirac-Delta function

Text Book:

- Elementary Differential Equations and Boundary Value Problems by William E. Boyce and Richard C. DiPrima

Supplementary books:

- Differential Equations with Application and Historical Notes by G Simmons
- Differential Equations by Dennis Zill
- Differential Equations – Schaum Series
- Introduction to Differential Equations by E.G. Phillips
- Differential Equations by Jane Cronin

B.Sc. Mathematical Sciences- FYUGP

Course Title : **Statistics** **Semester: 4th**

Course Code : MTHS252MJ **Category: Major**

Credit hrs. : 4

Course Objective: To make the students aware of different type of data sets and their graphical representations introducing of descriptive statistical measures, including those for two variables. The main objective is also to build the practical foundation of Testing of Hypothesis.

Course Outcomes: After completion of this course student will able to

1. Understand basic concepts of statistical data.

2. Recognize different diagrammatic tools for visualization of data

3. Apply different statistical measures to describe the data.

4. Asses relationship between two variables.

5. Apply different statistical test procedures for different testing of hypothesis problems.

6. Interpret the statistical results

Unit I. Statistics a conceptual frame work, Statistical enquiry, collection of data, Classification, Seriation and tabulation of data. Diagrammatic and Graphic presentation of data. Measures of central tendency: mean, median, mode. Measures of dispersion-range, mean deviation, quartile deviation Standard deviation and variance. Measure of skewness- Karl-Pearson's and Bowley's methods. Measures of Kurtosis.

Unit II. Correlation Analysis - conceptual frame work .Methods of studying correlation-Scatter diagram, Karl Pearson's correlation coefficient, Spearman's rank correlation coefficient and concurrent deviation methods. Probable error (ungrouped data), coefficient of determination.
Regression Analysis - definition and uses, Linear and Non-linear regression. Regression equations and regression coefficient, Properties of regression coefficient, multiple regression

Unit III: Population and sample; population parameter and sample statistics; Sampling distributions, Sampling distribution of mean, Variance and proportions. Hypothesis testing, general procedure and errors in hypothesis testing, hypothesis testing for population parameters with large and small samples, Hypothesis testing based on F-distribution and t-distribution. Chi-Square test for goodness of fit, chi-square test for population variances, chi-square test for association.

Unit IV: Analysis of variance, assumptions for ANOVA test, ANOVA for one-way and two-way classified data. Non-parametric inference, advantages of non-parametric methods over parametric methods, one-sample problem, Sign Test, Wilcoxon-Signed rank test, Kolmogorov-Smirnov test, General Two Sample Problem: Sign Test , Wilcoxon-Mann- Whitney Test, Kolmogorov-Smirnov two sample test (for samples of equal size), median test.

Textbook: An Introduction to probability Theory and Mathematical Statistics by V.K. Rohtagi and Saleh

Supplementary Texts:

- A First Course on Parametric Inference, Narosa Publishing by Kale, B.K. (1999)
- Applied non parametric statistical methods, second edition by H.C. Tuckwll.
- Business Mathematics & Statistics', Asian Books Private Ltd. By Verma A.P.
- Fundamentals of Statistics by S.C. Gupta

- Fundamentals of Statistics by Ellance D N, Veena Elhance & Aggarwal B. M, Kitab Mahal.
- New Mathematical Statistics (A Problem-Oriented First Course) by Sanjay Arora and Bansi Lal
- Non-Parametric Statistical Inference. By Marcel Decker and J.D. Gibbons (1985)

Course Title : **Operations Research** **Semester: 4th**

Course Code : MTHS253MJ **Category: Major**

Credit hrs. : 4

Course Objective: The aim of the course is to give knowledge to students to use quantitive methods and techniques for effective decisions–making; model formulation and applications that are used in solving business decision problems.

Course Outcomes:

1. Student will be able to Identify and develop operational research models from the verbal description of the real system.
2. Understand the mathematical tools that are needed to solve optimization problems.
3. Solve various linear programming, transportation, assignment, queuing, inventory and game problems related to real life.

UNIT-I: Linear programming; concept and uses of linear programming, formulation of linear programming problem. Solution of LP problem- graphical method, simplex method. Duality in Linear Programming, Properties of the primal-dual pair- Dual simplex Method.

UNIT II: Transportation and Assignment problems: Formulation of transportation and assignment problems as linear programs. Methods of obtaining the initial basic feasible solution to a transportation problem. Solution of the Transportation problem by MODI Method. Unbalanced transportation problems and their solutions. Degeneracy in Transportation problem and its resolution. Solution of Assignment Problem by Hungarian Method. Traveling salesman problem as an assignment problem (Formulation only).

UNIT III: Sequencing problems- problems with n jobs and 2 machines, problems with n jobs and k machines. Games and Strategies: Two person zero-sum games, Maximin-Minimax Principle, Mixed Strategies, Solution of 2×2 and $m\times n$ games.

UNIT-IV: Concept of PERT/CPM networks, estimating the activity time, determination of earliest expected and latest allowable times, determination of critical path Drawing network diagram, probability consideration in PERT networks PERT/CPM- cost analysis, applications of PERT/CPM. Simulation: meaning & uses; Monte Carlo method, random number generation, waiting line simulation model.

Books Recommended:

- Gass, S.I.: Linear Programming-Methods & Applications.
- Hillier & Liberman: Introduction to Operations Research, Mc. Graw Hill Book Co.
- Taha, H.A.: Operations Research-An introduction, Pentice Hall of India Pvt. Ltd. New Delhi. (7th Edition-2003)
- Swaroop K, Gupta, P.K. & Mohan, M.: Operations Research, Sultan Chand & Sons, New Delhi.
- Vohra, N D: 'Quantitative Techniques in Management' Tata McGraw Hill
- Sharma S.D.: 'Operational Research', Kedar Nath Ram Nath and Co., Meerut

- Kothari C R: ‘Quantitative Techniques’ Vikas Publishing House.
- Bicrman, H., C.P. Bonini & W.H. Hausman: ‘Quantitative Analysis for Business Decisions, Homewood, Illions: Rechard D, Irwin Inc.
- Gordon, R.L. and I. Pressman: ‘Quantitative Decisions making for Business’, Prentice Hall Inc.
- Kwas, N.K.: ‘Mathematical Programming with Business Applications’, McGraw Hill, New York.

B.Sc. Mathematical Sciences- FYUGP

Course Title : **Python** **Semester: 4th Course Code : DOMS250MV** **Category: Minor Vocational**

Credit hrs. : 4

UNIT - I:

Programming as a way of thinking, Installation and Working with Python, Understanding Python variables, Variables and Statements, Functions, Operators, Understanding python blocks.

UNIT – II:

Functions and Interfaces, Conditionals and Recursion, Return Values, Iteration and Search, Strings and Regular Expressions, Conditional blocks using if, else and elif, Simple for loops in python, For loop using ranges, continue, break and else, Programming using Python conditional and loops block.

UNIT – III:

Organizing python codes using functions, importing own module as well as external modules, Understanding Packages, Powerful Lambda function in python, Programming using functions, modules and external packages

UNIT – VI:

Lists, Dictionaries, Tuples, Text Analysis and Generation, understanding string in build methods, Dictionary manipulation, Programming using string, Files and Databases

UNIT – V:

Concept of class, object and instances, Inheritance, overlapping and overloading operators, Classes and Functions, Classes and Methods

RECOMMENDED TEXTBOOKS:

1. Mark Pilgrim, ― "Dive into Python 3", Apress, 2009.

2. Allen Downey, Jeffrey Elkner, Chris Meyers, ― "How to Think Like a Computer

Scientist _ Learning with Python", Green Tea Press,2002.