B.A./B.Sc. III (SEMESTER-VI) PAPER-I METRIC SPACES & COMPLEX ANALYSIS

Programme: Degree Class: B.A./B.Sc.	Year: Third	Semester: Sixth
Subject: Mathematics		
Course Code: B030601T	Course Title: METRIC SPACES & COMPLEX ANALYSIS	

Course outcomes:

CO1: The course is aimed at exposing the students to foundations of analysis which will be useful in understanding various physical phenomena and gives the student the foundation in mathematics.

CO2: After completion of this course the student will have rigorous and deeper understanding of fundamental concepts in Mathematics. This will be helpful to the student in understanding pure mathematics and in research.

CO3: Students will be able to know the concepts of metric space, basic concepts and developments of complex analysis which will prepare the students to take up further applications in the relevant fields.

Credits: 4	Core Compulsory / Elective
Max. Marks: 25+75	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0

Part- A

Metric Spaces

Unit	Topics	No. of Lectures
I	**Basic Concepts** Metric spaces**:** Definition and examples, Sequences in metric spaces, Cauchy sequences, Complete metric space.	8
II	**Topology of Metric Spaces** Open and closed ball, Neighborhood, Open set, Interior of a set, limit point of a set, derived set, closed set, closure of a set, diameter of a set, Cantor's theorem, Subspaces, Dense set.	8
III	**Continuity & Uniform Continuity in Metric Spaces** Continuous mappings, Sequential criterion and other characterizations of continuity, Uniform continuity, Homeomorphism, Contraction mapping, Banach fixed point theorem.	7
IV	**Connectedness and Compactness** Connectedness, Connected subsets of , Connectedness and continuous mappings, Compactness, Compactness and boundedness, Continuous functions on compact spaces.	7

Part- B
Complex Analysis

Unit	Topics	No. of Lectures
V	**Analytic Functions and Cauchy-Riemann Equations** Functions of complex variable, Mappings; Mappings by the exponential function, Limits, Theorems on limits, Limits involving the point at infinity, Continuity, Derivatives, Differentiation formulae, Cauchy-Riemann equations, Sufficient conditions for differentiability; Analytic functions and their examples.	8
VI	**Elementary Functions and Integrals** Exponential function, Logarithmic function, Branches and derivatives of logarithms, Trigonometric function, Derivatives of functions, Definite integrals of functions, Contours, Contour integrals and its examples, Upper bounds for moduli of contour integrals.	8
VII	**Cauchy's Theorems and Fundamental Theorem of Algebra** Antiderivatives, Proof of antiderivative theorem, Cauchy-Goursat theorem, Cauchy integral formula; An extension of Cauchy integral formula, Consequences of Cauchy integral formula, Liouville's theorem and the fundamental theorem of algebra.	7
VIII	**Series and Residues** Convergence of sequences and series, Taylor series and its examples; Laurent series and its examples, Absolute and uniform convergence of power series, Uniqueness of series representations of power series, Isolated singular points, Residues, Cauchy's residue theorem, residue at infinity; Types of isolated singular points, Residues at poles and its examples.	7

Suggested Readings (Part-A Metric Space):

1. Mathematical Analysis by Shanti Narain.
2. Shirali, Satish & Vasudeva, H. L. (2009). Metric Spaces, Springer, First Indian Print.
3. Kumaresan, S. (2014). Topology of Metric Spaces (2nd ed.). Narosa Publishing House. New Delhi.
4. Simmons, G. F. (2004). Introduction to Topology and Modern Analysis.Tata McGraw Hill. New Delhi.
5. Suggested digital plateform:NPTEL/SWAYAM/MOOCS.
6. Course Books published in Hindi may be prescribed by the Universities.

Suggested Readings (Part-B Complex Analysis):

1. Function of Complex Variable by Shanti Narain.
2. Complex variable and applications by Brown & Churchill.
3. Suggested digital plateform:NPTEL/SWAYAM/MOOCS.
4. Course Books published in Hindi may be prescribed by the Universities.

This course can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), B.Sc.(C.S.)

Suggested Continuous Evaluation Methods: Max. Marks: 25

SN	Assessment Type	Max. Marks
1	**Class Tests**	10
2	**Online Quizzes/ Objective Tests**	5
3	**Presentation**	5
4	**Assignment**	5

Course prerequisites: To study this course, a student must have Diploma in Mathematics

Suggested equivalent online courses:

Further Suggestions:

B.A./B.Sc. III (SEMESTER-VI) PAPER-II Numerical Analysis & Operation Research

Programme: Degree Class: B.A./B.Sc.	Year: Third	Semester: Sixth
Subject: Mathematics		
Course Code: B030602T	Course Title: Numerical Analysis & Operations Research	

Course outcomes:

CO1: The aim of this course is to teach the student the application of various numerical technique for variety of problems occurring in daily life. At the end of the course the student will be able to understand the basic concept of Numerical Analysis and to solve algebraic and differential equation.

CO2: The main outcome will be that students will be able to handle problems and finding approximated solution. Later he can opt for advance course in Numerical Analysis in higher Mathematics.

CO3: The student will be able to solve various problems based on convex sets and linear programming. After successful completion of this paper will enable the students to apply the basic concepts of transportation problems and its related problems to apply in further concepts and application of operations research.

Credits: 4	Core Compulsory / Elective
Max. Marks: 25+75	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0

PART-A

Numerical Analysis

Unit	Topics	No. of Lectures
I	Solution of equations: bisection, Secant, Regular Falsi, Newton Raphson's method, Newton's method for multiple roots, Interpolation, Lagrange and Hermite interpolation, Difference schemes, Divided differences, Interpolation formula using differences.	8
II	Numerical differentiation, Numerical Quadrature: Newton Cotes Formulas, Gaussian Quadrature Formulas, System of Linear equations: Direct method for solving systems of linear equations (Gauss elimination, LU Decomposition, Cholesky Decomposition), Iterative methods (Jacobi, Gauss Seidel, Relaxation methods). The Algebraic Eigen value problem: Jacobi's method, Givens method, Power method.	8
III	Numerical solution of Ordinary differential equations: Euler method, single step methods, Runge-Kutta method, Multi-step methods: Milne-Simpson method, Types of approximation: Last Square polynomial approximation, Uniform approximation, Chebyshev polynomial approximation.	7
IV	Difference Equations and their solutions, Shooting method and Difference equation method for solving Linear second order differential equation with boundary conditions of first, second and third type.	7

PART-B

Operations Research

Unit	Topics	No. of Lectures
V	Introduction, Linear programming problems, statement and formation of general linear programming problems, graphical method, slack and surplus variables, standard and matrix forms of linear programming problem, basic feasible solution.	8
VI	Convex sets, fundamental theorem of linear programming, basic solution, Simplex method, introduction to artificial variables, two phase method Big-M method and their comparison.	8
VII	Resolution of degeneracy, duality in linear programming problems, primal dual relationships, revised simplex method, sensitivity analysis.	7
VIII	Transportation problems, assignment problems.	7

Suggested Readings(Part-A Numerical Analysis):

1. Numerical Methods for Engineering and scientific computation by M. K. Jain, S.R.K. Iyengar & R.K. Jain.
2. Introductory methods of Numerical Analysis by S. S. Sastry
3. Suggested digital plateform:NPTEL/SWAYAM/MOOCs
4. Course Books published in Hindi may be prescribed by the Universities.

Suggested Readings(Part-B Operation Research):

1.Taha, Hamdy H, "Opearations Research- An Introduction ", Pearson Education.

2.Kanti Swarup , P. K. Gupta , Man Mohan Operations research, Sultan Chand & Sons

3.Hillier Frederick S and Lieberman Gerald J., “Operations Research”, McGraw Hill Publication.

4.Winston Wayne L., “Operations Research: Applications and Algorithms”, Cengage Learning, 4th Edition.

5.Hira D.S. and Gupta Prem Kumar, “Problems in Operations Research: Principles and Solutions”, S Chand & Co Ltd.

6. Kalavathy S., “Operations Research”, S Chand.

7. Suggested digital plateform:NPTEL/SWAYAM/MOOCs.

8. Course Books published in Hindi may be prescribed by the Universities.

This course can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), Economics(UG/PG), B.Sc.(C.S.)

Suggested Continuous Evaluation Methods: Max. Marks: 25

SN	Assessment Type	Max. Marks
1	**Class Tests**	10
2	**Online Quizzes/ Objective Tests**	5
3	**Presentation**	5
4	**Assignment**	5

Course prerequisites: To study this course, a student must have Certificate Course in Applied Mathematics

Suggested equivalent online courses:

Further Suggestions:

B.A./B.Sc. III (SEMESTER-VI) PAPER-III Practical

Programme: Degree **Class: B.A./B.Sc.**	**Year: Third**	**Semester: Sixth**
Subject: Mathematics		
Course Code: B030603P	**Course Title: Practical**	

Course outcomes:

The main objective of the course is to equip the student to solve the transcendental and algebraic equations, system of linear equations, ordinary differential equations, Interpolation, Numerical Integration, Method of finding Eigenvalue by Power method (up to 4×4), Fitting a Polynomial Function (up to third degree).

Credits: 2	**Core Compulsory / Elective**
Max. Marks: 25+75	**Min. Passing Marks:**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4

Unit	**Topics**	**No. of Lectures**
	Practical / Lab work to be performed in Computer Lab. List of the practicals to be done using computer algebra software (CAS), for example Mathematica/MATLAB/Maple/ Maxima/Scilab etc 1. Solution of transcendental and algebraic equations by i) Bisection method ii) Newton Raphson method (Simple root, multiple roots, complex roots). iii) Secant method. iv) Regula Falsi method. 2. Solution of system of linear equations i) LU decomposition method ii) Gaussian elimination method iii) Gauss-Jacobi method iv) Gauss-Seidel method 3. Interpolation i) Lagrange Interpolation ii) Newton's forward, backward and divided difference interpolations 4. Numerical Integration i) Trapezoidal Rule ii) Simpson's one third rule iii) Weddle's Rule iv) Gauss Quadrature 5. Method of finding Eigenvalue by Power method (up to 4×4) 6. Fitting a Polynomial Function (up to third degree)	

	7. Solution of ordinary differential equations i) Euler method ii) Modified Euler method iii) Runge Kutta method (order 4) (iv) The method of successive approximations (Picard)	

Suggested Readings:

This course can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), Economics(UG/PG), B.Sc.(C.S.)

Suggested Continuous Evaluation Methods: Max. Marks: 25

SN	Assessment Type	Max. Marks
1	**Class Tests**	**10**
2	**Online Quizzes/ Objective Tests**	**5**
3	**Presentation**	**5**
4	**Assignment**	**5**

Course prerequisites: To study this course, a student must have Certificate Course in Applied Mathematics

Suggested equivalent online courses:

Further Suggestions: