ख़्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत)
Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India)
U.P. STATE GOVERNMENT UNIVERSITY,
(Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE)

.C13 Group and Ring Theory & Linear Algebra **6 Credits (5L+1T)**

Duration 3hrs Marks: 100(75+25) 75 Lectures + 15 Tutorials

Programme: Degree **Class: B.Sc.**	**Year: Third**	**Semester: Fifth**
Subject: Mathematics		
Course Code: B030501T	**Course Title: Group and Ring Theory &Linear Algebra**	

Course outcomes:

CO1: Liner algebra is a basic course in almost all branches of science. The objective of this course is to introduce a student to the basics of linear algebra and some of its applications.

CO2: Students will be able to know the concepts of group, ring and other related properties which will prepare the students to take up further applications in the relevant fields.

CO3: The student will use this knowledge in computer science, finance mathematics, industrial mathematics and biomathematics. After completion of this Course students appreciate its interdisciplinary nature.

Credits:5	**Core Compulsory/Elective**
Max.Marks:25+75	**Min. Passing Marks:**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:5-0-0

PART-A

Group and Ring Theory

Unit	**Topics**	**No.of Lectures**
I	**IntroductiontoIndianancientMathematicsandMathematiciansshouldbeincluded under Continuous Internal Evaluation(CIE).** Automorphism, inner automorphism, Automorphism groups, Automorphism groups of finite and infinite cyclic groups, Characteristic subgroups, Commutator subgroup and its properties; Applications of factor groups to automorphism groups.	**10**
II	Conjugacy classes, The class equation, *p*-groups, The Sylow theorems and consequences, Applications of Sylow theorems; Finite Simple groups, Non simplicity tests; Generalized Cayley's theorem, Index theorem, Embedding theorem and applications.	**10**
III	Polynomial rings over commutative rings, Division algorithm and consequences, Principal ideal domains, Factorization of polynomials, Reducibility tests, Irreducibility tests, Eisenstein criterion, Unique factorization in Z[x].	**9**
IV	Divisibility in integral domains, Irreducibles, Primes, Unique factorization domains, Euclidean domains.	**9**

PART-B

Linear Algebra

Unit	Topics	No.of Lectures
V	Vector spaces, Subspaces, Linear independence and dependence of vectors, Basis and Dimension, Quotient space.	**10**
VI	Linear transformations, The Algebra of linear transformations, rank nullity theorem, their representation as matrices.	**9**
VII	Linear functionals, Dual space, Characteristic values, Cayley Hamilton Theorem.	**9**
VIII	Inner product spaces and norms, Cauchy-Schwarz inequality, Orthogonal vectors, Orthonormal sets and bases, Bessel's inequality for Finite dimensional spaces, Gram-Schmidth orthogonalization process, Bilinear and Quadratic forms.	**9**

Suggested Readings:

1. Topics in Algebra by I.N. Herstein.

2. Linear Algebra by K. Hoffman and R.Kunze.

3. Suggested digital plateform: NPTEL/SWAYAM/MOOCs

4. Course Books published in Hindi maybe prescribed by the Universities.

This course can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), BCA, 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 (Introduction to Indian ancient Mathematics and Mathematicians)**	**5**

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

Suggested equivalent online courses:

Further Suggestions:

C14 (i) Number Theory & Game Theory **6 Credits (5L+1T)**

Duration 3hrs **Marks: 100(75+25)** **75 Lectures + 15 Tutorials**

Programme: Degree **Class: B.Sc.**	**Year: Third**	**Semester: Sixth**
Subject: Mathematics		
Course Code: B030502T	**Course Title: Number Theory & Game Theory**	

Course outcomes:

CO1: Upon successful completion, students will have the knowledge and skills to solve problems in elementary number theory and also apply elementary Number theory to cryptography.

CO2: This course provides an introduction to Game Theory. Game Theory is a mathematical framework which makes possible the analysis of the decision-making process of interdependent subjects. It is aimed at explaining and predicting how individuals behave in a specific strategic situation, and therefore help improve decision making.

CO3: A situation is strategic if the outcome of a decision problem depends on the choices of more than one person. Most decision problems in real life are strategic.

CO4: To illustrate the concepts, real-world examples, case studies, and classroom experiments might be used.

Credits:5	**Core Compulsory/Elective**
Max.Marks:25+75	**Min. Passing Marks:**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:5-0-0

Part- A

Number Theory

Unit	**Topics**	**No.of Lectures**
I	**Theory of Numbers** Divisibility; Euclidean algorithm; primes; congruences; Fermat's theorem, Euler's theorem and Wilson's theorem; Fermat's quotients and their elementary consequences; solutions of congruences; Chinese remainder theorem; Euler's phi-function.	**10**
II	**Congruences** Congruence modulo powers of prime; primitive roots and their existence; quadratic residues; Legendre symbol, Gauss' lemma about Legendre symbol; quadratic reciprocity law; proofs of various formulations; Jacobi symbol.	**9**
III	**Diophantine Equations** Solutions of ax+by=c, $x^n+y^n=z^n$; properties of Pythagorean triples; sums of two, four and five squares; assorted examples of Diophantine equations.	**9**
IV	**Generating Functions and Recurrence Relations** Generating Function Models, calculating coefficient of generating functions, Partitions, Exponential Generating Functions, A Summation Method. Recurrence Relations: Recurrence Relation Models, Divide and conquer Relations, Solution of Linear, Recurrence Relations, Solution of Inhomogeneous Recurrence Relations, Solutions with Generating Functions.	**9**

Part- B
Game Theory

Unit	Topics	No.of Lectures
V	Introduction, overview, uses of game theory, some applications and examples, and formal definitions of: the normal form, pay offs, strategies, pure strategy Nash equilibrium.	10
VI	Introduction, characteristic of game theory, Two-person zero-sum game, Pure and Mixed strategies, Saddle point and its existence.	10
VII	Fundamental Theorem of Rectangular games, Concept of Dominance, Dominance and Graphical method of solving Rectangular games.	9
VIII	Relationship between rectangular game and Linear Programming Problem, Solving rectangular game by Simplex method, reduction of mxn game and solution of2x2,2 xs ,and rx2 cases by graphical method, algebraic and linear programming solution of mxn games.	9

Suggested Readings(Part-A Number Theory):

1. Niven,I.,Zuckerman, H.S. and Montegomery, H. L.(2003)An Int. to the Theory of Numbers (6thedition)John Wileyandsons,Inc.,New York.
2. Burton,D.M.(2002)ElementaryNumberTheory(4thedition)Universal BookStall,NewDelhi.
3. Balakrishnan,V.K.(1994)Schaum'sOutlineofTheoryandProblemsofCombinatoricsIncludingConceptsofGraphTheory,Schaum'sOutline.
4. Balakrishnan,V.K.(1996)IntroductoryDiscreteMathematics,DoverPublications.
5. Suggesteddigitalplateform:NPTEL/SWAYAM/MOOCs
6. CourseBookspublishedinHindimaybeprescribedbytheUniversities.

Suggested Readings (Part-B Game Theory):

1. Martin Osborne, An Introduction to Game Theory, OxfordUniversityPress,2003
2. Vijay Krishna,Game Theory, AcademicPress.
3. PrajitDutta, StrategiesandGames, MITPress, (Website1)http://www.ece.stevens-tech.edu/~ccomanic/ee800c.html
5. Allan Mackenzie, Game Theory forWirelessEngineers,SynthesislecturesonCommunications,2006
6. Suggesteddigitalplateform:NPTEL/SWAYAM/MOOCS
7. Course Books published in Hindi maybe prescribed by the Universities.

This course can be opted as an elective by the students of following subjects: Engg.andTech.(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 pre requisites: To study this course, a student must have Diploma in Mathematics

Suggested equivalent online courses:

Further Suggestions:

C14(ii) Graph Theory & Discrete Mathematics **6 Credits (5L+1T)**

Duration 3hrs **Marks: 100(75+25)** **75 Lectures + 15 Tutorials**

Programme:Degree Class:B.Sc.	**Year: Third**	**Semester: Sixth**
Subject: Mathematics		
CourseCode:B030502T	**Course Title: Graph Theory & Discrete Mathematics**	

Course outcomes:

CO1: Upon successful completion, students will have the knowledge of various types of graphs, their terminology and applications.

CO2: After Successful completion of this course students will be able to understand the isomorphism and homomorphism of graphs. This course covers the basic concepts of graphs used in computer science and other disciplines. The topics include path, circuits, adjacency matrix, tree, coloring. After successful completion of this course the student will have the knowledge graph coloring, color problem, vertex coloring.

CO3: After successful completion, students will have the knowledge of Logic gates, Karnaugh maps and skills to proof by using truth tables. After Successful completion of this course students will be able to apply the basics of the automation theory, transition function and table.

CO4: This course covers the basic concepts of discrete mathematics used in computer science and other disciplines that involve formal reasoning. The topics i include logic, counting, relations, Hasse diagram and Boolean algebra. After successful completion of this course the student will have the knowledge in Mathematical reasoning, combinatorial analysis, discrete structures and Applications.

Credits:5	**Core Compulsory/Elective**
Max.Marks:25+75	**Min. Passing Marks:**
TotalNo.ofLectures-Tutorials-Practical(inhoursperweek):L-T-P:5-0-0	

Part- A

Graph Theory

Unit	Topics	No. of Lectures
I	Introduction to graphs, basic properties of graphs, Simple graph, multigraph, graph terminology, representation of graphs, Bipartite, regular, planar and connected graphs, connected components in a graph, Euler graphs, Directed, Undirected, multi-graph, mixed graph.	**10**
II	Walk and unilateral components, unicursal graph, Hamiltonian path and circuits, Graph colouring, chromatics number, isomorphism and homomorphism of graphs, Incidence relation and degree of the graph.	**9**
III	Operation of graph circuit, Path and circuits, Eulerian circuits, Hamiltonian path and cycles, Adjacency matrix, Weighted graph, Travelling salesman problem, shortest path, Dijkstra’s algorithm.	**9**
IV	Tree, Binary and Spanning trees, Coloring, Color problems, Vertex coloring and important properties.	**9**

Part- B

Discrete Mathematics

Unit	Topics	No.of Lectures
V	**Propositional Logic**-Proposition logic, basic logic, logical connectives, truth tables, tautologies, contradiction, normal forms (conjunctive and disjunctive), modus ponens and modus tollens, validity, predicate logic, universal and existential quantification, proof by implication, converse, inverse contrapositive, contradiction, direct proof by using truth table. **Relation**-Definition, types of relation, domain and range of a relation, pictorial representation of relation, properties of relation, partial Ordering relation.	**10**
VI	**Boolean Algebra-** Basic definitions, Sum of products and products of sums, Logic gates and Karnaugh maps. **Graphs-** Simple graph, multi graph, graph terminology, representation of graphs, Bipartite, regular, planar and connected graphs, connected components in a graph, Euler graphs, Hamiltonian path and circuits, Graph coloring, chromatics number, isomorphism and Homomorphism of graphs.	**10**
VII	**Combinatories-** Inclusion- exclusion, recurrence relations (nth order recurrence relation with constant coefficients, Homogeneous recurrence relations, Inhomogeneous recurrence relations), generating function (closed form expression, properties of G.F., solution of Recurrence relations using G.F. solution of combinatorial problem using G.F.)	**9**
VIII	**Finite Automata**-Basic concepts of automation theory, Deterministic Finite Automation (DFA), transition function, transition table, Non Deterministic Finite Automata (NDFA), Mealy and Moore machine, Minimization of finite automation.	**9**

Suggested Readings(Part-A Graph Theory):

1. "GraphTheorywithApplicationstoEngineeringandComputerScience"byNarsinghDeo
2. "IntroductiontoGraphTheory"byDouglasBWest
3. "GraphTheorywithAlgorithmsandItsApplications:InAppliedScienceandTechnology"bySantanuSahaRay
4. Suggesteddigitalplateform:NPTEL/SWAYAM/MOOCs
5. CourseBookspublishedinHindimaybeprescribedbytheUniversities.

Suggested Readings(Part-B Discrete Mathematics):

1. Discrete Mathematics by C.L.Liu.
2. Discrete Mathematics with computer application by Trembley and Manohar.
3. Discrete Mathematics and Its Applications by Kenneth H.Rosen
4. Suggested digital plateform:NPTEL/SWAYAM/MOOCS
5. Course Books published in Hindi maybe 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 pre requisites: To study this course, a student must have Diploma in Mathematics

Suggested equivalent online courses:

Further Suggestions:

C14(iii) Differential Geometry &Tensor Analysis **6 Credits (5L+1 T)**

Duration 3hrs **Marks : 100(75+25)** **75 Lectures + 15 Tutorials**

Programme: Degree **Class: B.Sc.**	**Year: Third**	**Semester: Sixth**
Subject: Mathematics		
Course Code: B030502T	**Course Title: Differential Geometry &Tensor Analysis**	

Course outcomes:

CO1: After Successful completion of this course, students should be able to determine and calculate curvature of curves in different coordinate systems.

CO2: This course covers the Local theory of curves, Local theory of surfaces, Geodesics, Geodesics curvature, Geodesic polars, Curvature of curves on surfaces, Gaussian curvature, Normal curvature etc.

CO3: After Successful completion of this course, students should have the knowledge of tensor algebra, different types of tensors, Riemannian space, Ricci tensor, Einstein space and Einstein tensor etc.

Credits:5	**Core Compulsory/Elective**
Max.Marks:25+75	**Min. Passing Marks:**
TotalNo.ofLectures-Tutorials-Practical(inhoursperweek):L-T-P:5-0-0	

Part- A

Differential Geometry

Unit	**Topics**	**No.of Lectures**
I	Local theory of curves-Space curves, Examples, Plane Curves, tangent and normal and binormal, Osculating Plane, normal plane and rectifying plane, Osculating circle, osculating sphere Helices, Serret-Frenet apparatus, contact between curve and surfaces, tangents surfaces, involutes and evolutes of curves, Bertrand curves, Intrinsic equations, fundamental existence theorem for space curves.	**10**
II	Local Theory of Surfaces-Parametric patches on surface curve of a surface, family of surfaces (one parameter),edge of regression, rues surfaces, skew ruled surfaces and developable surfaces, surfaces of revolution, Helicoids.	**9**
III	Metric-first fundamental form and arc length, Direction coefficients, families of curves, intrinsic properties, geodesics, canonical geodesic equations, normal properties of geodesics, geodesics curvature, Geodesic polars.	**9**
IV	Gauss-Bonnet theorem, curvature of curves on surfaces, Gaussian curvature, normal curvature, Meusneir’s theorem, mean curvature, Gaussian curvature, umbilic points, lines of curvature, Rodrigue’s formula, Euler’s theorem.	**9**

Part- B

Tensor Analysis

Unit	Topics	No.of Lectures
V	Tensor algebra: Vector spaces, the dual spaces, tensor product of vector spaces, transformation formulae, contraction, special tensors- Symmetric tensor, inner product, associated tensor with examples.	**10**
VI	Tensor Analysis: Contravariant and covariant vectors and tensors, Mixed tensors, Symmetric and skew-symmetric tensors, Algebra of tensors, Contraction and inner product, Quotient theorem, Reciprocal tensors, Christoffel's symbols, Law of transformation of Christoffel's symbols, Covariant differentiation, non-commutativity of Covariant derivative.	**10**
VII	Gradient of scalars, Divergence of a contravariant vector, covariant vector and conservative vectors, Laplacian of an invariant, curl of a covariant vector, irrotational vector, with examples.	**9**
VIII	Riemannian space, Riemannian curvatures and their properties, geodesics, geodesic curvature, geometrical interpretation of curvature tensor, Ricci tensor, scalar curvature, Einstein space and Einstein tensor.	**9**

Suggested Readings (Part-A Differential Geometry):

1. T.J.Willmore,AnIntroductiontoDifferentialGeometry,DoverPublications,2012.
2. B.O'Neill,ElementaryDifferentialGeometry,2ndEd.,AcademicPress,2006.
3. C.E.Weatherburn,DifferentialGeometryofThreeDimensions,CambridgeUniversityPress2003.
4. D.J.Struik,LectureonClassicalDifferentialGeometry,DoverPublications,1988.
5. S.Lang,FundamentalsofDifferentialGeometry,Springer,1999.
6. B.Spain,TensorCalculus:AConciseCourse,DoverPublications,2003.
7. AnIntroductiontoDifferentialGeometry(withtheuseoftensorCalculus),L.P.Eisenhart,PrincetonUniversityPress,1940.
8. Tensor Analysis, Theory and Applications to Geometry and Mechanics of Continua,2nd Edition, I. S. Sokolnikoff, JohnWileyandSons.,1964.
9. Suggested digital plateform: NPTEL/SWAYAM/MOOCs
10. Course Books published in Hindi may be prescribed by the Universities.

Suggested Readings(Part-B Tensor Analysis):

1. Tensors-Mathematics of Differential Geometry by Z.Ahsan,PHI,2015
2. DavidC.Kay, TensorAnalysis, Schaum'sOutlineSeries, McGrawHill1988.
3. R.S,Mishra,ACourseinTensorswithApplicationstoReimannianGeometry,PothishalaPvt.Ltd,Allahabad.
4. Suggested digital plateform: NPTEL/SWAYAM/MOOCS
5. Course Books published in Hindi maybe 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 pre requisites: To study this course, a student must have Diploma in Mathematics

Suggested equivalent online courses:

Further Suggestions:

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C17METRIC SPACES & COMPLEX ANALYSIS **6 Credits (5L+1 T)**

Duration 3hrs **Marks : 100(75+25)** **75 Lectures + 15 Tutorials**

Programme: Degree **Class: 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

Metrics paces

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** Anti-derivatives, 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 Metrics pace):

1. Mathematical Analysis by Shanti Narain.
2. Shirali,Satish&Vasudeva,H.L.(2009).MetricSpaces,Springer, First Indian Print.
3. Kumaresan,S.(2014).TopologyofMetricSpaces(2nded.).NarosaPublishingHouse.NewDelhi.
4. Simmons,G.F.(2004).IntroductiontoTopologyandModernAnalysis.TataMcGrawHill.NewDelhi.
5. Suggested digital plateform:NPTEL/SWAYAM/MOOCS.
6. Course Books published in Hindi maybe prescribed by the Universities.

Suggested Readings(Part-B Complex Analysis):

1. Function of Complex Variable by Shanti Narain.
2. ComplexvariableandapplicationsbyBrown&Churchill.
3. Suggesteddigitalplateform:NPTEL/SWAYAM/MOOCS.
4. CourseBookspublishedinHindimaybeprescribedbytheUniversities.

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 pre requisites: To study this course, a student must have Diploma in Mathematics

Suggested equivalent online courses:

Further Suggestions:

C18 Numerical Analysis & Operation Research **5 Credits (4L+1 P)**

Duration 3hrs **Marks : 100(75+25)** **75 Lectures + 15 Practical**

Programme:Degree Class: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:**

TotalNo.ofLectures-Tutorials-Practical(inhoursperweek):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 maybe prescribed by the Universities.

Suggested Readings (Part-B Operation Research):

1. Taha,HamdyH,"Operations Research-An Introduction", Pearson Education.
2. Kanti Swarup, P.K.Gupta,ManMohanOperationsresearch,Sultan Chand&Sons
3. HillierFrederickSandLiebermanGeraldJ.,"OperationsResearch",McGrawHillPublication.
4. WinstonWayneL.,"OperationsResearch:ApplicationsandAlgorithms",CengageLearning,4th Edition.
5. HiraD.S. and Gupta Prem Kumar, "ProblemsinOperationsResearch:PrinciplesandSolutions",SChand&CoLtd.
6. KalavathyS., "Operations Research",S Chand.
7. Suggesteddigitalplateform:NPTEL/SWAYAM/MOOCs.
8. Course Books published in Hindi maybe 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 pre requisites: To study this course, a student must have Certificate Course in Applied Mathematics

Suggested equivalent online courses:

Further Suggestions:

Practical

Programme: Degree **Class: 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 Eigen value by Power method(upto4×4), Fitting a Polynomial Function (upto third degree).

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

TotalNo.ofLectures-Tutorials-Practical(inhoursperweek): 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.Solutionoftranscendentalandalgebraicequationsby i) Bisection method ii) Newton Raphson method (Simple root, multiple roots, complex roots). iii) Secant method. iv) Regula Falsi method. 2.Solutionofsystemoflinearequations i) L U 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.NumericalIntegration i) Trapezoidal Rule ii) Simpson’s one third rule iii) Weddle’s Rule iv) Gauss Quadrature 5. Method of finding Eigenvalue by Power method (upto4 ×4) 6. Fitting a Polynomial Function (up to third degree)	

	7.Solutionofordinarydifferentialequations i) Euler method ii) Modified Euler method iii) Runge Kutta method(order4) (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 pre requisites: To study this course, a student must have Certificate Course in Applied Mathematics

Suggested equivalent online courses:

Further Suggestions: