JAGANNATH BAROOAH COLLEGE (AUTONOMOUS), JORHAT

Syllabus for Three Years Degree Course

In

MATHEMATICS

Under Choice Based Credit Semester System

Objectives : This degree Programme (***B.Sc. (Honours) , Mathematics)*** under ***CBCS*** offers students the largest selection of choices, preferably for those who are Mathematically gifted and wish to keep their options open. Students will receive great all-round Mathematical information together with the capacity to encounter progressively particular outcomes, strategies and thoughts. They can pick courses from different branches and a wide assortment of Mathematics, enabling them to graduate with finely-sharpened aptitudes in Mathematics. This course is designed to provide them the core Mathematical learning and aptitudes, and the reason for further developed work later on. This programme is shrouded in six semesters. In addition to the core courses this programme contains two ***Skill Enhancement*** courses and two ***Discipline Specific Elective*** courses, to further increase the understanding of the significance and power of Mathematics in various application fields. During the programme they can build up their ability to learn and apply mathematical ideas, to comprehend the noteworthiness and intensity of science, and to secure a careful information and comprehension of those scientific points that any business would expect of a Mathematics graduate.

Expected Outcome: Students graduating from this programme will be able to:

- Demonstrate advanced theoretical and technical knowledge in Mathematics.
- Exhibit a computational capacity in settling a wide cluster of Mathematical problems.
- Distinguish utilizations of Mathematics in different branches and in the public arena.
- Utilize innovation to address numerical thoughts and tackling to faced critical problems.
- Use Mathematics to take care of hypothetical and connected issues.

Course Structure- MATHEMATICS (Honours)

Semester	Course No	Course Code	Course Title	Course Type	Marks Distribution					Remark
					TH	TH-IA	PR	PR-IA	Total	
1st	C-01	MTHC101	Calculus	Theory+Practical	50	15	30	05	100	
	C-02	MTHC102	Algebra	Theory	80	20			100	
2nd	C-03	MTHC201	Real Analysis	Theory	80	20			100	
	C-04	MTHC202	Differential Equations	Theory+Practical	50	15	30	05	100	
3rd	C-05	MTHC301	Theory of Real Functions	Theory	80	20			100	
	C-06	MTHC302	Group Theory I	Theory	80	20			100	
	C-07	MTHC303	PDE and Systems of ODE	Theory+Practical	50	15	30	05	100	
	SEC01	MTHS301	Latex & HTML	Project				40	10	
4th	C-08	MTHC401	Numerical Methods	Theory+Practical	50	15	30	05	100	
	C-09	MTHC402	Riemann Integration & Series of Functions	Theory	80	20			100	
	C-10	MTHC403	Ring Theory and Linear Algebra I	Theory	80	20			100	
	SEC02	MTHS401	Graph Theoretic Modeling	Project				40	10	
5th	C-11	MTHC501	Multivariate Calculus	Theory	80	20			100	
	C-12	MTHC502	Group Theory II	Theory	80	20			100	
	DSE01	MTHD501A	Number Theory	Theory	80	20			100	Ongoing
	DSE01	MTHD501B	C++Programming	Theory+Practical	50	15	30	05	100	
	DSE02	MTHD502A	Boolean Algebra and Automata Theory	Theory	80	20			100	
	DSE02	MTHD502B	Cryptography & Network Security	Theory	80	20			100	Ongoing
6th	C-13	MTHC601	Metric Spaces and Complex Analysis	Theory	80	20			100	
	C-14	MTHC602	Ring Theory & Linear Algebra II	Theory	80	20			100	
	DSE03	MTHD601A	Linear Programming	Theory	80	20			100	Ongoing
	DSE03	MTHD601B	Theory of Equations	Theory	80	20			100	
	DSE04	MTHD602A	Mechanics	Theory	80	20			100	
	DSE04	MTHD602B	Differential Geometry	Theory	80	20			100	Ongoing

Generic Elective-Mathematics										
Semester	**Course No**	**Course Code**	**Course Title**	**Course Type**	**Marks Distribution**					
					TH	**TH-IA**	**PR**	**PR-IA**	**Total**	
1st	GE-01	MTHG-101	Trigonometry & Analysis I	Theory	80	20			100	
2nd	GE-02	MTHG-201	Analysis II	Theory	80	20			100	
3rd	GE-03	MTHG-301	Computational Methods	Theory+Practical	50	15	30	05	100	
4th	GE-04	MTHG-401	Coordinate Geometry & Abstract Algebra	Theory	80	20			100	

Semester	Core Course	Ability Enhancement Compulsory Course (AECC)(2)	Skill Enhancement Course (SEC)(2)	Elective Discipline DSE(4)	Generic Elective (GE) (4)
I	C1 Calculus (including practicals) C2 Algebra	(English /MIL Communication) / Environmental Science			GE-1 **(Trigonometry & Analysis I)**
II	C3 Real Analysis C4 Differential Equations (including practicals)	Environmental Science / (English /MIL Communication)			GE-2 (**Analysis II)**
III	C5 Theory of Real Functions C6 GroupTheory I C7 PDE andSystems of ODE (including practicals)		SEC 1 **(Latex & HTML)**		GE-3 **(Computational Methods)**
IV	C8 NumericalMethods (including practicals) C9 Riemann Integration and Series of Functions C10 Ring Theory and Linear Algebra I		SEC 2 **(Graph Theoretic Modeling)**		GE-4 **(Coordinate Geometry & Abstract Algebra)**
V	C11 Multivariate Calculus C12 GroupTheory II			DSE-1 DSE-2	
VI	C13 MetricSpaces and Complex Analysis C14 Ring Theory and Linear Algebra II			DSE-3 DSE-4	

Structure

Discipline Specific Electives (DSE)
Choices for DSE 1 (choose one)

1. Number Theory
2. C++ Programming

Choices for DSE 2 (choose one)

1. Boolean Algebra and Automata Theory
2. Cryptography and Network Security

Choices for DSE 3 (choose one)

1. Linear Programming
2. Theory of Equations

Choices for DSE 4 (choose one)

1. Mechanics
2. Differential Geometry

Skill Enhancement Course (SEC)

SEC 1: Latex & HTML

SEC 2: Graph Theoretic Modeling

Generic Electives (GE)

GE 1
Trigonometry & Analysis I

GE 2
Analysis II

GE 3
. Computational Methods

GE 4
Coordinate Geometry & Abstract Algebra

Details of courses under B.A./ B.Sc. (Hons.) Mathematics

Course		***Credits**
	Theory + Practical	Theory + Tutorial
I. Core Course (14 Papers)	14×4 = 56	14×5 = 70
Core Course Practical / Tutorial* (14 Papers)	14×2 = 28	14×1 = 14
II. Elective Course (8 Papers)		
A.1. Discipline Specific Elective **(4 Papers)**	4×4 = 16	4×5 = 20
A.2. Discipline Specific Elective Practical/ Tutorial* **(4 Papers)**	4×2 = 8	4×1 = 4
B.1. Generic Elective/ Interdisciplinary **(4 Papers)**	4×4 = 16	4×5 = 20
B.2. Generic Elective Practical/ Tutorial* **(4 Papers)**	4×2 = 8	4×1 = 4
III. Ability Enhancement Courses		
1.**Ability Enhancement Compulsory Courses (AECC) (2 Papers of 2 credit each)** Environmental Science English/MIL Communication	2×2 = 4	2×2 = 4
2. **Skill Enhancement Courses (SEC) (Minimum 2) (2 Papers of 2 credit each)**	2×2 = 4	2×2 = 4
Total credit	140	140

 Optional Dissertation or project work in place of one Discipline Specific Elective Paper (6 credits) in 6th Semester

Detailed Syllabus for Core Course
B.Sc. (Honours) Mathematics

Semester-I

COURSE TITLE: CALCULUS

Course Code: MTHC-101 **Course No: C- 01**

Credits: 06 (Theory-04, Practicals-02) **No. of Classes: 60**

Marks: 100 **Theory End Semester: 50** **Theory Internal Assessment: 15**

Practical End Semester: 30 **Practical Internal Assessment: 05**

Objective: Students will be able to identify the analytical aspects of Mathematical concepts and will be able to handle practical problems. By Computer Laboratory, they will be exposed to a hand on experience on various Mathematical Software.

Unit I: Hyperbolic functions, higher order derivatives, Leibniz rule and its applications to problems of type $e^{ax+b}\sin x, e^{ax+b}\cos x, (ax+b)^n\cos x, (ax+b)^n\sin x$,concavity and inflection points, asymptotes, curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves, L'Hospital's rule, applications in business, economics and life sciences.

(18 Classes) MARKS:15

Unit II: Reduction formulae, derivations and illustrations of reduction formulae of the type $\int \sin^n x dx, \int \cos^n x dx, \int \tan^n x dx, \int \sec^n x dx, \int (\log x)^n dx, \int \sin^n x \cos^m x dx$ volumes by slicing, disks and washers methods, volumes by cylindrical shells, parametric equations, parameterizing a curve, arc length, arc length of parametric curves, area of surface of revolution. Techniques of sketching conics, reflection properties of conics, rotation of axes and second degree equations, classification into conics using the discriminate, polar equations of conics.

(25 Classes) MARKS:20

Unit III: Triple product, introduction to vector functions, operations with vector-valued functions, limits and continuity of vector functions, differentiation and integration of vector functions, tangent and normal components of acceleration.

(17 Classes) MARKS:15

Practical Classes : 30 (2 hour per practical class)

List of Practicals (using software MATLAB/MATHMATICA/MAPLE)

(i) Plotting of graphs of function $e^{ax+b}, \log(ax+b), 1/(ax+b), sin(ax+b), cos(ax+b), |ax+b|$ and to illustrate the effect of a and b on the graph.

(ii) Plotting the graphs of polynomial of degree 4 and 5, the derivative graph, the second derivative graph and comparing them.

(iii) Sketching parametric curves (E.g. Trochoid, cycloid, epicycloids, hypocycloid).

(iv) Obtaining surface of revolution of curves.

(v) Tracing of conics in cartesian coordinates/ polar coordinates.

(vi) Sketching ellipsoid, hyperboloid of one and two sheets, elliptic cone, elliptic, paraboloid, hyperbolic paraboloid using cartesian coordinates.

(vii) Matrix operation (addition, multiplication, inverse, transpose).

Text Books:

1. **G.B. Thomas and R.L. Finney**, ***Calculus*****,** 9th Ed., Pearson Education, Delhi, 2005
2. **B. C. Das & B. N. Mukherjee**, ***Differential Calculus***, U. N. Dhur and Sons. Pvt Ltd
3. **S. Narayan & P. K. Mittal**, ***Integral Calculus***, S. Chand Publishing
4. **S. Narayan & P. K. Narayan**, ***A Text Book on Vector Calculus***, S. Chand Publishing.

Reference Books:

1. **M.J. Strauss, G.L. Bradley and K. J. Smith**, ***Calculus***, 3rd Ed., D. Kindersley (India) P. Ltd. (Pearson Education), Delhi, 2007.
2. **H. Anton, I. Bivens and S. Davis,** ***Calculus***, 7th Ed., John Wiley and Sons (Asia) P. Ltd., Singapore, 2002.
3. **R. Courant and F. John**, ***Introduction to Calculus and Analysis (Volumes I & II),*** Springer-Verlag, New York, Inc., 1989.

Detailed Syllabus for Core Course
B.Sc. (Honours) Mathematics

Semester-I

COURSE TITLE: Algebra

Course Code: MTHC-102 **Course No: C- 02**

Credits: 06 **No. of Classes: 75**

Marks: 100 **End Semester: 80** **Theory Internal Assessment: 20**

Objective : The students can have a deeper insight of the developments of the generalized notions of Trigonometry, Also, will be able to use matrix methods for solving linear equations.

Unit I: Polar representation of complex numbers, nth roots of unity, De Moivre's theorem for rational indices and its applications.

(10 Lectures) MARKS: 1

Unit II: Equivalence relations, Functions, Composition of functions, Invertible functions, One to one correspondence and cardinality of a set, Well-ordering property of positive integers, Division algorithm, Divisibility and Euclidean algorithm, Congruence relation between integers, Principles of Mathematical Induction, statement of Fundamental Theorem of Arithmetic.

(25 Lectures) MARKS:20

Unit III: Systems of linear equations, row reduction and echelon forms, vector equations, the matrix equation Ax=b, solution sets of linear systems, applications of linear systems, linear independence.

(20 Lectures) MARKS: 25

Unit IV: Introduction to linear transformations, matrix of a linear transformation, inverse of a matrix, characterizations of invertible matrices. Subspaces of Rn, dimension of subspaces of Rn and rank of a matrix, Eigen values, Eigen Vectors and Characteristic Equation of a matrix.

(20 Lectures) MARKS:25

Text Books:

1. **Hall & Night**, ***Higher Algebra***, Arihant Publishers.
2. **Kenneth Hoffman**, **Ray Alden Kunze**, ***Linear Algebra,*** 2nd Ed., Prentice-Hall of India Pvt. Ltd., 1971.
3. **S. L. Loney**, ***Plane Trigonometry***, University Press Publishers.

Reference Books:

1. **Titu Andreescu and Dorin Andrica**, ***Complex Numbers from A to Z***, Birkhauser, 2006.

2. **Edgar G. Goodaire and Michael M. Parmenter,** ***Discrete Mathematics with Graph*** *Theory,* 3rd Ed., Pearson Education (Singapore) P. Ltd., Indian Reprint, 2005**.**

3. **David C. Lay**, ***Linear Algebra and its Applications,*** 3rd Ed., Pearson Education Asia, Indian Reprint, 2007.

Detailed Syllabus for Core Course
B.Sc. (Honours) Mathematics

Semester-II

COURSE TITLE: Real Analysis

Course Code: MTHC-201 **Course No: C- 03**
Credits: 06 **No. of Classes: 75**
Marks: 100 **End Semester: 80** **Theory Internal Assessment: 20**

Objective: To infuse the classical ideas of algebraic and analytic structures.

Unit I: Review of Algebraic and Order Properties of R, δ-neighborhood of a point in R, Idea of countable sets, uncountable sets and uncountability of R. Bounded above sets, Bounded below sets, Bounded Sets, Unbounded sets, Suprema and Infima, The Completeness Property of R, The Archimedean Property, Density of Rational (and Irrational) numbers in R, Intervals. Limit points of a set, Isolated points, Illustrations of Bolzano-Weierstrass theorem for sets.

(31 Lectures) MARKS: 30

Unit II: Sequences, Bounded sequence, Convergent sequence, Limit of a sequence. Limit Theorems, Monotone Sequences, Monotone Convergence Theorem. Subsequences, Divergence Criteria, Monotone Subsequence Theorem (statement only), Bolzano Weierstrass Theorem for Sequence, Cauchy sequence, Cauchy's Convergence Criterion.

(22 Lectures) MARKS: 25

Unit III: Infinite series, convergence and divergence of infinite series, Cauchy Criterion, Tests for convergence: Comparison test, Limit Comparison test, Ratio Test, Cauchy's n^{th} root test, Integral test, Alternating series, Leibniz test, Absolute and Conditional convergence.

(22 Lectures) MARKS: 25

Text Books:

1. **S.C. Malik and S.L. Arora**, ***Mathematical Analysis,*** New age international(p) Ltd. New Delhi. 3rd revised edition.
2. **R.G. Bartle and D. R. Sherbert,** ***Introduction to Real Analysis,*** 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
3. **A. Kumar and S. Kumarasen,** ***A Basic Course in Real Analysis***, CRC Press
4. **G. B. Thomas and R. L. Finney**, ***Calculus,*** Pearson.

Reference Books:

1. **Gerald G. Bilodeau , Paul R. Thie, G.E. Keough,** ***An Introduction to Analysis,*** 2nd Ed., J. & Bartlett, 2010.
2. **Brian S. T. Andrew. M. Bruckner and Judith B. Bruckner,** ***Elementary Real Analysis,*** Prentice Hall, 2001.
3. **S.K. Berberian,** ***A First Course in Real Analysis*****,** Springer Verlag, New York, 1994.

Detailed Syllabus for Core Course
B.Sc. (Honours) Mathematics

Semester-II

COURSE TITLE: Differential Equations

Course Code: MTHC-202 **Course No: C- 04**

Credits: 06 (Theory-04, Practicals-02) **No. of Classes: 60**

Marks: 100 **Theory End Semester: 50** **Theory Internal Assessment: 15**

Practical End Semester: 30 **Practical Internal Assessment : 05**

Objectives : Students will be able to understand the basic idea of mathematical model by using differential equations, and ideas on the basics of differential equations.

Unit I: Differential equations and mathematical models. General, particular, explicit, implicit and singular solutions of a differential equation. Exact differential equations and integrating factors, separable equations and equations reducible to this form, linear equation and Bernoulli equations, special integrating factors and transformations.

(15 Classes) MARKS: 10

Unit II: Introduction to compartmental model, exponential decay model, lake pollution model (case study of Lake Burley Griffin), drug assimilation into the blood (case of a single cold pill, case of a course of cold pills), exponential growth of population, limited growth of population, limited growth with harvesting.

(15 Classes) MARKS: 10

Unit III: General solution of homogeneous equation of second order, principle of super position for homogeneous equation, Wronskian: its properties and applications, Linear homogeneous and non-homogeneous equations of higher order with constant coefficients, Euler's equation, method of undetermined coefficients, method of variation of parameters.

(20 Classes) MARKS: 20

Unit IV: Equilibrium points, Interpretation of the phase plane, predatory-prey model and its analysis, epidemic model of influenza and its analysis, battle model and its analysis.

(10 Classes) MARKS: 10

Practical classes : 30 (2 hour per practical class)

List of Practicals (using any software)

1. Plotting of second order solution family of differential equation.
2. Plotting of third order solution family of differential equation.
3. Growth model (exponential case only).
4. Decay model (exponential case only).
5. Lake pollution model (with constant/seasonal flow and pollution concentration).

6. Case of single cold pill and a course of cold pills.
7. Limited growth of population (with and without harvesting).
8. Predatory-prey model (basic volterra model, with density dependence, effect of DDT, two prey one predator).
9. Epidemic model of influenza (basic epidemic model, contagious for life, disease with carriers).
10. Battle model (basic battle model, jungle warfare, long range weapons).
11. Plotting of recursive sequences.
12. Study the convergence of sequences through plotting.
13. Verify Bolzano-Weierstrass theorem through plotting of sequences and hence identify convergent subsequences from the plot.
14. Study the convergence/divergence of infinite series by plotting their sequences of partial sum.
15. Cauchy's root test by plotting n^{th} roots.
16. Ratio test by plotting the ratio of nth and $(n+1)^{th}$ term.

Text Books:

1. **S.L. Ross,** ***Differential Equations****,* 3rd Ed., John Wiley and Sons, India, 2004.
2. **E. A. Coddington,** ***An Introduction to Ordinary Differential Equation*****,** Dover Publications.

Reference Books:

1. **Belinda Barnes and Glenn R. Fulford,** ***Mathematical Modeling with Case Studies, A Differential Equation Approach using Maple and Matlab,*** 2nd Ed., Taylor and Francis group, London and New York, 2009.
2. **C.H. Edwards and D.E. Penny,** ***Differential Equations and Boundary Value problems Computing and Modeling****,* Pearson Education India, 2005**.**
3. **Martha L Abell, James P Braselton,** ***Differential Equations with MATHEMATICA****,* 3rd Ed., Elsevier Academic Press, 2004.
4. **M.D. Raisinghania,** ***Advanced Differential Equation,*** S. Chand Company.

Detailed Syllabus for Core Course
B.Sc. (Honours) Mathematics

Semester-III

COURSE TITLE: Theory of Real Functions

Course Code: MTHC-301 **Course No: C- 05**
Credits: 06 **No. of Classes: 75**
Marks: 100 **End Semester: 80** **Theory Internal Assessment: 20**

Objective: Students will be able to identify the analytical aspects of Mathematical concepts of Continuity, uniform Continuity, Differentiability and applications.

Unit I: Limits of functions ($\varepsilon-\delta$ approach), sequential criterion for limits, divergence criteria. Limit theorems, one sided limits. Infinite limits and limits at infinity. Continuous functions, sequential criterion for continuity and discontinuity. Algebra of continuous functions. Continuous functions on an interval, intermediate value theorem, location of roots theorem, preservation of intervals theorem. Uniform continuity, non-uniform continuity criteria, uniform continuity theorem.

(22 Classes) MARKS: 25

Unit II: Differentiability of a function at a point and in an interval, Caratheodory's theorem, algebra of differentiable functions. Relative extrema, interior extremum theorem. Rolle's theorem, Mean value theorem, intermediate value property of derivatives, Darboux's theorem. Applications of mean value theorem to inequalities and approximation of polynomials, Taylor's theorem to inequalities.

(30 Classes) MARKS: 30

Unit III: Cauchy's mean value theorem. Taylor's theorem with Lagrange's form of remainder, Taylor's theorem with Cauchy's form of remainder, Convex function, application of Taylor's theorem to convex functions, relative extrema. Taylor's series and Maclaurin's series expansions of exponential and trigonometric functions, $\ln(1+x), 1/ax+b$ and $(1+x)^n$.

(23 Classes) MARKS: 25

Text Books:

1. **R. Bartle and D.R. Sherbert,** ***Introduction to Real Analysis,*** John Wiley and Sons, 2003.
2. **S.R. Ghorpade and B.V. Limaye,** ***A Course in Calculus and Real Analysis,*** Springer, 2006.
3. ***Mathematical Analysis*** , **Apostole**

Reference Books:

1. **K.A. Ross,** ***Elementary Analysis: The Theory of Calculus*****,** Springer, 2004.

2. **A. Mattuck,** ***Introduction to Analysis***, Prentice Hall, 1999.

Detailed Syllabus for Core Course
B.Sc. (Honours) Mathematics

Semester-III

COURSE TITLE: Group Theory I

Course Code: MTHC-302 **Course No: C- 06**

Credits: 06 **No. of Classes: 75**

Marks: 100 **End Semester: 80** **Theory Internal Assessment: 20**

Objective: Students will be able to identify the Structures and characteristics of Abstract Algebra.

Unit I: Definition and examples of groups including, abelian groups, permutation groups and quaternion groups (illustration through matrices), Symmetries of a triangle, square, Dihedral groups, elementary properties of groups.

(15 Classes) MARKS: 15

Unit II: Properties of cyclic groups, classification of subgroups of cyclic groups. Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group, properties of cosets, Lagrange's theorem and consequences including Fermat's Little theorem.

(18 Classes) MARKS: 20

Unit III: Product of two subgroups, External direct product of a finite number of groups, normal subgroups, factor groups, Cauchy's theorem for finite abelian groups.

(15 Classes) MARKS: 15

Unit IV: Subgroups and examples of subgroups, normal subgroups, cosets, centralizer, normalizer, center of a group.

(12 Classes) MARKS: 15

Unit V: Group homomorphisms, properties of homomorphisms, Cayley's theorem, properties of isomorphisms, First, Second and Third isomorphism theorems.

(15 Classes) MARKS: 15

Text Books:

1. **John B. Fraleigh,** ***A First Course in Abstract Algebra***, 7th Ed., Pearson, 2002**.**
2. **M. Artin**, ***Abstract Algebra***, 2nd Ed., Pearson, 2011.
3. ***Abstract Algebra*** , Khanna & Bhambri
4. **Joseph A. Gallian,** ***Contemporary Abstract Algebra,*** 4th Ed., Narosa Publishing House, New Delhi, 1999.

Reference Books:

1. **Joseph J. Rotman**, ***An Introduction to the Theory of Groups,*** 4th Ed., Springer Verlag, 1995.
2. **I.N. Herstein**, ***Topics in Algebra*****,** Wiley Eastern Limited, India, 1975.

Detailed Syllabus for Core Course
B.Sc. (Honours) Mathematics

Semester-III

COURSE TITLE: PDE and Systems of ODE

Course Code: MTHC-303 **Course No: C- 07**

Credits: 06 (Theory-04, Practicals-02) **No. of Classes: 60**

Marks: 100 **Theory End Semester: 50** **Theory Internal Assessment: 15**

Practical End Semester: 30 **Practical Internal Assessment : 05**

Objectives : Students will be able to understand the basic idea of mathematical model by using partial differential equations, and ideas on the basics of partial differential equations.

Unit I: Systems of linear differential equations, types of linear systems, differential operators, an operator method for linear systems with constant coefficients, Basic Theory of linear systems in normal form, homogeneous linear systems with constant coefficients: Two Equations in two unknown functions, The method of successive approximations, the Euler method, the modified Euler method, The Runge-Kutta method.

(15 Classes) MARKS: 14

Unit II: Partial Differential Equations – Basic concepts and Definitions, Mathematical Problems. First-Order Equations: Classification, Construction and Geometrical Interpretation. Method of Characteristics for obtaining General Solution of Quasi Linear Equations. Canonical Forms of First-order Linear Equations. Method of Separation of Variables for solving first order partial differential equations.

(18 Classes) MARKS: 14

Unit III: Derivation of Heat equation, Wave equation and Laplace equation using method of separation of variables. Classification of second order linear equations as hyperbolic, parabolic or elliptic. Reduction of second order Linear Equations to canonical forms.

(15 Classes) MARKS: 12

Unit IV: The Cauchy problem, Cauchy problem of an infinite string. Initial Boundary Value Problems, Solving the Vibrating String Problem, Solving the Heat Conduction problem.

(12 Classes) MARKS: 10

List of Practicals (using any software) **(30 Classes)**

(i) Solution of Cauchy problem for first order PDE.

(ii) Finding the characteristics for the first order PDE.

(iii) Plot the integral surfaces of a given first order PDE with initial data.

(iv) Solution of wave equation $\frac{\partial^2 u}{\partial t^2} - c^2 \frac{\partial^2 u}{\partial x^2} = 0$ for the following associated conditions

(a) $u(x,0)=\phi(x),\ \ u_t(x,0)=\psi(x),\ \ \ x\in R,\ t>0$

(b) $u(x,0)=\phi(x),\ \ u_t(x,0)=\psi(x),\ \ u(0,t)=0,\ x\in(0,\infty),\ t>0$

(c) $u(x,0)=\phi(x),\ \ u_t(x,0)=\psi(x),\ \ \ u_x(0,t)=0,\ x\in(0,\infty),\ t>0$

(d) $u(x,0)=\phi(x),\ \ u_t(x,0)=\psi(x),\ \ u(0,t)=0,\ \ u(1,t)=0,\ \ 0<x<l,\ t>0$

(v) Solution of wave equation $\frac{\partial u}{\partial t}-k^2\frac{\partial^2 u}{\partial x^2}=0$ for the following associated conditions

(a) $u(x,0)=\phi(x),\ u(0,t)=a,\ u(l,t)=b,\ 0<x<l,\ t>0$

(b) $u(x,0)=\phi(x),\ x\in R,\ 0<t<T$

(c) $u(x,0)=\phi(x),\ \ u(0,t)=a,\ \ x\in(0,\infty),\ t\geq 0$

Text Books:

1. **S.L. Ross,** ***Differential equations,*** 3rd Ed., John Wiley and Sons, India, 2004.
2. **I. N. Sneddon,** ***Elements of Partial Differential Equations***, Dover Publications.

Reference Books:

1. **Tyn Myint-U and Lokenath Debnath**, ***Linear Partial Differential Equations for Scientists and Engineers,*** 4th edition, Springer, Indian reprint, 2006.
2. **Martha L Abell, James P Braselton,** ***Differential equations with MATHEMATICA,*** 3rd Ed., Elsevier Academic Press, 2004.

Detailed Syllabus for Core Course
B.Sc. (Honours) Mathematics

Semester-IV

COURSE TITLE: Numerical Methods

Course Code: MTHC-401 **Course No: C- 08**

Credits: 06 (Theory-04, Practicals-02) **No. of Classes: 60**

Marks: 100 **Theory End Semester: 50** **Theory Internal Assessment: 15**

Practical End Semester: 30 **Practical Internal Assessment : 05**

Objectives : Students will be able to use matrix methods for solving linear equations, have ideas on the basics of differential equations and also about the numerical methods of obtaining results where complexity of obtaining analytical solutions is sufficiently high.

Unit I: Flow chart**,** Algorithms, Convergence, Errors: Relative, Absolute, Round off, Truncation. Transcendental and Polynomial equations: Bisection method, Newton's method, Secant method. Rate of convergence of these methods.

(15 Classes) MARKS: 12

Unit II: System of linear algebraic equations: Gaussian Elimination and Gauss Jordan methods. Gauss Jacobi method, Gauss Seidel method and their convergence analysis.

(12 Classes) MARKS: 10

Unit III: Interpolation: Lagrange and Newton's methods. Error bounds. Finite difference operators. Gregory forward and backward difference interpolation.

(12 Classes) MARKS: 10

Unit IV: Numerical Integration: Trapezoidal rule, Simpson's $1/3^{rd}$ rule, Simpsons 3/8th rule, Boole's Rule. Midpoint rule, Composite Trapezoidal rule, Composite Simpson's rule.

(13 Classes) MARKS: 10

Unit V: Ordinary Differential Equations: Euler's method. Runge-Kutta methods of orders two and four.

(8 Classes) MARKS: 8

List of Practicals (using any software) **(30 Classes)**

(i) Calculate the sum 1/1 + 1/2 + 1/3 + 1/4 + ----------+ 1/ N.
(ii) To find the absolute value of an integer.
(iii) Enter 100 integers into an array and sort them in an ascending order.
(iv) Bisection Method.
(v) Newton Raphson Method.
(vi) Secant Method.
(vii) Regulai Falsi Method.
(viii) LU decomposition Method.
(ix) Gauss-Jacobi Method.
(x) SOR Method or Gauss-Siedel Method.
(xi) Lagrange Interpolation or Newton Interpolation.
(xii) Simpson's rule.

Text Books:

1. **M.K. Jain, S.R.K. Iyengar and R.K. Jain**, ***Numerical Methods for Scientific and Engineering Computation*****,** 6th Ed., New age International Publisher, India, 2007.
2. ***Getting Started with Matlab****, Rudra pratap, OXFORD , University Press. Reprint 2011.*
3. **K. Atkinson**, **An Introduction to Numerical Analysis (2nd Edition),** Wiley Publications

Reference Books:

1. **Brian Bradie,** ***A Friendly Introduction to Numerical Analysis***, Pearson Education, India, 2007.
2. **C.F. Gerald and P.O. Wheatley,** ***Applied Numerical Analysis*****,** Pearson Education, India, 2008.
3. **Uri M. Ascher and Chen Greif,** ***A First Course in Numerical Methods*****,** 7th Ed., PHI Learning Private Limited, 2013.
4. **John H. Mathews and Kurtis D. Fink,** ***Numerical Methods using Matlab*****,** 4th Ed., PHI Learning Private Limited, 2012.

Detailed Syllabus for Core Course
B.Sc. (Honours) Mathematics

Semester-IV

COURSE TITLE: Riemann Integration and Series of Functions

Course Code: MTHC-402 **Course No: C- 09**
Credits: 06 **No. of Classes: 75**
Marks: 100 **End Semester: 80** **Theory Internal Assessment: 20**

Objective: Students will be able to understand the basic idea of Riemann Integration and Series of Functions.

Unit I: Limit superior and Limit inferior, Riemann integration: Darboux's theorem, inequalities of upper and lower sums; Riemann conditions of integrability, Riemann limit of sum and definition of Riemann integral through Riemann sums; equivalence of two definitions; Riemann integrability of monotone and continuous functions, Properties of the Riemann integral; definition and integrability of piecewise continuous and monotone functions. Intermediate Value theorem for Integrals; Fundamental theorems of Calculus

(22Classes) MARKS:25

Unit II: Improper integrals of all kinds & its convergence; Beta and Gamma functions and its properties & applications

(8 Classes) MARKS:20

Unit III: Pointwise and uniform convergence of sequence of functions. Theorems on continuity, derivability and integrability of the limit function of a sequence of functions. Series of functions; Theorems on the continuity and derivability of the sum function of a series of functions.

(20 Classes) MARKS:17

Unit IV: Power series, radius of convergence, Cauchy Hadamard Theorem, Differentiation and integration of power series; Abel's Theorem; Weierstrass Approximation Theorem.

(17 Classes) MARKS:18

Text Books:

1. ***Real Analysis*** , **Walter Ruddin**
2. **R. Bartle and D.R. Sherbert,** ***Introduction to Real Analysis***, John Wiley and Sons, 2003.
3. **S.R. Ghorpade and B.V. Limaye**, ***A Course in Calculus and Real Analysis,*** Springer, 2006.

Reference Books:

1. **K.A. Ross,** ***Elementary Analysis, The Theory of Calculus*****,** Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.

2. **Charles G. Denlinger**, ***Elements of Real Analysis***, Jones & Bartlett (Student Edition), 2011

Detailed Syllabus for Core Course
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Semester-IV

COURSE TITLE: Ring Theory and Linear Algebra I

Course Code: MTHC-403 **Course No: C- 10**
Credits: 06 **No. of Classes: 75**
Marks: 100 **End Semester: 80** **Theory Internal Assessment: 20**

Objective: Students will be exposed to structural concepts of Ring theory and different spaces of linear Algebra.

Unit I: Definition and examples of rings, properties of rings, subrings, integral domains and fields, characteristic of a ring. Ideal, ideal generated by a subset of a ring, factor rings, operations on ideals, prime and maximal ideals.

(22 Classes) MARKS:25

Unit II: Ring homomorphisms, properties of ring homomorphisms, Isomorphism theorems I, II and III, field of quotients. **(13 Classes) MARKS:15**

Unit III: Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces.

(18 Classes) MARKS:20

Unit IV: Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, algebra of linear transformations. Isomorphisms, Isomorphism theorems, invertibility and isomorphisms, change of coordinate matrix.

(22 Classes) MARKS:20

Text Books:

1. **John B. Fraleigh,** ***A First Course in Abstract Algebra*****,** 7th Ed., Pearson, 2002**.**
2. **P.K. Saikia** , ***"Linear Algebra"***
3. **K.P.Gupta** , ***"Linear Algebra"***
4. **Joseph A. Gallian,** ***Contemporary Abstract Algebra***, 4th Ed., Narosa Publishing House, New Delhi, 1999.
5. **S. Kumaresan**, ***Linear Algebra- A Geometric Approach***, Prentice Hall of India,1999.

Reference Books:

1. **M. Artin,** ***Abstract Algebra***, 2nd Ed., Pearson, 2011.
2. **Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence,** ***Linear Algebra,*** 4th Ed., Prentice-Hall of India Pvt. Ltd., New Delhi, 2004.
3. **S. Lang**, ***Introduction to Linear Algebra,*** 2nd Ed., Springer, 2005.
4. **D.A.R. Wallace,** ***Groups, Rings and Fields***, Springer Verlag London Ltd., 1998.
5. **Kenneth Hoffman, Ray Alden Kunze**, ***Linear Algebra,*** 2nd Ed., Prentice-Hall of India Pvt. Ltd., 1971.

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Semester-V

COURSE TITLE: Multivariate Calculus

Course Code: MTHC-501 **Course No: C- 11**
Credits: 06 **No. of Classes: 75**
Marks: 100 **End Semester: 80** **Theory Internal Assessment: 20**

Objective: Students will be able to understand the concept of calculus in several direction.

Unit I: Functions of several variables, limit and continuity of functions of two variables Partial differentiation, total differentiability and differentiability, sufficient condition for differentiability. Chain rule for one and two independent parameters, directional derivatives, the gradient, maximal and normal property of the gradient, tangent planes, Extrema of functions of two variables, method of Lagrange multipliers, constrained optimization problems, Definition of vector field, divergence and curl.

(25 Classes) MARKS:30

Unit II: Double integration over rectangular region, double integration over non-rectangular region, Double integrals in polar co-ordinates, Triple integrals, Triple integral over a parallelepiped and solid regions. Volume by triple integrals, cylindrical and spherical co-ordinates.

(22 Classes) MARKS:20

Unit III: Change of variables in double integrals and triple integrals. Line integrals, Applications of line integrals: Mass and Work. Fundamental theorem for line integrals, conservative vector fields, independence of path. **(18 Classes) MARKS:20**

Unit IV: Green's theorem, surface integrals, integrals over parametrically defined surfaces. Stoke's theorem, The Divergence theorem. **(10 Classes) MARKS:10**

Text Books:

1. **G.B. Thomas and R.L. Finney, *Calculus***, 9th Ed., Pearson Education, Delhi, 2005.
2. **James Stewart**, ***Multivariable Calculus****, Concepts and Contexts*, 2nd Ed., Brooks Cole, Thomson Learning, USA, 2001.
3. **P. M. Fitzpatrick**, ***Advanced Calculus***, American Mathematical Society.
4. ***Mathematical Analysis*** By Apostole.

Reference Books

1. **M.J. Strauss, G.L. Bradley and K. J. Smith**, ***Calculus,*** 3rd Ed., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2007.
2. **E. Marsden, A.J. Tromba and A. Weinstein**, ***Basic Multivariable Calculus***, Springer (SIE), Indian reprint, 2005.
3. **S.C. Malik and S. Arora, *Mathematical Analysis*, *New Age International(P) Limited, Publishers***.

Detailed Syllabus for Core Course
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Semester-V

COURSE TITLE: Group Theory II

Course Code: MTHC-502 **Course No: C- 12**
Credits: 06 **No. of Classes: 75**
Marks: 100 **End Semester: 80** **Theory Internal Assessment: 20**

Objective: students will be able to understand the algebraic structure of group and its application.

Unit I: Automorphism, inner automorphism, automorphism groups, automorphism groups of finite and infinite cyclic groups, applications of factor groups to automorphism groups, Characteristic subgroups, Commutator subgroup and its properties.

(25 Classes) MARKS:30

Unit II: Properties of external direct products, the group of units modulo n as an external direct product, internal direct products, Fundamental Theorem of finite abelian groups.

(14 Classes) MARKS:15

Unit III: Group actions, stabilizers and kernels, permutation representation associated with a given group action. **(16 Classes) MARKS:10**

Unit IV: Groups acting on themselves by conjugation, class equation and consequences, conjugacy in S_n, p-groups, Sylow's theorems and consequences, Cauchy's theorem, Simplicity of A_n for $n \geq 5$, non-simplicity tests.

(20 Classes) MARKS:25

Text Books:

1. **David S. Dummit and Richard M. Foote**, ***Abstract Algebra***, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2004.
2. **I. N. Herstein,** ***Topics in Algebra***, Jon Wiley & Sons
3. **P. B. Bhattacharjee, S. K. Jain & S. R. Nagpaul**, ***Basic Abstract Algebra***, Cambridge University Press.
4. **Joseph A. Gallian,** ***Contemporary Abstract Algebra,*** **4th Ed.,** Narosa Publishing House, 1999.
5. **Khanna and Bhambri**, ***A course of Abstract Algebra***, 4th Ed., Vikas Publishing House pvt.ltd

Reference Books:

1. **John B. Fraleigh,** ***A First Course in Abstract Algebra***, 7th Ed., Pearson, 2002**.**

2. **M. Artin,** ***Abstract Algebra***, 2nd Ed., Pearson, 2011.

3. **J.R. Durbin**, ***Modern Algebra***, John Wiley & Sons, New York Inc., 2000.

4. **D. A. R. Wallace,** ***Groups, Rings and Fields***, Springer Verlag London Ltd., 1998.

Detailed Syllabus for Core Course
B.Sc. (Honours) Mathematics

Semester-VI

COURSE TITLE: Metric Spaces and Complex Analysis

Course Code: MTHC-601 **Course No: C- 13**

Credits: 06 **No. of Classes: 75**

Marks: 100 **End Semester: 80** **Theory Internal Assessment: 20**

Objective: To understand the various application of metric on different spaces and application of complex analysis

Unit I: Metric spaces: definition and examples. Sequences in metric spaces, Cauchy sequences. Complete Metric Spaces. Open and closed balls, neighbourhood, open set, interior of a set. Limit point of a set, closed set, diameter of a set, Cantor's theorem. Subspaces, dense sets, separable spaces.

(17 Classes) MARKS:20

Unit II: Continuous mappings, sequential criterion and other characterizations of continuity. Uniform continuity. Homeomorphism, Compactness, Connectedness, connected subsets of R, Contraction mappings.

(12 Classes) MARKS:15

Unit III: Limits, Limits involving the point at infinity, continuity. Properties of complex numbers, regions in the complex plane, functions of complex variable, mappings. Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability.

(15 Classes) MARKS:12

Unit IV: Analytic functions, examples of analytic functions, exponential function, Logarithmic function, trigonometric function, derivatives of functions, definite integrals of functions. Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals. Cauchy- Goursat theorem, Cauchy integral formula.

(17Classes) MARKS:15

Unit V: Liouville's theorem and the fundamental theorem of algebra. Convergence of sequences and series, Taylor series and its examples. **(8 Classes) MARKS:10**

Unit VI: Laurent series and its examples, absolute and uniform convergence of power series.

(6 Classes) MARKS:8

Text Books:

1. **S. Kumaresan**, ***Topology of Metric Spaces***, 2nd Ed., Narosa Publishing House, 2011.
2. **G.F. Simmons,** ***Introduction to Topology and Modern Analysis***, McGraw-Hill, 2004.
3. **James Ward Brown and Ruel V. Churchill,** ***Complex Variables and Applications,*** 8th Ed., McGraw – Hill International Edition, 2009.

Reference Books:

1. **Satish Shirali and Harikishan L. Vasudeva**, ***Metric Spaces***, Springer Verlag, London, 2006.
2. **Joseph Bak and Donald J. Newman**, ***Complex Analysis,*** 2nd Ed., Undergraduate Texts in Mathematics, Springer-Verlag New York, Inc., NewYork, 1997. Mathematics, Springer-Verlag,New York, Inc., NewYork, 1997.
3. **M.R. Spiegel**, ***Theory and problem of Complex Variables***, SI(metric) edition, Schaum's Outline Series.

Detailed Syllabus for Core Course
B.Sc. (Honours) Mathematics

Semester-VI

COURSE TITLE: Ring Theory and Linear Algebra II

Course Code: MTHC-602 **Course No: C- 14**

Credits: 06 **No. of Classes: 75**

Marks: 100 **End Semester: 80** **Theory Internal Assessment: 20**

Objective: To understand the concept and application of Ring theory and Linear algebra on different fields.

Unit I: 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]**.** Divisibility in integral domains, irreducibles, primes, uniquefactorization domains, Euclidean domains. **(30 Classes) MARKS:30**

Unit II: Dual spaces, dual basis, double dual, transpose of a linear transformation and its matrix in the dual basis, annihilators, Eigen spaces of a linear operator, diagonalizability, invariant subspaces and Cayley-Hamilton theorem, the minimal polynomial for a linear operator.

(20 Classes) MARKS:25

Unit III: Inner product spaces and norms, Gram-Schmidt orthogonalisation process, orthogonal complements, Bessel's inequality, the adjoint of a linear operator, Least Squares Approximation, minimal solutions to systems of linear equations, Normal and self-adjoint operators, Orthogonal projections and Spectral theorem.

(25 Classes) MARKS:25

Text Books:

1. **John B. Fraleigh,** ***A First Course in Abstract Algebra***, 7th Ed., Pearson, 2002**.**
2. **Joseph A. Gallian,** ***Contemporary Abstract Algebra*****,** 4th Ed., Narosa Publishing House, 1999.
3. **Gilbert Strang,** ***Linear Algebra and its Applications*****,** Thomson, 2007.
4. **S. Kumaresan,** ***Linear Algebra- A Geometric Approach***, Prentice Hall of India, 1999.
5. **Kenneth Hoffman, Ray Alden Kunze,** ***Linear Algebra****,* 2nd Ed., Prentice-Hall of India Pvt. Ltd., 1971.
6. **P. K. Saikia,** ***Linear Algebra*****,** Pearson Publication.
7. **Neel Mccoy,** ***The Theory of Rings***, MacMillan & Co LTD-1964.

Reference Books:

1. **M. Artin,** ***Abstract Algebra*****,** 2nd Ed., Pearson, 2011.
2. **Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence,** ***Linear Algebra,*** 4th Ed., Prentice-Hall of India Pvt. Ltd., New Delhi, 2004.
3. **S. Lang,** ***Introduction to Linear Algebra,*** 2nd Ed., Springer, 2005.
4. **S.H. Friedberg, A.L. Insel and L.E. Spence,** ***Linear Algebra***, Prentice Hall of India Pvt. Ltd., 2004.
5. **S. Singh, Q. Zameeruddin,** ***Modern Algebra****,* Vikas Publishing House Pvt. Ltd

Detailed Syllabus for Skill Based Course
Sub: Mathematics

Semester-III

COURSE TITLE: LaTeX and HTML

Course Code: MTHS-301 **Course No: SEC- 01**

Credits: 02 **Nature of the Course-Project**

Marks: 50 **Dissertation: 40** **Internal Assessment: 10**

Objective: To trained students for effective writing of documents and designing webpages.

Elements of LaTeX; Hands-on-training of LaTex ; graphics in LaTeX; PS Tricks; Beamer presentation; HTML, creating simple web pages, images and links, design of web pages. [1] Chapter 9-11, 15

Practical : **Classes :15**

Six practical should be done by each student. The teacher can assign practical from the exercises from [1].

Text Books:

1. **Martin J. Erickson and Donald Bindner,** ***A Student's Guide to the Study***, Practice, and Tools of Modern Mathematics, CRC Press, Boca Raton, FL, 2011.

2. **L. Lamport, LATEX: A Document Preparation System,** ***User's Guide and Reference Manual.*** Addison-Wesley, New York, second edition, 1994.

Detailed Syllabus for Skill Based Course
Sub: Mathematics

Semester-IV

COURSE TITLE: Graph Theoretic Modeling

Course Code: MTHS-401 **Course No: SEC- 02**

Credits: 02 **Nature of the Course-Project**

Marks: 50 **Dissertation: 40** **Internal Assessment: 10**

Objective: Students will be able to understand the fundamentals of graph theory and different representation of graphs.

Graph Theory: Definition, Directed and undirected graphs, basic terminologies, finite and infinite graph, incidence and degree of vertex, isolated and pendent vertices, null graph, Handshaking theorem, types of graphs, sub graphs, graphs isomorphism, operations of graphs, connected graph, disconnected graphs and components.

Project : Modeling a project on Real life application of Graph theory .

Text Books:

1**.** ***Graph Theory with application to Engineering and computer Science***; **Narasingh Deo**, Prentice Hall of India, New Delhi, 2006.
2. **D.B.West ,** ***Graph Theory.***

Reference Books :

1. ***Graph Theory with Application***; **C. Vasudev**, New Age International Publishers.
2. ***Discrete Mathematics***; **Swapan Kumar Sarkar**, S. Chand & company.

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Semester-V

COURSE TITLE: Number Theory

Course Code: MTHD-501 **Course No: DSE 01(A)**
Credits: 06 **No. of Classes: 75**
Marks: 100 **End Semester: 80** **Theory Internal Assessment: 20**

Objective: The students will be able to formulate and solve various practical models using Number Theory.

Unit I: Linear Diophantine equation, prime counting function, statement of prime number theorem, Goldbach conjecture, linear congruences, complete set of residues, Chinese Remainder theorem, Fermat's Little theorem, Wilson's theorem.

(20 Classes) Marks :20

Unit II: Number theoretic functions, sum and number of divisors, totally multiplicative functions, definition and properties of the Dirichlet product, the Mobius Inversion formula, the greatest integer function, Euler's phi-function, Euler's theorem, reduced set of residues, some properties of Euler's phi-function.

(22 Classes) Marks :30

Unit III: Order of an integer modulo n, primitive roots for primes, composite numbers having primitive roots, Euler's criterion, the Legendre symbol and its properties, quadratic reciprocity, quadratic congruences with composite moduli. Public key encryption, RSA encryption and decryption, the equation x2 + y2= z2, Fermat's Last theorem.

(23 Classes) Marks :30

Text Books :

1. **David M. Burton,** ***Elementary Number Theory,*** 6th Ed., Tata McGraw-Hill, Indian reprint, 2007.
2. **Neville Robinns,** ***Beginning Number Theory,*** 2nd Ed., Narosa Publishing House Pvt. Ltd., Delhi, 2007.

Reference Books:

1. **G. H. Hardy, E.W. Wright,** ***An Introduction to the Theory of Numbers***, 6th edition,

2 **Rose, Harvey E.** ***A course in number theory***. Oxford University Press, 1995.

Detailed Syllabus for Discipline Specific Elective Course
B.Sc. (Honours) Mathematics

Semester-V

COURSE TITLE: C++ Programming

Course Code: MTHD-501 **Course No: DSE 01(B)**

Credits: 06 (Theory-04, Practicals-02) **No. of Classes: 60**

Marks: 100 **Theory End Semester: 50** **Theory Internal Assessment: 15**

Practical End Semester: 30 **Practical Internal Assessment : 05**

Objective: The students will be able to formulate and solve various practical models using Programming techniques

(A) Object Oriented Programming in C++:

Unit I: OOP Paradigm: Comparison of Programming paradigms, Characteristics of Object-Oriented Programming Languages, Object-based programming languages C++: Brief History of C++,Structure of a C++ program, Difference between C and C++ - cin, cout, new, delete operators, ANSI/ISO Standard C++, Comments, Working with Variables and const Qualifiers. Enumeration, Arrays and Pointer. Implementing oops concepts in C++ Objects, Classes, Encapsulation, Data Abstraction, Inheritance, Polymorphism, Dynamic Binding, Message Passing, Default Parameter Value, Using Reference variables with Functions.

(12 Classes) Marks : 18

Unit II: Abstract data types, Class Component, Object & Class, Constructors Default and Copy Constructor, Assignment operator deep and shallow coping, Access modifiers – private, publicand protected. Implementing Class Functions within Class declaration or outside the Class declaration. instantiation of objects, Scope resolution operator, Working with Friend Functions, Using Static Class members. Understanding Compile Time Polymorphism function overloading.

(10 Classes) Marks : 18

Unit III: Rules of Operator Overloading (Unary and Binary) as member function/friend function, Implementation of operator overloading of Arithmetic Operators, Overloading Output/Input,Prefix/ Postfix Increment and decrement Operators, Overloading comparison operators, Assignment, subscript and function call Operator , concepts of namespaces.

(8 Classes) Marks : 14

(B) Computer Laboratory (Practical) **Classes: 30**

C++- Programming

1. Temperature conversion
2. Area of triangle
3. Solution of linear equations Page 20 of 31
4. Simple and compound interest
5. Sum of series
6. Solution of quadratic equation
7. Checking of Prime numbers
8. Sum of sine, cosine and Fibonacci series,

9. Mean and standard deviation
10. Printing of a matrix
11. Matrix addition, subtraction, multiplication, transpose
12. Solution of equation by Newton – Raphson method, Bisection method.
13. Simpson's 1/3 rule
14. Sorting of numbers (ascending and descending)
15. Computation of salary
16. Find the largest number among three numbers
17. Finding the factorial of a number
18. Printing of even and odd numbers in a range.
19. Sum of digits of a number
20. Printing of numbers in various forms, number tables.

Text Books :

1. **A. R. Venugopal, Rajkumar, and T. Ravishanker, M*astering C*++,** TMH, 1997.
2. **S. B. Lippman and J. Lajoie, *C*++ *Primer,*** 3rd Ed., Addison Wesley, 2000.
3. **Bruce Eckel, *Thinking in C*++,** 2nd Ed., President, Mindview Inc., Prentice Hall.

Reference Books :

1. **D. Parasons, *Object Oriented Programming with C*++,** BPB Publication.
2. **Bjarne Stroustrup , *The C*++ *Programming Language*,** 3rd Ed., Addison Welsley.

Detailed Syllabus for Discipline Specific Elective Course
B.Sc. (Honours) Mathematics

Semester-V

COURSE TITLE: Boolean Algebra and Automata Theory

Course Code: MTHD-502 **Course No: DSE 02(A)**

Credits: 06 **No. of Classes: 75**

Marks: 100 **End Semester: 80** **Theory Internal Assessment: 20**

Objective: The students will understand the basics idea about the Boolean Algebra and Automata theory.

Unit I: Definition, examples and basic properties of ordered sets, maps between ordered sets, duality.

(6 Classes) Marks : 10

Unit II: Principle, lattices as ordered sets, lattices as algebraic structures, sublattices, products and homomorphisms.Definition, examples and properties of modular and distributive lattices, Boolean algebras,Boolean polynomials, minimal forms of Boolean polynomials, Quinn-McCluskey method,Karnaugh diagrams, switching circuits and applications of switching circuits.

(22 Classes) Marks : 30

Unit III: Introduction: Alphabets, strings, and languages. Finite Automata and Regular Languages: deterministic and non-deterministic finite automata, regular expressions, regular languages and their relationship with finite automata, pumping lemma and closure properties of regular languages.

(14 Classes) Marks : 15

Unit IV: Context Free Grammars and Pushdown Automata: Context free grammars (CFG), parse trees, ambiguities in grammars and languages, pushdown automaton (PDA) and the language accepted by PDA, deterministic PDA, Non- deterministic PDA, properties of context free languages; normal forms, pumping lemma, closure properties, decision properties. **(16 Classes) Marks : 15**

Unit V: Undecidability: Recursively enumerable and recursive languages, undecidability problems about CFGs.

(9 Classes) Marks : 10

Text Books:

1. **B A. Davey and H. A. Priestley,** ***Introduction to Lattices and Order***, Cambridge University Press, Cambridge, 1990.
2. **J. E. Hopcroft, R. Motwani and J. D. Ullman,** ***Introduction to Automata Theory****, Languages, and Computation,* 2nd Ed., Addison-Wesley, 2001.

Reference Books :

1. **Edgar G. Goodaire and Michael M. Parmenter,** ***Discrete Mathematics with Graph Theory,*** (2nd Ed.), Pearson Education (Singapore) P.Ltd., Indian Reprint 2003.
2. **Rudolf Lidl and Günter Pilz,** ***Applied Abstract Algebra***, 2nd Ed., Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.
3**. H.R. Lewis, C.H. Papadimitriou, C. Papadimitriou,** ***Elements of the Theory of Computation***, 2nd Ed., Prentice-Hall, NJ, 1997.
4. **J.A. Anderson,** ***Automata Theory with Modern Applications***, Cambridge University Press, 2006.

Detailed Syllabus for Discipline Specific Elective Course
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Semester-V

COURSE TITLE: Cryptography and Network Security

Course Code: MTHD-502 **Course No: DSE 02(B)**

Credits: 06 **No. of Classes: 75**

Marks: 100 **End Semester: 80** **Theory Internal Assessment: 20**

Objective: The students will be able get the insight of cipher and security of networks.

Unit I: Public Key Cryptography Principles & Applications, Algorithms: RSA, Message Authentication: One way Hash Functions: Message Digest, MD5, SHA1. Public Key Infrastructure: Digital Signatures, Digital Certificates, Certificate Authorities.

(20 Classes) Marks :20

Unit II: Network Attacks: Buffer Overflow, IP Spoofing, TCP Session Hijacking, Sequence Guessing, Network Scanning: ICMP, TCP sweeps, Basic Port Scans; Denial of Service Attacks: SYN Flood, Teardrop attacks, land, Smurf Attacks.IP security Architecture: Overview, Authentication header, Encapsulating Security Pay Load, combining Security Associations, Key Management. Virtual Private Network Technology: Tunneling using IPSEC.

(30 Classes) Marks :35

Unit III: Requirements, Secure Socket Layer, and Secure Electronic Transactions, Network Management Security: Overview of SNMP Architecture- SNMPV1, SNMPV3.Firewall Characteristics & Design Principles, Types of Firewalls: Packet Filtering Router, Application Level Gateway or Proxy, Content Filters, Bastion Host.

(25 Classes) Marks :25

Text Books :

1. **W. Stallings,** ***Networks Security Essentials: Application & Standards,*** Pearson Education, 2000.
2.**TCP/IP Protocol Suite , Behrouz A. Forouzan,** ***Data Communication and Networking***, Tata McGraw Hill.

Reference Books :

1. **W. Stallings,** ***Cryptography and Network Security, Principles and Practice***, Pearson Education, 2000.

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Semester-VI

COURSE TITLE: Linear Programming
Course Code: MTHD-601 **Course No: DSE 03(A)**
Credits: 06 **No. of Classes: 75**
Marks: 100 **End Semester: 80** **Theory Internal Assessment: 20**

Objective: The students will be able to formulate and solve various practical models using Linear Programming techniques

Unit I: LP Model formulation & Graphical Method: Introduction, General structure and assumption of LP model, Mathematical formulation of a linear programming problem, Example of LP model Formulation, Feasible solution, basic solution, graphical method for the solution of a linear programming problem.

(12 Classes) Marks : 15

Unit II: Theory of simplex algorithm and simplex method: Standard form of an LP Problem, Simplex Algorithm, Solutions of unique optimal solution, alternative optimal solution, **(**unbounded solution**)**, artificial variable technique (Charnes' M-technique, two phase method), Degeneracy.

(15 Classes) Marks : 18

Unit III: Duality Theory: Concept of duality, Types of primal dual problem, Standard form, Rules for constructing the dual from primal, Simple and mixed type problems, Theorem on duality, Fundamental duality theorem (Statement only). **(15 Classes) Marks : 12**

Unit IV: Transportation Problem: Definition, Transportation Table, Loops in transportation tables and their properties, Determination of an initial basic feasible solution by North West corner method, Matrix minima or least cost method and Vogel approximation method, unbalanced transportation problem, optimization by Modi method. **(18 Classes) Marks : 20**

Unit V: Game theory: formulation of two person zero sum games, solving two person zero sum games, games with mixed strategies, graphical solution procedure, linear programming solution of games.

(15 Classes) Marks : 15

Text Books:

1. ***Linear Programming and Game Theory;*** **Dipak Chatterjee,** Prentice Hall of India (P) Ltd

2. ***Linear Programming,*** **R. K. Gupta, Krishna** Publication House

Reference Books :

1. ***Operations Research,*** **S.D. Sharma,** Kedarnath Ramnath Publications.U.P, IndiaS

2. ***Linear Programming,*** **G. Hadley**, Narosa Publishing House.

3. ***Operation Research – Theory and Application,*** **J.K.Sharma**, McMillan India Ltd. New Delhi.

4. ***Linear programming and Theory of Game,*** **P. M. Karak**, New Central Book Agency(P) Ltd

Detailed Syllabus for Discipline Specific Elective Course
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Semester-VI

COURSE TITLE: Theory of Equations

Course Code: MTHD-601 **Course No: DSE 03(B)**
Credits: 06 **No. of Classes: 75**
Marks: 100 **End Semester: 80** **Theory Internal Assessment: 20**

Objective: The students will be able to learn various techniques of solving linear equations.

Unit I: General properties of polynomials, Graphical representation of a polynomial, maximum and minimum values of a polynomials, General properties of equations, Descarte's rule of signs positive and negative rule, Relation between the roots and the coefficients of equations.

(20 Classes) Marks :20

Unit II: Symmetric functions, Applications of symmetric function of the roots, Transformation of equations. Solutions of reciprocal and binomial equations. Algebraic solutions of the cubic and biquadratic. Properties of the derived functions.

(20 Classes) Marks :20

Unit III: Symmetric functions of the roots, Newton's theorem on the sums of powers of roots, homogeneous products, limits of the roots of equations.

(15 Classes) Marks :20

Unit IV: Separation of the roots of equations, Strums theorem, Applications of Strum's theorem, Conditions for reality of the roots of an equation and biquadratic. Solution of numerical equations.

(20 Classes) Marks :20

Text Books :

1. **W.S. Burnside and A.W. Panton, *The Theory of Equations*,** Dublin University Press, 1954.
2. **C. C. MacDuffee, *Theory of Equations***, John Wiley & Sons Inc., 1954.

Reference Books:

1. **J.V. Uspensky, *The Theory of Equations*,** McGRAW-HILL Paperbacks:

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Semester-VI

COURSE TITLE: Mechanics

Course Code: MTHD-602 **Course No: DSE 04(A)**

Credits: 06 **No. of Classes: 75**

Marks: 100 **End Semester: 80** **Theory Internal Assessment: 20**

Objective: The students will be able to formulate and solve various practical models using Mechanics.

Unit I: Moment of a force about a point and an axis, couple and couple moment, Moment of a couple about a line, resultant of a force system, Reduction of a system of forces on a rigid body, Change of base point, Conditions of equilibrium, distributed force system, free body diagram, free body involving interior sections, general equations of equilibrium, two point equivalent loading, problems arising from structures, static indeterminacy **(30 Classes) Marks : 25**

Unit II: Laws of Coulomb friction, application to simple and complex surface contact friction problems, transmission of power through belts, screw jack, wedge, first moment of an area and the centroid, other centers, Theorem of Pappus-Guldinus, second moments and the product of area of a plane area, transfer theorems, relation between second moments and products of area, polar moment of area, principal axes.

(20 Classes) Marks : 20

Unit III: Conservative force field, conservation for mechanical energy, work energy equation, kinetic energy and work kinetic energy expression based on center of mass, moment of momentum equation for a single particle and a system of particles, translation and rotation of rigid bodies, Chasles' theorem, general relationship between time derivatives of a vector for different references, relationship between velocities of a particle for different references, acceleration of particle for different references.

(25 Classes) Marks : 35

Text Books :

1. **Statics**; **Dr Md Motiur Rahman,** New Central Book Agency (P) Ltd 2007

2. **A Text Book on Dynamics**; **M. Ray & G.C. Sharma**, S. Chand and Company Ltd.

3. I.H. Shames and G. Krishna Mohan Rao, ***Engineering Mechanics: Statics and Dynamics*** (4th Edition), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2009.

Reference Books :

1. ***Dynamic of a Particle and of Rigid Bodies***; **S.L. Loney,** S. Chand and Company Ltd.
2. ***An Elementary Treatise on Statics;*** **S.L. Loney,** Cambridge University Press.
3. ***A Text Book on Statics;*** **M. Ray. R.D. Manglik, G.C. Sharma,** S. Chand and Company Ltd.
4. ***Statics;*** **P.N. Chatterji,** A Rajhans Publication.
5. ***Dynamics;*** **A.R. Vasishtha, R.K. Gupta;** Krishna Prakashan Media Pvt. Ltd.

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B.Sc. (Honours) Mathematics

Semester-VI

COURSE TITLE: Differential Geometry

Course Code: MTHD-602 **Course No: DSE 04(B)**

Credits: 06 **No. of Classes: 75**

Marks: 100 **End Semester: 80** **Theory Internal Assessment: 20**

Objective: The students will be able to formulate and solve various practical models using Linear Programming techniques

Unit I: Theory of Space Curves: Space curves, Planer curves, Curvature, torsion and Serret-Frenet formulae. Osculating circles, Osculating circles and spheres. Existence of space curves. Evolutes and involutes of curves.

(15 Classes) Marks : 16

Unit II: Theory of Surfaces: Parametric curves on surfaces. Direction coefficients. First and second Fundamental forms. Principal and Gaussian curvatures. Lines of curvature, Euler's theorem. Rodrigue's formula, Conjugate and Asymptotic lines.

(15 Classes) Marks :16

Unit III: Developable: Developable associated with space curves and curves on surfaces, Minimal surfaces.

(08 Classes) Marks :10

Unit IV: Geodesics: Canonical geodesic equations. Nature of geodesics on a surface of revolution. Clairaut's theorem. Normal property of geodesics. Torsion of a geodesic. Geodesic curvature. Gauss-Bonnet theorem. Surfaces of constant curvature. Conformal mapping. Geodesic mapping. Tissot's theorem.

(17 Classes) Marks :18

Unit V: Tensors: Summation convention and indicial notation, Coordinate transformation and Jacobian, Contra-variant and Covariant vectors, Tensors of different type, Algebra of tensors and contraction, Metric tensor and 3-index Christoffel symbols, Parallel propagation of vectors, Covariant and intrinsic derivatives, Curvature tensor and its properties, Curl, Divergence and Laplacian operators in tensor form, Physical components.

(20 Classes) Marks :20

Text Books :

1. **T.J. Willmore,** ***An Introduction to Differential Geometry*****,** Dover Publications, 2012.
2. **B. O'Neill,** ***Elementary Differential Geometry***, 2nd Ed., Academic Press, 2006.
3. **C.E. Weatherburn,** ***Differential Geometry of Three Dimensions***, Cambridge University Press2003.

Reference Books :

4. **D.J. Struik,** ***Lectures on Classical Differential Geometry***, Dover Publications, 1988.
5. **S. Lang,** ***Fundamentals of Differential Geometry***, Springer, 1999.
6. **B. Spain,** ***Tensor Calculus: A Concise Course***, Dover Publications, 2003.

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Semester-I

COURSE TITLE: Trigonometry & Analysis I

Course Code: MTHG-101 **Course No: GE-01**

Credits: 06 **No. of Classes: 75**

Marks: 100 **End Semester: 80** **Theory Internal Assessment: 20**

Objective: Students will be able to use trigonometry, vectors and matrix methods for solving linear equations and also about the numerical methods of obtaining results where complexity of obtaining analytical solutions is sufficiently high.

Unit I: De-Moivre's theorem and important deductions from De-Moivre's theorem

(5 Classes) MARKS:8

Unit II: Trigonometrical and exponential functions of complex arguments., Hyperbolic functions.

(5 Classes) MARKS: 8

Unit III: Ordinary derivatives of vectors , Space curves, Continuity and differentiability, Differentiation formulae, Partial derivatives of vectors and related problems, Vector differential operator del, Gradient, Directional derivative, Divergence and Curl, Laplacian operator ∇^2 , Vector identities and related problems.

(14 Classes) MARKS: 16

Unit IV: Rank of a matrix, Elementary operations on a matrix, determination of rank by reduction into echelon form & normal form, elementary matrices. **(5 Classes) MARKS: 5**

Unit V: Solution of homogeneous & non- homogeneous linear equations, Characteristic Polynomial, Characteristic equation, Eigen values and Eigen vectors, Cayley-Hamilton theorem.

(10 Classes) MARKS: 10

Unit VI: Special types of matrices: idempotent, nilpotent, involution, and projection tridiagonal matrices, circulant matrices, Vandermonde matrices, Hadamard matrices. Positive Semi-definite matrices: positive semi-definite matrices, square root of a positive semi-definite matrix, a pair of positive semi-definite matrices, and their simultaneous diagonalization. Symmetric matrices and quadratic forms: diagonalization of symmetric matrices, quadratic forms.

(12 Classes) MARKS: 7

Unit VII: Solution of algebraic and transcendental equation: Bisection method, Regula-falsi method, Iteration method, Newton-Raphson method and its geometrical interpretation. Solution of system of equations: Gauss elimination method, Gauss Seidal Method, Gauss Jordan method. **(12 Classes) MARKS**: **13**

Unit VIII: Diagonal and horizontal differential table, finite difference operators, Newton's forward, backward and general interpolation formulae, Lagrange's interpolation formula, Quadrature: Trapezoidal rule, Simpson's quadrature (1/3 and 3/8 rule).

(12 Classes) MARKS: 13

Text Books :

1. ***Higher Trigonometry;*** **B.C. Das , B.N. Mukherjee**, U.N. Dhur and Sons, Calcutta
2. ***Text book of vector calculus;*** **Shanti Narayan, J. N. Kapur**, S. Chand and company, N. Delhi .
3. ***A text Book of Matrices;*** **Shanti Narayan and P.K. Mittal**, S. Chand and Company Ltd.
4. ***Introductory Method of Numerical Analysis*****; S. S. Sastry,** Prentice Hall India Pvt. Ltd.

Reference Books :

1. ***Fuzhen Zhang, Matrix theory***, Springer-Verlag New York, Inc., New York, 1999.
2. ***Numerical Mathematical Analysis***; **J.B. Scarborough**, Oxford & IBH Publishing Co.

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Semester-II

COURSE TITLE: Analysis II
Course Code: MTHG-201 **Course No: GE-02**
Credits: 06 **No. of Classes: 75**
Marks: 100 **End Semester: 80** **Theory Internal Assessment: 20**

Objectives: Students will be able to identify the analytical aspects of Mathematical concepts.

Unit I: Successive differentiation, Leibnitz's theorem, indeterminate forms. Partial Derivatives, Euler's theorem on homogeneous function. **(8 Classes) MARKS:8**

Unit II: Function of severable variable: Explicit and implicit functions, continuity, partial derivatives, definition of Jacobian, partial derivatives of higher order, Young's and Schwarz's theorem (without proof), change of variables, Tailor's theorem, extreme values. **(10 Classes) MARKS: 10**

Unit III: Evaluation of definite integrals by using properties only, Reduction formula of the integrands

$\sin^n\theta, \cos^n\theta, \tan^n\theta$ and $\sin^m\theta\cos^n\theta$. **(10 Classes) MARKS: 8**

Unit IV: Rectification of plane curves. Surface and volume of solids of revolution.

(6 Classes) MARKS: 6

Unit V : Definitions and existence of R-integrals, inequalities of R-integrals, refinement and related theorems, Darboux's theorem, conditions of integrability (both the forms), Integral as a limit of sum (Reimann sums) and its relationship with Darboux's condition of integrability, some applications, integrability of continuous and monotonic functions, functions with finite and infinite number of discontinuities, related examples. Primitive, fundamental theorem (1^{st} & 2^{nd}) of integral calculus, first mean value theorem.

(10 Classes) MARKS: 10

Unit VI: Improper integrals: Introduction and their convergence, Statements of Comparision test, Cauchy's test, Abel's test, Dirichlet's test and their applications. **(7 Classes) MARKS: 8**

Unit VII: Differential equation of the type: Exact differential equations of first order, Equations of first order higher degree, Clairaut's form, wronskian, its properties and application. **(8 Classes) Marks: 10**

Unit VIII: Linear differential equation of higher order with constant coefficients, linear homogeneous equations. **(8 Classes) Marks: 10**

Unit IX: Linear equation of second order with variable coefficient : Removal of first order derivative. Change of independent variables. Method of variation of parameters. **(8 Classes) Marks: 10**

Text Books :

1. ***Differential Calculus;*** **B.C. Das and B.N. Mukherjee** , U.N. Dhar and Sons, Private Ltd, Calcutta. 51st edition.
2. ***Mathematical Analysis*****; S.C. Malik, S. Arora**, New Age International (P) Ltd, Third Edition 2007 (reprint) New Delhi.
3. ***Integral Calculus including Differential equations;*** **B.C. Das & B.N. Mukherjee** , U.N. Dhar and Sons Pvt. Ltd, Calcutta. 53rd Edtion.
4. **Advance Differential Equation; M.D. Raisinghania**, S. Chand Company.
5. ***Introduction to Real Analysis;*** **R. G. Bartle and D. R. Sherbert** (3rd edition), John Wiley and Sons (Asia) Pvt. Ltd, Singapore, 2002.

Reference Books :

1. ***Principles of Mathematical Analysis;*** **Walter Rudin;** Mc Graw Hill International.
2. ***Mathematical Analysis;*** **Tom M Apostol,** Narosa Publishing House.
3. ***Differential Equations;*** **S.C. Ross, John Wiley and sons**, India 2004.

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Sub: Mathematics

Semester-III

COURSE TITLE: Computational Methods

Course Code: MTHG-301 **Course No: GE-03**

Credits: 06 (Theory-04, Practicals-02) **No. of Classes: 60**

Marks: 100 **Theory End Semester: 50** **Theory Internal Assessment: 15**

Practical End Semester: 30 **Practical Internal Assessment : 05**

Objectives: The students will be able to formulate and solve various practical models using Linear Programming techniques and also by using Computer Laboratory they will attain computational proficiency in dealing with Mathematical Software.

Unit I: LP Model formulation & Graphical Method: Introduction, General structure and assumption of LP model, Mathematical formulation of a linear programming problem, Example of LP model Formulation, Feasible solution, basic solution, graphical method for the solution of a linear programming problem, convex set. **(15 Classes) Marks : 10**

Unit II: Theory of simplex algorithm and simplex method: Standard form of an LP Problem, Simplex Algorithm, Solutions of unique optimal solution, alternative optimal solution, unbounded solution, artificial variable technique (Charnes' M-technique, two phase method), Degeneracy. **(20 Classes) Marks : 15**

Unit III: Matrix inversion methods: Gauss elimination, Gauss Jordan, LU-Decomposition Methods: Crout's method, Doolittle method. Related examples. **(10 Classes) Marks : 10**

Unit IV: Transportation Problem: Definition, Transportation Table, Loops in transportation tables and their properties, Determination of an initial basic feasible solution by North West corner method, Matrix minima or least cost method and Vogel approximation method. **(15 Classes) Marks : 15**

Computer Laboratory (Practical)

Matlab / Mathematica: Evaluation of arithmetic expression, exponential and logarithms, trigonometric functions, computation of complex numbers, Plotting of curves (Algebraic function, trigonometric function, and exponential function), Operations in matrices, Plotting of three 3D curves and shapes, Solution of algebraic equation, simultaneous linear equations. **(Classes : 30)**

Text Books:

1. ***Linear programming and Theory of Game ;*** **P. M. Karak,** New Central Book Agency(P) Ltd
2. ***Operation Research – Theory and Application;*** **J.K.Sharma,** McMillan India Ltd. New Delhi.
3. ***Getting Started with Matlab,*** **Rudra Pratap,** Oxford University Press.

Reference Books :

1. ***Linear Programming;*** **G. Hadley,** Narosa Publishing House
2. ***Linear Programming and Game Theory***; Dipak Chatterjee, Prentice Hall of India (P) Ltd.
3. ***Linear Programming*****, R.K. Gupta,** Krishna Prakashan Media (P) Ltd.

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Semester-IV

COURSE TITLE: Coordinate Geometry & Abstract Algebra

Course Code: MTHG-401 **Course No: GE- 04**

Credits: 06 **No. of Classes: 75**

Marks: 100 **End Semester: 80** **Theory Internal Assessment: 20**

Objective: The students will be able to get a deeper understanding of geometrical approach through Co-ordinate system and also able to know about preliminary idea about abstract algebra and its application in various fields like chemical structure.

Unit I: Transformation of coordinates: Translation of axes, Rotation of axes, Invariants, Removal of *xy*-term. **(6 Classes) Marks : 10**

Unit II: Pair of straight lines: Pair of straight lines through origin, Angle Bisectors of the angle between the lines given by homogenous equation of 2nd degree, Condition for the general equation of second degree to represent a pair of straight lines, Pair of intersecting straight lines, Pair of parallel straight lines. **(12 Classes) Marks : 13**

Unit III: General Equation of second degree: Equation to the conic sections, Centre of a conic, Reduction to central and non central conic, Tangent to the conic and condition of tangency, Chord of contact, Pole and Polar, conjugate diameter, **(10 Classes) Marks : 12**

Unit IV: Sphere , Conicoides . **(10 Classes) Marks : 8**

Unit V: Cylinder & Cone **(7 Classes) Marks : 7**

Unit VI: Relations : definition & example, Equivalence relations, Equivalence Classes, Binary Compositions. **(5 Classes) Marks: 5**

Unit VII : Groups : Definition, Semi group, Subgroup, Normal subgroup, Abelian group, Example and Related Theorem **(15 Classes) Marks: 15**

Unit VIII : Application of Abstract Algebra , Dihedral groups, group theory in Chemistry. **(10 Classes) Marks: 10**

Text Books:

1. ***Analytical Geometry and Vector Analysis***; **B. Das,** Orient Book Company, Calcutta.
2. ***A Course in Abstract Algebra***; **V.K. Khanna, S.K. Bhambri**, Vikas Publishing house Ltd.

Reference Books :

1. ***Analytical Geometry of two and three dimensions***; **R.M. Khan,** New Central Book Agency, Calcutta
2. ***Analytical Geometry of two dimensions;*** **P K Jain & K. Ahmed,** Wiley Eastern Ltd.
3. ***Analytical Geometry of three dimensions***; **P K Jain & K. Ahmed**, Wiley Eastern Ltd
4. ***Topics in Algebra***; **I.N. Herstein,** Wiley India, Pvt.Ltd.
5. **Joseph A. Gallian**, ***Contemporary Abstract Algebra,*** 4th Ed., Narosa Publishing House, New Delhi,1999.

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