

**CHOICE BASED CREDIT SYSTEM
SCHEME & SYLLABUS**

M.Sc.(Hons.) Mathematics



**Department of Physical Sciences
University Institute of Science & Humanities
SANT BABA BHAG SINGH UNIVERSITY
2020**

SCHEME & SYLLABUS

ABOUT THE DEPARTMENT

The Physical Sciences expands our knowledge of the universe and underlines new technologies, which benefit our society. In keeping with the heritage of imparting quality education, teaching and research are the prime motive of the Department of Physical Sciences. Department of Physical Sciences is dynamic and progressive in its development of new course initiatives. The faculty is well placed to contribute substantially to the goal of SBBSU and becoming research-oriented organization. The teaching is by way of interactive sessions between students and teachers. Our courses ensure a coherent degree structure while encouraging interdisciplinary approach. The Department has highly qualified, young and dynamic faculty in various fields of Physical Sciences viz. in chemistry research interests include Green Chemistry, Polymer Chemistry, Advanced controlled drug delivery systems, Advanced heterocyclic chemistry etc. The thrust area in Physics includes Materials Physics, Condensed matter Physics, Nuclear Physics and nanomaterials and their applications. The research interests of faculty of mathematics includes Numerical Analysis, Wavelet methods, topology, fixed point theory, qualitative behavior of dynamical systems. The outcome-based teaching model of faculty comprising of theoretical work, regular academic activities such as research projects, seminars, resource learning and hands-on laboratory work.

SALIENT FEATURES OF THE DEPARTMENT

- The department is blessed to have specialized faculty in various fields of Physical Sciences viz. Chemistry, Physics, Mathematics.
- The Department keeps its students abreast of latest advancements in technology through ultra-modern computer facilities, e-learning, virtual labs, SWAYAM Courses as per UGC guidelines.
- Elective courses that bridges the gap between industry requirements and academia.
- The Department has well equipped laboratories with a number of instruments and facilities.



MSc. Hons' Mathematics(Masters in Mathematics)

In this degree, candidates get a deeper knowledge of advanced mathematics through a vast preference of subjects such as geometry, calculus, algebra, number theory, dynamical systems, differential equations, etc. The students become more skilled and specialized in a particular subject after the master degree program. In this course, students learn to collect big data and analyse them with the help of different tools and methods.

VISION

To aspire, achieve and sustain for excellence in academics and research through scientific knowledge so as to provide solutions to global environmental issues and transform graduates into responsible citizens and competent professionals

MISSION

Holistic development of students through academic excellence, employability, acquisition of analytical skills and higher research.To explore and advance new frontiers in physical sciences integrated with life sciences, medicine , energy, materials and environmental sciences through visionary research for the benefit of society.To develop graduates for lifelong learning and professional growth.

ELIGIBILITY CRITERIA

B.Sc. Non-Medical with atleast 50% marks in aggregate with mathematics or equivalent as one course subject.

DURATION

2 Years

CAREER PATHWAYS

Mathematics offers a huge variety of career opportunities. It is important to plan ahead and know about your options.

The following guide is designed to help you navigate through the maze of career options that exist for maths graduates. Each of the pages below offer an insight into relevant careers for maths graduates, including a description of career, the skills required, the pros and cons, as well as useful links.

Possible career choices:

[Accountancy & Professional Service](#)

[The Actuarial Profession](#)

[Banking - Investment Banking](#)

[Banking - Retail Banking](#)

[Computing & IT](#)

[Engineering Sciences](#)

[General Management, Operational research](#)

[Postgraduate Study - MSc & Taught Courses; Postgraduate Study - PhD](#)

[Statistical research](#)

[Teaching](#)

Programme Educational Objective (PEO) (The Course Objective is....)	
PEO1.	To provide high quality education in pure and applied mathematics.
PEO2.	To develop talented and committed human resource which act as catalyst to support interdisciplinary research and become fit for industry and entrepreneur.
PEO3	To motivate for research in mathematical and statistical sciences.
PEO4	To empower students to investigate new mathematical methodologies for future applications.
PEO5	To develop employable skills and life time leaning skills to handly real world challenging problems.
Programme Outcomes (PO)(At the end of Programme/Degree mentioned above , the graduates will be able to	
PO1.	Able to identify, analyze, think critically, formulate and solve mathematical problems.
PO2.	Able to think critically on abstract concepts of Mathematics.
PO3	Apply logical reasoning skills, arithmetic skills, self-confidence for better employability.
PO4	Eligible for competetive examinations such as NET,SLET, GATE, for research and employment in Government and private organizations.
PO5	Able to function in multidisciplinary teams become equiped for industrial outreach and to meet the desired needs of society
PO6	Become Proficient and ethically responsible citizen.
Programme Specific Outcomes (PSO) Post graduates will	
PSO1.	Acquired critical analysis and problem solving skills with respect to all field of core mathematics required for science and engineering application.
PSO2.	Attained mathematical knowledge of experimental/computational techniques and instrumentation required to work independently in research or industrial environments.
PSO3	Become a person with sharpen analytical thinking, logical deductions and rigor in reasoning.
PSO4	Ability to apply mathematical methodologies to open- ended real -world situations.

ABOUT THE CHOICE BASED CREDIT SYSTEM (CBCS)

The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/minor or skill based courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. The basic idea is to look into the needs of the students so as to keep up-to-date with development of higher education in India and abroad. CBCS aims to redefine the curriculum keeping pace with the liberalization and globalization in education. CBCS allows students an easy mode of mobility to various educational institutions spread across the world along with the facility of transfer of credits earned by students.

1. Curriculum Structure: M.Sc (Mathematics) degree programme will have a curriculum with Syllabus consisting of following type of courses:

I. Ability Enhancement Courses (AEC): The Ability Enhancement Courses (AEC) may be of two kinds: Ability Enhancement Compulsory Courses (AECC) and Skill Enhancement Courses (SEC). AECC courses are the courses based upon the content that leads to Knowledge enhancement; these are mandatory for all disciplines.

SEC courses are value-based and/or skill-based and are aimed at providing hands-on-training, competencies, skills, etc.

A. Ability Enhancement Compulsory Courses (AECC): Environmental Science, English Communication/MIL Communication.

B. Skill Enhancement Courses (SEC): These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based knowledge.

II. Core Courses (CR): A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course. These courses are employability enhancement courses relevant to the chosen program of study. Program core comprises of Theory, Practical, Project, Seminar etc. Project work is considered as a special course involving application of knowledge in solving/analyzing/exploring a real life situation/ difficult problem.

III. Elective Courses: Elective course is generally a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill. Accordingly, elective course may be categorized as:

A. Discipline Specific Elective (DSE) Course: Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective.

B. Project (I): An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project.

2. NOMENCLATUREUSED:

A. Postgraduate CoreCourses

- i. CoreCourse(CR)
- ii. Theory Subject(T)
- iii. Practical(P)

B. Ability Enhancement Courses(AEC):

- i. Ability Enhancement Compulsory Courses(AECC)
- ii. Skill Enhancement Courses(SEC).

C. Elective Courses(EL)

Discipline Specific Elective(DSE) Index

S.No.	Type of course	Subject Code	Subject Name	Semester	Page No
1.	CR	MAT501	Real Analysis-I	I	12
2.	CR	MAT503	Complex Analysis	I	13-14
3.	CR	MAT505	Abstract Algebra-I	I	15-16
4.	CR	MAT507	Ordinary Differential Equations	I	17
5.	CR	MAT509	Classical Mechanics and Calculus of Variations	I	18
6.	AECC	SSC006	Human Values and Professional Ethics	I	19-20
7.	CR	MAT502	Real Analysis-II	II	21
8.	CR	MAT504	Abstract Algebra-II	II	22
9.	CR	MAT506	Mathematical Methods	II	23-24
10.	CR	MAT508	Partial Differential Equations	II	25
11.	CR	MAT510	Linear Algebra	II	26
12.	AECC	CSE558	Fundamental of Computer Science-Theory	II	27
13.	AECC	CSE560	Fundamental of Computer Science-Lab	II	28
14.	SEC	MAT540	Research Methodology & IPR	II	29-30
15.	CR	MAT601	Topology	III	31
16.	CR	MAT603	Probability and Statistics	III	32-33

17.	CR	MAT605	Numerical Analysis	III	34
18.	CR	MAT625	Numerical Analysis Lab	III	35-36
19.	SEC	MAT627	Seminar	III	
20.	EC	MAT*	Discipline Specific Elective I (Choose any one) A. MAT613 Operation Research-I) B. MAT615 (Fluid Mechanics - I) C. MAT617 (Topological Vector Spaces)	III	37-39
21.	EC	MAT*	Discipline Specific Elective II Choose any one) A. MAT619 (Discrete Mathematics) B. MAT621 (Differential Geometry) C. MAT623 (Calculus of Several Variables)	III	40-42
22.	AECC	BOT001	Natural Hazards and Disaster management	III	43-44
23.	CR	MAT602	Functional Analysis	IV	45
24.	CR	MAT604	Number Theory	IV	46
25.	CR	MAT606	Field Extensions and Galois Theory	IV	47-48
26.	EC	MAT*	Discipline Specific Elective III (Choose any one) A. MAT616 (Operational Research-II) B. MAT618 (Fluid Mechanics-II) C. MAT620(Special Functions)	IV	49-51
27.	EC	MAT*	Discipline Specific Elective IV (Choose any one) A. MAT622(Advanced Numerical Analysis) B. MAT624(Fuzzy Set Theory) C. MAT626(Advanced Complex Analysis)	IV	52-55
28.	SEC	MAT628	Project (Research Paper review and Viva)	IV	

Core Courses

S.No.	Subject Code	Subjects	Semester	Page no.
1.	MAT501	Real Analysis-I	I	12
2.	MAT503	Complex Analysis	I	13-14
3.	MAT505	Abstract Algebra-I	I	15-16
4.	MAT507	Ordinary Differential Equations	I	17
5.	MAT509	Classical Mechanics and Calculus of Variations	I	18
6.	MAT502	Real Analysis-II	II	21
7.	MAT504	Abstract Algebra-II	II	22
8.	MAT506	Mathematical Methods	II	23-24
9.	MAT508	Partial Differential Equations	II	25
10.	MAT510	Linear Algebra	II	26
11.	MAT601	Topology	III	31
12.	MAT603	Probability and Statistics	III	32-33
13.	MAT605	Numerical Analysis	III	34
14.	MAT625	Numerical Analysis Lab	III	35-36
15.	MAT602	Functional Analysis	IV	45
16.	MAT604	Number Theory	IV	46
17.	MAT606	Field Extensions and Galois Theory	IV	47-48

Ability Enhancement Courses

S.No.	Subject Code	Subjects	Semester	Page no.
1.	CSE558	Fundamental of Computer Science-Theory	II	27
2.	CSE560	Fundamental of Computer Science-Lab	II	28
3.	SSC006	Human values and professional Ethics	I	19-20
4.	BOT001	Natural Hazards and Disaster management	III	43-44

Discipline Specific Elective Courses

S.No.	Subject Code	Subjects	Semester	Page no.
1	MAT613 MAT615 MAT617	A. Operation Research – I B. Fluid Mechanics-I C. Topological Vector Spaces	III	37-39
2	MAT619 MAT621 MAT623	A. Differential Geometry B. Calculus of Several Variables C. Discrete Mathematics	III	40-42
3	MAT616 MAT618 MAT620	A. Operation Research-II B. Fluid Mechanics –II C. Special Functions	IV	49-51
4	MAT622 MAT624 MAT626	A. Advanced Numerical Analysis B. Fuzzy Set Theory C. Advanced Complex Analysis	IV	52-55

Skill Enhancement Courses

S.No.	Subject Code	Subjects	Semester
1.	MAT540	Research Methodology & IPR	II
2	MAT500	Seminars	III
3.	MAT628	Project (Research Paper review and Viva)	IV

Scheme for M.Sc. (Hon's) Mathematics

Semester-I

I. Theory Subjects

S. No.	Type of course	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	CR	MAT501	Real Analysis-I	5:0:0	5:0:0	5	5
2	CR	MAT503	Complex Analysis	5:0:0	5:0:0	5	5
3	CR	MAT505	Abstract Algebra-I	5:0:0	5:0:0	5	5
4	CR	MAT507	Ordinary Differential Equations	5:0:0	5:0:0	5	5
5	CR	MAT509	Classical Mechanics and Calculus of Variations	5:0:0	5:0:0	5	5
6	AECC	SSC006	Human values and professional Ethics	3:0:0	3:0:0	3	3

Total Credit Hours-28
Total; Contact Hours- 28

CR: Core Course

AEC: Ability Enhancement Course

SEC: Skill Enhancement Course

Scheme for M.Sc.(Hon's) Mathematics

Semester-II

I. Theory Subjects

S. No.	Type of course	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	CR	MAT502	Real Analysis-II	5:0:0	5:0:0	5	5
2	CR	MAT504	Abstract Algebra-II	5:0:0	5:0:0	5	5
3	CR	MAT506	Mathematical Methods	5:0:0	5:0:0	5	5
4	CR	MAT508	Partial Differential Equations	5:0:0	5:0:0	5	5
5	CR	MAT510	Linear Algebra	5:0:0	5:0:0	5	5
6	AEC	CSE558	Fundamental of Computer Science-Theory	3:0:0	3:0:0	3	3
7	SEC	MAT540	Research Methodology & IPR	3:0:0	3:0:0	3	3

II. Practical Subject

S.No.	Type of course	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	AEC	CSE560	Fundamentals of Computer Science-Lab	0:0:2	0:0:1	2	1

**Total Credit Hours-32
Total; Contact Hours- 33**

CR: Core Course

AEC: Ability Enhancement Course

SEC: Skill Enhancement Course

Scheme for M.Sc. (Hon's) Mathematics

Semester-III

I. Theory Subjects

Sr. No.	Type of Course	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	CR	MAT601	Topology	5:0:0	5:0:0	5	5
2	CR	MAT603	Probability and Statistics	5:0:0	5:0:0	5	5
3	CR	MAT605	Numerical Analysis	4:0:0	4:0:0	4	4
4	DSE	MAT613/ MAT615/ MAT617	Choose Any One: Operation Research-I/ Fluid Mechanics -I/ Topological Vector Spaces	4:0:0	4:0:0	4	4
5	DSE	MAT619/ MAT621/ MAT623	Choose Any One: Discrete Mathematics/ Differential Geometry Calculus of Several Variables	4:0:0	4:0:0	4	4
6.	AECC	BOT001	Natural hazards and disaster management	3.0.0	3:0:0	3	3

II. Practical Subjects

Sr. No.	Type of Course	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	CR	MAT625	Numerical Analysis Lab	0:0:4	0:0:2	4	2
2	SEC	MAT627	Seminar	0:0:2	0:0:1	2	1

Total Credit Hours-28
Total; Contact Hours- 31

CC: Core Course
EC: Elective Course
SEC: Skill Enhancement Course

Scheme for M.Sc. (Hons.) Mathematics

Semester-IV

I. Theory Subjects

Sr. No.	Type of course	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	CR	MAT602	Functional Analysis	5:0:0	5:0:0	5	5
2	CR	MAT604	Number Theory	5:0:0	5:0:0	5	5
3	CR	MAT606	Field Extensions and Galois Theory	5:0:0	5:0:0	5	5
4	DSE		Choose Any One:	4:0:0	4:0:0	4	4
		MAT616/	Operational Research-II/				
		MAT618/ MAT620	Fluid Mechanics-II/ Special Functions				
5	DSE		Choose Any One:	4:0:0	4:0:0	4	4
		MAT622/	Advanced Numerical Analysis/				
		MAT624/ MAT626	Fuzzy Set Theory/ Advanced Complex Analysis-II				

II. Practical Subjects

Sr. No.	Type of Course	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	SEC	MAT628	Project (Research Paper review and Viva)	0:0:8	0:0:4	8	4

**Total Credit Hours-27
Total; Contact Hours- 31**

CR: Core Course
EC: Elective Course
SECC: Skill Enhancement Course

Summarized Report of Course Scheme for M.Sc.(Hon's) Mathematics

SEM	L	T	P	Contact hrs/week	Credits hrs/week	Credits hrs/week			
						CR	AEC	SEC	DSE
I	25	0	0	28	28	25	3	0	0
II	30	0	2	33	32	25	4	3	0
III	22	0	6	31	28	16	3	1	8
IV	23	0	8	31	27	15	0	4	8
Total	100	0	16	123	115	81	10	8	16



SEMESTER I

Course Code	MAT501
Course Title	Real Analysis-I
Type of course	Core
L T P	50 0
Credits	5
Course prerequisite	B.Sc. with Mathematics or B.A with Mathematics
Course Objective (CO)	The aim of this course is to make the students learn fundamental concepts of metric spaces, The Riemann-Stieltjes integral as a generalization of Riemann Integral, the calculus of several variables and basic theorem.
Course Outcomes (CO)	Students will be able to: 1. describe fundamental properties of the real numbers that lead to the formal development of real analysis. 2. comprehend rigorous arguments developing the theory underpinning real analysis. 3. demonstrate an understanding of limits and how they are used in sequences, series, differentiation and integration.

UNIT-I

Finite, Countable and Uncountable sets, Metric spaces: definition, open sets, closed sets, interior and exterior point, adherent point, Compact sets, Heine-Borel Theorem, Perfect sets, The Cantor set, Separated sets, connected sets, Connected subsets of real line, Disconnected sets, Components.

UNIT-II

Limits of functions, Continuous functions, Compactness, Connectedness, monotonic functions, Infinite limits and Limits at infinity.

UNIT-III

Definition and existence of the Riemann-Stieltjes integral, Properties of the integral, Integration and differentiation, Fundamental Theorem of Calculus, Mean Value Theorems of Riemann Stieltje's integral.

UNIT-IV

Convergent sequences, Sub sequences, Cauchy sequences, Complete metric spaces, Cantor's Intersection Theorem, Baire's Category Theorem, Banach contraction principle, Functions of bounded variation.

Text & Reference Books:-

S. No.	Name	Author(S)	Publisher
1	Principles of Mathematical Analysis	Walter Rudin	McGraw-Hill Ltd
2	A course of Mathematical Analysis	Shanti Narayan	S.Chand

3	Mathematical Analysis	S.C.Malik	Wiley Eastern
4	Introduction to Real Analysis	R. G. Bartle	John Wiley and Sons
5	Elements of Real Analysis	H. S. Gaskill and P. P.Narayanaswami	Printice Hall,
6	Real Analysis	H.L. Royden	Macmillan <i>Company</i> Collier-Macmillan Limited

Course Code	MAT503
Course Title	Complex Analysis
Type of course	Core
L T P	5 0 0
Credits	5
Course prerequisite	B.Sc. with Mathematics or B.A with Mathematics
Course Objective (CO)	This course is aimed to provide an introduction to the theories for functions of a complex variable. It begins with the exploration of the algebraic, geometric and topological structures of the complex number field. The concepts of analyticity, Cauchy-Riemann relations and harmonic functions are then introduced.
Course Outcomes (CO)	Students will : <ol style="list-style-type: none"> 1. Define the concepts of derivation of analytic functions. 2. Express Liouville's theorem and the fundamental theorem of the algebra. 3. Define the concepts of zeros of complex functions and Residue Theorem.

UNIT-I

Complex plane, Stereographic projection, Riemann sphere, Function of complex variables, Continuity and Differentiability, Analytic functions, Conjugate function, Harmonic function, Cauchy Riemann equations (Cartesian and Polar form), Construction of analytic functions. Branch cut and Branch point.

UNIT-II

Complex line integral, Cauchy's theorem, Cauchy's integral formula and its generalized form. Cauchy's inequality, Poisson's integral formula, Morera's theorem, Liouville's theorem, conformal transformation, Bilinear transformation, critical points, fixed points, Cross ratio problems.

UNIT-III

Meromorphic and entire function, Power series, Taylor's theorem, Laurent's theorem, Maximum modulus theorem (Principle), Schwarz's Lemma, poles and zeroes of meromorphic functions, Argument principle, and Fundamental theorem of Algebra and Rouché's theorem.

UNIT-IV

Zeros, Singularities, Residue at a pole and at infinity, Cauchy's Residue theorem, Jordan's lemma, Integration round unit circle, Evaluation of Integrals of the type $\int f(z)dz$ where $f(z)$ is a rational function with degree of denominator polynomial greater than that of numerator polynomial by at least two and C is a circle, $\int_0^{2\pi} f(\sin\theta, \cos\theta)d\theta$ and $\int_{-\infty}^{\infty} f(x)dx$.

Text & Reference books:-

S. No	Name	Author(S)	Publisher
1	Complex Analysis	J.V Deshpande	Tata McGraw-Hill Publishing Company
2	Complex Analysis, third edition (International student edition)	D.V Ahlfors	McGraw-Hill International Book Company.
3	An Introduction to the theory of functions of a Complex Variable	E.T Copson	The English Language Book Society and Oxford University Press.
4	Functions of Complex Variable and Application	James Ward Brown, Ruel V. Churchill	McGraw Hill Higher Education
5	Complex Variables	M. R. Spiegel	McGraw Hill Book Company
6	Complex Variables and Applications	J. W. Brown, R. V. Churchill.	McGraw Hill,

Course Code	MAT505
Course Title	Abstract Algebra-I
Type of course	Core
L T P	500
Credits	5
Course prerequisite	B.Sc. with Mathematics or B.A with Mathematics
Course Objective (CO)	This course covers some advanced topics of Group Theory and basic concept of ring theory, which are two most important branches of algebra.
Course Outcomes(CO)	Students will be able to: <ol style="list-style-type: none"> 1. demonstrate insight into abstract algebra with focus on axiomatic theories. 2. demonstrate knowlegde and understanding of fundamental concepts including groups, subgroups, normal subgroups, homomorphisms and isomorphism. 3. demonstrate knowlegde and understanding of rings, fields and their properties.

UNIT-I

Review of basic property of Groups: Subgroups and cosets, cyclic groups, normal subgroups and quotient groups. Permutation groups, Even and odd permutations, Conjugacy classes of permutations, Alternating groups, Simplicity of A_n , $n > 4$. Cayley's Theorem, Direct productsof groups.

UNIT-II

Fundamental Theorem for finite abelian groups, Sylow theorems and their applications, Finite Simple groups, Groups of order $p^2 \cdot pq$ (p and q primes).

UNIT-III

Solvable groups, Normal and subnormal series, composition series, the theorems of Schreier and Jordan Holder

UNIT-IV

Review of rings and homomorphism of rings, Ideals, Algebra of Ideals, Maximal and prime ideals, Ideal in Quotient rings, Field of Quotients of integral Domain, Matrix Rings and their ideals, Rings of Endomorphisms of Abelian Groups.

Text & Reference books:-

S. No	Name	Author(S)	Publisher
1	Schaum's outline of modern abstract algebra	Frank Ayres	Schaum's outline series

2	Basic Abstract Algebra	P.B. Bhattacharya, S.K. Jain & S.R. Nagpaul	Cambridge University Press
3	A Course in Abstract Algebra	Vijay K Khanna and S K Bhambri	Vikas Publishing house
4	Contemporary Abstract Algebra,	J. A. Gallian	NarosaPublisihng House,
5	A First Course in Abstract Algebra	J. B. Fraleigh	Addison-WeseleyPublishing
6	The Theory of Groups	J. Rotman	Allyn and Bacon, London,



Course Code	MAT507
Course Title	Ordinary Differential Equations
Type of course	Core
L T P	5 0 0
Credits	5
Course prerequisite	B.Sc. with Mathematics or B.A with Mathematics
Course Objective (CO)	The objective of this course is to equip the students with fundamental knowledge and problem solving skills in Power series methods of solution of ODE, Existence and Uniqueness theory of Initial Value Problems and Solution of system of differential equations.
Course Outcomes(CO)	Students will be able to: <ol style="list-style-type: none"> 1. explain the concept of differential equation. 2. solve higher order differential equations and exact equations. 3. Expresses the basic existence theorem for higher- order linear differential equations.

UNIT-I

Review of fundamentals of Ordinary differential equations. The method of successive approximation. Initial value problem, Ascoli's Lemma, Gronwall's inequality, Cauchy Peano Existence Theorem, Picard's existence and uniqueness theorem, Lipschitz condition.

UNIT-II

Linear system of equations (homogeneous & non homogeneous). Superposition principle, Fundamental set of solutions, Fundamental Matrix, Wronskian, Abel Liouville formula, Reduction of order, Adjoint systems and Self Adjoint systems of second order. Linear 2nd order equations, preliminaries, Sturm's separation theorem, Sturm's fundamental comparison theorem.

UNIT-III

Orthogonal set of functions, Orthonormal set of functions, Gram-Schmidt process of orthonormalization, Sturm Liouville's boundary value problems, Orthogonality of Eigenfunctions and reality of Eigenvalues. Adjoint forms, Lagrange identity, Green function to solve boundary value problems.

UNIT-IV

Power series solution of differential equation about an ordinary point, Solution about regular singular points: The method of Frobenius, Applications, Legendre's, Hermite's and Bessel's equation. Ordinary differential equations in more than two variables: Simultaneous Differential equations of the first order and the first degree in three variables, Methods of their solution and applications.

Text & Reference books:-

S. No	Name	Author(S)	Publisher
1	Differential Equations	Piaggio	CBS Publisher
2	Differential Equations	S.L. Ross	John Wiley and Sons
3	Introduction to Ordinary Differential	E.A. Coddington	Prentice-Hall of India

	Equations.		Private Ltd
4	Elements of Partial Differential Equations.	I. N. Sneddon	Tata McGraw Hill
5	Ordinary Differential Equations: Theory and Applications	M. Rama MohanaRao	East-West Press Pvt. Ltd
6	Advanced Differential Equations	M.D.Raisinghania	S.Chand& Company Ltd.

Course Code	MAT509
Course Title	Classical Mechanics and Calculus of Variations
Type of course	Core
L T P	5 0 0
Credits	5
Course prerequisite	B.Sc. with Mathematics or B.A with Mathematics
Course Objective (CO)	To introduce the concept of variation of functionals and variational techniques. Dynamics of rigid bodies, Lagrangian and Hamiltonian equations for dynamical systems are also introduced at large.
Course Outcomes(CO)	Students will be able to: <ol style="list-style-type: none"> 1. solve isoperimetric problems of standard type. 2. solve simple initial and boundary value problems by using several variable calculus. 3. solve mechanics problems in one dimension that involve one or more of the forces of gravity, friction and air resistance.

UNIT-I

The variation of a functional and its properties, Fundamental lemma of calculus of variations, Euler's equation for one dependent function and its different forms, Motivational problems of calculus of variation- Shortest distance in a plane, Minimum surface of revolution, Brachistochrone problem, Geodesics, Isoperimetric problems, Functionals involving several dependent variables, Functionals involving higher order derivatives.

UNIT-II

Variational problems with moving boundaries, Approximate solutions of Boundary Value Problems- Rayleigh-Ritz method, Galerkin's method, Generalised coordinates, Degree of freedom, Constraints, Holonomic and non-holonomic systems, Generalised velocity, Generalised potential, Generalised force, principle of virtual work, D'Alembert's principle, Lagrange's Equation, Simple applications of the Lagrangian formulation.

UNIT-III

Hamiltonian principle, principle of least action, derivation of Lagrange's equations from Hamilton's principle, Legendre transformations, Hamilton's canonical equation of motion, Solving problems using Hamilton's equations, Cyclic co-ordinates, Conservation theorems, Routhian.

UNIT-IV

Central force, Equivalent one-body problem, Motion in a central force field, Moments and product of inertia, Theorems of Parallel and Perpendicular axes, Angular momentum of a rigid

body about a fixed point and about fixed principal axes, Euler's dynamical equations for motion of rigid body.

Text & Reference Books:-

S. No	Name	Author(S)	Publisher
1	Text Book of Dynamics	F. Chorlton	CBS Publishers, New Delhi.
2	Dynamics of rigid body	S.L. Loney	New Age International Private Limited
3	Classical Mechanics	D.E Rutherford,	Oliver & Boyd Ltd.
4	An Introduction to the Calculus of Variation	C. Fox	York: Dover Publications, 1987
5	Differential Equations and the Calculus of Variations	Elsgolts, L.	University Press of the Pacific, 2003.

Course Code	SSC006
Course Title	Human values & Professional Ethics
Type of Course	ID
L T P	3:0:0
Credits	3
Course Prerequisites	None
Course Objectives (CO)	To help the students to discriminate between valuable and superficial in the life. To help students develop sensitivity and awareness; leading to commitment and courage to act on their own belief. This Course will encourage the students to discover what they consider valuable. Accordingly, they should be able to discriminate between valuable and the superficial in real situations in their life. This course is an effort to fulfill our responsibility to provide our students significant input about understanding
Course Outcome	<ol style="list-style-type: none"> 1. Students will behave ethically and promote human values in society. 2. Students will behave professionally.

UNIT-I: Course Introduction-Need, Basic Guidelines, Content and Process for Value Education

: Understanding the need, basic guidelines, content and process for Value Education, Understanding Happiness and Prosperity correctly.

Understanding Harmony in the Human Being : Understanding the harmony with self and the Body: Sanyam and Swasthya.

UNIT II: Harmony in Human Relationship: Understanding harmony in the Family- the basic unit of human interaction, visualizing a universal harmonious order in society **Understanding Harmony in the Nature and Existence**: Understanding the harmony in the Nature, Holistic perception of harmony at all levels of existence

UNIT III: Understanding of Harmony on Professional Ethics: Ability to utilize the professional competence for augmenting universal human order, Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems

UNIT IV: Strategy for transition from the present state to Universal Human Order: At the level of individual, at the level of society. **Case studies**: typical holistic technologies, management models and production systems

Recommended Books

S. No.	Author(S)	Year	Publisher
1	A Foundation Course in Value Education	R R Gaur, R Sangal	Excel Books Publishers
2	Energy & Equity	Ivan Illich	.The Trinity Press, Worcester, and HarperCollins, USA
3	Human Values and Professional Ethics	RishabhAnand	Satya Prakashan, New Delhi
4	Jeevan VidyaekParichay.	A Nagraj	Divya Path Sansthan,Amarkantak.





SEMESTER II

Course Code	MAT502
Course Title	Real Analysis-II
Type of course	Core
L T P	5 0 0
Credits	5
Course prerequisite	B.Sc. with Mathematics or B.A with Mathematics
Course Objective (CO)	The objective of this course is to study the convergence of sequences and measure in an abstract setting after having studied Lebesgue measure on real line. The general L^p spaces are also studied.
Course Outcomes(CO)	Students will be able to: <ol style="list-style-type: none"> 1. Improve and outline the logical thinking. 2. Illustrate how to communicating with: Peers, Lecturers and Community 3. Define and recognize the basic properties of the field of real number

UNIT-I

Cluster Point, Definition of point-wise and uniform convergence, Uniform convergence and continuity, Uniform convergence and integration, Uniform convergence, nowhere differentiable functions, Weierstrass's non-differentiable function, Weierstrass Approximation Theorem, Stone-Weierstrass's Theorem.

UNIT-II

Lebesgue and Outer Measure, Properties of Measurable Sets and Non Measurable Sets, σ -Algebra, Borel sets.

UNIT-III

Definition & Properties of Measurable functions, Characteristic functions, Step Functions and Simple Functions, Egoroff's Theorem, Lusin Theorem, Little wood's three Principles, Signed measures, The L_p -spaces, Riesz-Fischer Theorem; Riesz Representation theorem for L_p spaces, Radon-Nikodym theorem, Dual of L_p -spaces, The extension theorem.

UNIT-IV

Lebesgue Integral of bounded function, Comparison of Riemann and Lebesgue Integral, Integral of a non negative function, Convergence in measure, Bounded Convergence Theorem, The general Lebesgue integral. Differentiation and Integration: Differentiation of monotone functions, Fatou's Lemma, Monotone Convergence Theorem and Differentiation of an integral, Absolute Continuity.

Text & Reference books:-

S. No	Name	Author(S)	Publisher
1	Principles of Mathematical Analysis (3rd Edition)	Walter Rudin	McGraw-Hill Ltd
2	Mathematical Analysis	S.C.Malik	Wiley Eastern
3	Introduction to Real Analysis	R. G. Bartle	John Wiley and Sons
4	Elements of Real Analysis	H. S. Gaskill and P. P. Narayanaswami	Printice Hall,

5	Real Analysis	H.L. Royden,	Macmillan Co.
6	Mathematical Analysis,	T. Apostol	Narosa Publishers
7	Elementary Analysis: The Theory of Calculus	K. Ross	Springer Int. Edition

Course Code	MAT504
Course Title	Abstract Algebra-II
Type of course	Core
L T P	500
Credits	5
Course prerequisite	B.Sc. with Mathematics or B.A with Mathematics
Course Objective (CO)	The objective of this course is to introduce the advanced concepts of ring theory and modules.
Course Outcomes(CO)	Students will : 1. recognise technical terms and appreciate some of the uses of algebra 2. simplify some formulas 3. solve simple linear equations

UNIT-I

Rings:-Factorization Theory in Integral Domains, Divisibility, Unique Factorization Domain, Principal Ideal Domain , Euclidian Domain and their relationships, Polynomial rings over UFD's, Gauss's Lemma, Reducible and irreducible polynomials.

UNIT-II

Noetherian and Artinian Rings, Examples and Counter Examples, Artinian Rings without zero divisors, Nil Ideals in Artinian Rings, Hilbert Basis Theorem.

UNIT-III

Modules, submodules, free modules, quotient modules, Homomorphism theorems, direct sums, finitely generated modules, Simple modules, cyclic modules, differences between modules over rings and vector spaces.

UNIT-IV

Modules over PID's, structure theorem of modules over PID's, Torsion modules, Torsion free modules, Artinian and Noetherian Modules, Artinian And Noetherian rings, modules of finite length.

Text & Reference books:-

S. No	Name	Author(S)	Publisher
1	Topics in Algebra	I. N. Herstein,	Xerox Publishing Company Mass
2	Schaum's outline of modern abstract algebra	Frank Ayres	Schaum's outline series

3	Basic Abstract Algebra,	P.B. Bhattacharya, S.K. Jain, & S.R. Nagpaul	Cambridge University Press
4	A Course in Abstract Algebra	Vijay K Khanna and S. K. Bhambri	Vikas Publishing house
5	Contemporary Abstract Algebra,	J. A. Gallian	NarosaPublisihng

Course Code	MAT506
Course Title	Mathematical Methods
Type of course	Core
L T P	5 0 0
Credits	5
Course prerequisite	B.Sc. with Mathematics or B.A with Mathematics
Course Objective (CO)	To acquaint the students with the application of Laplace and Fourier transform to solve Linear Integral Equations.
Course Outcomes(CO)	Students will be able to: <ol style="list-style-type: none"> 1. Solve problems using mathematics in unfamiliar settings. 2. engage in analyzing, solving, and computing real-world applications. 3. use mathematical concept while solving various problems of Engineering.

UNIT-I

Laplace Transform: Definition, existence and basic properties of the Laplace transform, Inverse Laplace transform, Convolution theorem, Laplace Transform solution of linear differential equation and simultaneous linear differential equation with constant coefficients, Complex inversion formula.

UNIT-II

Fourier Transform: Definition, existence and basic properties, Inversion formula of Fourier transform Convolution theorem, Parseval's relation. Fourier transform of derivatives and integrals, Fourier sine and cosine transform, Inverse Fourier transform, Solution of linear ordinary differential equations and partial differential equations.

UNIT-III

Linear integral equations, Special types of kernels, Singular integrals equations, Connection of integral equations with differential equations, Integral equations of the convolution type.

UNIT-IV

Solution of Fredholm Equations with iterated kernel, Fredholm Equations with general kernel: Solution by the method of successive approximations, adomian decomposition method, Volterra integral equations: Solution by the method of successive approximations, adomian decomposition method.

Text & Reference Books

S. No	Name	Author(S)	Publisher
1	Integral Equations	B.L. Moiseiwitsch	Pitman press, Bath Ltd.
2	Fourier series and Integral Transform	A. Pinckusand S. Zafrany.	Cambridge University Press
3	The Classical Theory of Integral Equations: A Concise Treatment.	S. M. Zemyan	New York: Birkhäuser
4	A First Course in Integral Equations.	A.M. Wazwaz	World Scientific



Course Code	MAT508
Course Title	Partial Differential Equations
Type of course	Core
L T P	5 0 0
Credits	5
Course prerequisite	B.Sc. with Mathematics or B.A with mathematics
Course Objective (CO)	The objective of this course is to introduce the concepts of partial differential equations. To develop analytical techniques to solve partial differential equations. To understand the properties of solution of partial differential equations
Course Outcomes(CO)	Students will : 1. be able to solve systems of linear differential equations. 2. Solves the homogeneous linear systems with constant coefficients. 3. Determines the type of a linear differential equation systems.

UNIT-I

First Order linear and quasi Partial differential equations, method of Lagrange's, Integral surface through a given curve, Surface orthogonal to given system of surfaces. Nonlinear Partial differential equations of first order, Charpit's Method and Jacobi's Method, Cauchy problem for first order PDE's.

UNIT-II

Partial Differential Equations of Second and Higher Order: Origin of second order partial differential equations. Higher order partial differential equations with constant coefficients. Equations with variable coefficients. Classification of second order partial differential equations. Canonical forms. Solution of non-linear second order partial differential equations by Monge's method.

UNIT-III

Method of Solution: Separation of variables in a PDE; Laplace, wave and diffusion equations, Elementary solutions of Laplace equations.

UNIT-IV

Applications of PDE: Wave equation, the occurrence of wave equations, elementary solutions of one dimensional wave equation; vibrating membranes, three dimensional problems. Diffusion equation, resolution of boundary value problems for diffusion equation, elementary solutions of diffusion equation.

Text & Reference books:-

S. No	Name	Author(S)	Publisher
1	Elements of Partial Differential Equations.	I.N. Sneddon, I. N.	Tata McGraw Hill
2	Differential Equations.	Piaggio	CBS Publisher
3	Differential Equations.	S.L. Ross	John wiley and Sons
4	Introduction to Ordinary Differential Equations.	E. A. Coddington	McGraw-Hil
5	Advanced Differential Equations	M.D. Raisinghanian	S. Chand & Company

Course Code	MAT510
Course Title	Linear Algebra
Type of course	Core
L T P	5 0 0
Credits	5
Course prerequisite	B.sc with Mathematics and B.A with Mathematics
Course Objective (CO)	The concepts and techniques from linear algebra are of fundamental importance in many scientific disciplines. The main objective is to introduce basic notions in linear algebra that are often used in mathematics and other sciences.
Course Outcomes (CO)	Students will be able to: <ol style="list-style-type: none"> 1. recognise technical terms and appreciate some of the uses of linear algebra. 2. Determine basis & dimension. 3. Identification of various linear transformation.

UNIT-I

Vector Spaces, Subspaces, Linear dependence, Basis and Dimensions, Algebra of Linear Transformation, Algebra of Matrices, Row rank, Column rank and their equality, System of Linear Equations.

UNIT-II

Eigen values and Eigenvectors, Characteristic and minimal polynomials, companion matrix, Cayley Hamilton Theorem, Matrix representation of Linear Transformation, Change of Basis, Canonical forms, Diagonal forms, triangular forms, Rational and Canonical Jordan Forms.

UNIT-III

Eigen spaces and similarity, Linear functional, Dual Spaces and dual basis, the double dual, Inner Product Spaces, Norms and Distances, Orthonormal basis, The Gram-Schmidt Orthogonalization, Orthogonal complements.

UNIT-IV

The adjoint of a Linear operator on an inner product space, Normal and self-adjoint Operators, Unitary and Normal Operators, Spectral Theorem, Bilinear and Quadratic forms.

Text & Reference books:-

S. No.	Name	Author(S)	Publisher
1	Linear Algebra, 3rd Edition	S. Lipschutz and M. Lipso	Tata McGraw Hill
2	Linear algebra, 2nd Edition	K. Hoffman and R. Kunze	Prentice Hall
3	Undergraduate Texts in Mathematics, 3rd Edition.	S. Lang	New York: SpringerVerlag
4	Linear Algebra Done Right, 2nd Edition.	S. Axler	Springer Verlag

Course Code	CSE558
Course Title	Fundamentals of Computer Science-Theory
Type of course	Ability Enhancement Course
L T P	3 0 0
Credits	3
Course prerequisite	B.sc with Mathematics and B.A with Mathematics
Course Objective (CO)	To provide the excellent training/knowledge in basic computer science,Operating System,DBMS,SQL,C++.
Course Outcomes(CO)	Students will be able to: 1. Be exposed to basic hardware and software concepts. 2. Be familiar with using C++ functions and the concepts related to good modular design. 3. Be familiar with using C++ structures, pointers and reference parameters.

UNIT- I

Introduction to Computer System:Block diagram of a Computer System and its working, Hardware - CPU, Memory, Input, Output & Storage devices, Software - System &Application,introduction to word processors, creating, editing, printing and saving documents, spell check, mail merge, creating power point presentations, creating spreadsheets and simple graphs,introduction to MS-EXCEL and its features,Internet and its applications.

UNIT-II

Introduction to Operating System: Operating Systems functions, Types of operating systems, Multiprogramming systems, Batch systems, Time-sharing systems, Operating system operations, distributed system.Development Tools: Editors, Translators - Compilers, Interpreters, Linkers Loaders, Debuggers.

UNIT-III

Introduction to Databases: Introduction to database system, purpose of database system, view of data, relational databases, database architecture, Constraint, View and SQL:Introduction to SQL, Features, Data Types, Database Languages, Introduction to view, Integrity constraints and their types.

UNIT-IV

Programming using C++: program design tools–algorithms, flow charts, pseudocode, Decision table,introduction to C++, structure of C++ , basic terminology- Character set, tokens, identifiers, keywords, fundamental data types, literal and symbolic constants,declaring variables,initializingvariables,typemodifiers,Operators and expressions in C++,Control Statements: if, nested if, if - else. Else if ladder, switch,Loops and iteration: while loop, for loop, do - while loop, nesting of loops, Break statement, continue statement, goto statement,

Text & Reference books:-

S.No.	Name	Author(s)	Publisher
1	A Text Book on Windows Based Computer Courses	Gurvinder Singh & Rachhpal Singh	Kalyani Publishers
2	Introduction to Computers	Norton, Peter	McGraw Hill
3	C++ Programming	Satish Jain	BPB Publications
4	Operating Systems: A Modern Perspective	G. Nutt	Pearson Education
5	Fundamentals of Database Systems, Third Edition	Elmasri/Navathe	Addison Wesley

Course Code	CSE560
Course Title	Fundamentals of Computer Science-Lab
Type of course	Ability Enhancement Course
L T P	0 0 2
Credits	2
Course prerequisite	B.Sc with Mathematics and B.A with Mathematics
Course Objective (CO)	To provide the practical training/knowledge in basic computer science, Operating System, DBMS, SQL, C++.
Course Outcomes(CO)	Students will be able to: <ol style="list-style-type: none"> 1. Be able to work with basic features of MS excel. 2. To display documents using various views. 3. Be able to work with the basic features of Word.

4. Wi Familiarization of the computer system and on hand practice on power on and power off window Closing, Maximizing, Icon shifting & Ordering. Practice with Control Panel and File manager.
5. Practice with MS Word. Opening and Closing document. Preparation and setting of a document. Familiarization with various tools, mail-merge practice.
6. Practice with Power Point and MS Excel sheets
7. **C++ PROGRAMS:**
 1. WAP to find the sum of two numbers.
 2. WAP to print a string on the screen.
 3. WAP to find the simple interest.
 4. WAP to find to find the greatest of two numbers.
 5. WAP to find P by using $P=(W-X)/(Y-Z)$
 6. WAP to convert temp from Celsius to Fahrenheit.
 7. WAP to convert days into years, weeks, days.
 8. WAP to display table of given number
 9. WAP to find the Arithmetic operations on two numbers.
 10. WAP which finds the square root of a number.
 11. WAP which use the if statement.
 12. WAP which using the if-else statement.
 13. WAP which describes the functionality of switch statement.
 14. WAP which uses the conditional ternary operator.
 15. WAP which uses the for loop.

16. WAP which describes the functionality of While loop.
17. WAP which describes the functionality of Do-While loop.
18. WAP which having the functionality of jumping statements(go to, break,continue).
19. WAP to find the sum of the digits of a number.

Text & References Books

S. No.	Name	Author(s)	Publisher
1	A Text Book on Windows Based Computer Courses	Gurvinder Singh & Rachhpal Singh	Kalyani Publishers
2	C++ Programming	Satish Jain	BPB Publications
3	SQL,PL/SQL,The programming language of oracle	Ivan Bayross	BPB Publication

Course Code	MAT540
Course Title	Research Methodology & IPR
Type of course	Skill Enhancement Course
L T P	3 0 0
Credits	3
Course prerequisite	B. Sc. Medical or Non-medical
Course Objective	To acquaint the students about the different types of property rights that a person possesses.
Course Outcomes(CO)	Students will be able to: <ol style="list-style-type: none"> 1. help during research. 2. learn how to determine relevant information. 3. learn to how to include references.

UNIT I

Motivation and objectives – Research methods vs. Methodology. Types of research, Research process; criteria of good research. Defining and formulating the research problem, selecting the problem, necessity of defining the problem, importance of literature review in defining a problem, literature review development of working hypothesis.

UNIT II

Meaning of research design; need for research design; important concepts related to research design; different research designs. Writing research proposal: Characteristics of a proposal; content and organization of a proposal.

Methods and techniques of data collection- Types of data, Methods of primary data collection (observation/ experimentation/ questionnaire/ interviewing/ case/ pilot study), Methods of secondary data collection (internal/ external), schedule method.

UNIT III

Interpretation and report writing: Meaning of interpretation; technique of interpretation; precautions in interpretation; significance of report writing; layout of research report; types of reports; Presentation of research work-oral, poster and writing research paper; Precautions for writing research report, Computer and its role in research.

UNIT IV

Research Ethics; Role of Intellectual Property Rights (IPR) in Research and development - intellectual property rights and patent law, copy right. Scholarly publishing- IMRAD concept and design of research paper, citation and acknowledgement, plagiarism, reproducibility and accountability.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Research Methodology: Methods & Techniques (Rev. Ed.)	C.R. Kothari	New Age International. New Delhi
2	An Introduction to Research Methodology	B.L. Garg, R. Karadia, R., F. Agarwal, F. and U.K. Agarwal	RBSA Publishers
3	Qualitative Inquiry and Research Design: Choosing Among Five Approaches	John W. Creswell	SAGE Publication
4	Principles of Intellectual Property	N.S. Gopalakrishnan, and T.G. Agitha	Eastern Book Company
5	Law relating to patents, trade marks, copyright designs and geographical indications	B.L.Wadhwa	Universal Law Publishing
6	An Introduction to Intellectual Property Rights	Venkataraman M	Affiliated East-West Press





SEMESTER III

Course Code	MAT601
Course Title	Topology
Type of course	Core
L T P	5 0 0
Credits	5
Course prerequisite	B.Sc with Mathematics or B.A with Mathematics
Course Objective (CO)	This course aims to teach the fundamentals of point set topology and constitute an awareness of need for the topology in Mathematics.
Course Outcomes(CO)	Students will be able to: Demonstrate an understanding of the concepts of metric spaces and topological spaces, and their role in mathematics. Prove basic results about completeness, compactness, connectedness and convergence within these structures. Demonstrate an understanding of the concepts of Hausdorff spaces.

UNIT-I

Topological Spaces, Examples of topological spaces: the product topology, the metric topology, the quotient topology Topological Spaces, Basic concept, closure, interior, exterior and boundary of set, dense set, Closure operator and interior operator. Neighborhoods and neighborhood system.

UNIT-II

Bases for a topology, the subspace topology, Open sets, closed sets and limit points, closures, interiors, continuous functions, homeomorphisms.

UNIT-III

Separated sets, Connected sets, Connected and disconnected spaces, Connectedness on real line, locally connected space, Totally disconnected space, Compact space of the real line, limit point compactness, Heine-Borel Theorem, Local –compactness.

UNIT-IV

The Separation Axioms: The countability axioms T_0 , T_1 , and T_2 spaces, examples and basic properties, Hausdorff spaces, Regularity, Complete Regularity, Normal Spaces, Normality, the Urysohn Lemma, the Urysohn Metrization Theorem, the Tietze Extension Theorem, the Tychonoff Theorem.

Text & Reference Books:

S. No	Name	Author(S)	Publisher
1	Elementary general Topology	T.O. Moore	Prentice-Hall
2	Topology	J.R. Munkres	Prentice-Hall
3	Introduction to Topology and Modern Analysis	G.F.Simmons	Tata McGraw-Hill Edition

Course Code	MAT603
Course Title	Probability and Statistics
Type of course	Core
L T P	5 0 0
Credits	5
Course prerequisite	B.sc with Mathematics and B.A with Mathematics
Course Objective (CO)	The course is designed to equip the students with various probability distributions and to develop greater skills and understanding of Sampling and Estimation.
Course Outcomes(CO)	Students will be able to: <ol style="list-style-type: none"> 1. explain the concept of a random variable and the probability distributions. 2. Calculate the expected value and the moments. 3. explain major distributions of random variables.

UNIT-I

Random Variables and Distribution Functions: Discrete and continuous random variables, Probability mass, Probability density and cumulative distribution functions, Joint, marginal and conditional distributions, Mathematical expectation, Variance and moments and Moment generating function.

UNIT-II

Discrete probability distributions: Bernoulli, Binomial, Poisson, Geometric and Negative Binomial distributions and their properties. Continuous probability distributions: Uniform, normal, beta distribution of first and second kind, gamma, exponential distributions and their properties.

UNIT-III

Sampling Theory: Types of Sampling- Simple, Stratified, Systematic, Errors in sampling, Parameter and Statistics. Estimation: Unbiasedness, Consistency, Invariant Estimator, Efficient Estimator, Minimum Variance Unbiased Estimators, Characteristics of Estimators, the Method of Maximum Likelihood Estimation,, properties of estimators, confidence intervals. Exact Sampling Distributions: Chi-square distribution, Student's-t distribution, Snedecor's F-distribution, Fisher's – Z distribution.

UNIT-IV

Hypothesis Testing: Tests of significance for small samples, Null and Alternative hypothesis, Critical region and level of significance, Tests of hypotheses: most powerful and uniformly most powerful tests, likelihood ratio tests. Tests of significance based on t, Z and F distributions, Chi square test of goodness of fit. Large Sample tests, Sampling of attributes, Tests of significance for single Proportion and for difference of proportions, Sampling of variables, tests of significance for single mean and for difference of means and for difference of standard deviations.

Text & Reference Books

S.No.	Name	Author(S)	Publisher
1	Introduction to Mathematical Statistics	Hogg Robert V., JosephMcKlean, and Allen T Craig	Pearson Education Limited
2	Introductory Probability and Statistical Applications	P. L. Meyer	Philippines: Addison- Wesley Publishing Company
3	Fundamentals of Mathematical Statistics	S. C. Guptaand V. K. Kapoor	Sultan Chand & Sons: New Delhi
4	Introduction to Probability and Statistics	J.S. Milton and J.C. Arnold,	Fourth Edition, McGraw Hill
5	An outline of statistical theory (Vol. 1 & 2).	A.M. Goon,M.K. Gupta, & B. Dasgupta	World Press Pvt Limited



Course Code	MAT605
Course Title	Numerical Analysis
Type of course	Core
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. with Mathematics or B.A with Mathematics
Course Objective (CO)	To familiarize the students about different numerical techniques e.g. solving algebraic and transcendental equations, large linear system of equations, differential equations, approximating functions by polynomials upto a given desired accuracy.
Course Outcomes(CO)	Students will be able to: <ol style="list-style-type: none"> 1. Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems. 2. Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.

UNIT-I

Errors, Error propagation, Order of approximation. Solution of non-linear equations: Bisection, Regula-falsi, Secant, Newton-Raphson, Generalized Newton's method, Chebyshev method, Halley's methods, General iteration method, Muller's method. Rate of convergence. Newton's method for complex roots and multiple roots, Simultaneous non-linear equations by Newton-Raphson method.

UNIT-II

Operators: Forward, Backward and Shift (Definitions and some relations among them). Interpolation: Finite differences, divided differences, Newton's formulae for interpolation, Lagrange and Hermite interpolation, Cubic Spline interpolation. Numerical integration- Trapezoidal, Simpson's 1/3rd rule, Simpson's 3/8th rule, Boole's rule, Weddle's rule, Errors in Integration formulae.

UNIT-III

Curve fitting: Linear and non-linear curve fitting, curve fitting by sum of exponentials, fitting of exponential Solution of Linear system of equations: Matrix inversion, Gauss-elimination and Gauss-Jordan method, LU decomposition method, Gauss Jacobi and Gauss Seidal method.

UNIT-IV

Solution of differential equations: Taylor series method, Euler's method, Modified Euler's method, Runge - Kutta methods of order two, three and four, Predictor -Corrector methods, Finite Difference Method for ODE and PDE (Boundary value problem).

Text & Reference Books:-

S. No	Name	Author(S)	Publisher
1	Introductory methods of Numerical Analysis	S. S. Sastry	PHI Learning Private Limited
2	Numerical Methods for Scientific and Engineering Computation	IyengerJain, and Mahinder Kumar	New Age International Publishers.
3	Numerical Mathematical Analysis	Scarborough	Prentice Hall of India.
4	Simulation and Monte Carlo method	R.Y.Rubinstein	John Wiley

Course Code	MAT625
Course Title	Numerical Analysis Lab
Type of course	Core
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. with Mathematics or B.A with Mathematics
Course Objective (CO)	Writing Programs in C/C++ /MATLAB for the problems based on the methods studied in theory paper and to run the Program on PC.
Course Outcomes(CO)	Students will be able to: <ol style="list-style-type: none"> 1. Analyse and evaluate the accuracy of common numerical methods. 2. implement numerical methods in Matlab. 3. Write efficient, well-documented Matlab code and present numerical results in an informative way.

List of Practicals:

- (i) To find the absolute value of an integer.
- (ii) Bisection Method and error analysis.
- (iii) Newton-Raphson Method and error analysis
- (iv) Secant Method and error analysis
- (v) RegulaFalsi Method and error analysis
- (vi) Matrix-inversion method
- (vii) Gauss-Jacobi Method.
- (viii) Gauss-Seidal Method.
- (ix) Calculation of derivatives using Newton interpolation.
- (x) Lagrange interpolation.
- (xi) Weddle's rule.
- (xii) Taylor series method.
- (xiii) Euler's method.
- (xiv) Predictor –Corrector methods

Text & Reference books:-

S. No	Name	Author(S)	Publisher
1	Introductory methods of Numerical Analysis	S.S. Sastry	PHI Learning Private Limited
2	Numerical Methods for Scientific and Engineering Computation	Iyenger, Jain, and Mahinder Kumar	New Age International Publishers.
3	Numerical Methods using Matlab 4th Edition.	Mathews, H. John and D. Fink Kurtis	PHI Learning Private Limited
4	Numerical Methods in Engineering and Science.	B.S. Grewal	Khanna Publishers



DISCIPLINE SPECIFIC ELECTIVE SUBJECTS

FOR 3RD SEMESTER

Course Code	MAT613
Course Title	Operations Research-I
Type of course	Discipline Specific Elective
L T P	4 0 0
Credits	4
Course pre-requisite	B.Sc with Mathematics and B.A with Mathematics
Course Objective (CO)	To inculcate the traits of rational decision making. To develop the research proposal and also find out the optimal solution.
Course Outcomes(CO)	Students will be able to: <ol style="list-style-type: none"> 1. formulate and solve problems as networks and graphs. 2. construct linear integer programming models and discuss the solution techniques. 3. set up decision models and use some solution methods for nonlinear optimization problems.

UNIT-I

Linear programming problem, properties of a solution to the linear programming problem, generating extreme point solution, simplex computational procedure, development of minimum feasible solution, the artificial basis techniques, a first feasible solution using slack variables, twophase and Big-M method with artificial variables.

UNIT-II

General transportation problem, transportation table, duality in transportation problem, loops in transportation tables, Linear Programming formulation, solution of transportation problem, test for optimality, degeneracy, transportation algorithm (MODI method), time-minimization transportation problem.

UNIT—III

Replacement of equipment/Asset that deteriorates gradually, replacement of equipment that fails suddenly, recruitment and promotion problem, equipment renewal problem Mathematical formulation of assignment problem, assignment method, typical assignment problem, the traveling salesman problem.

UNIT-IV

Two-person zero-sum games, maximum minimum principle, games without saddle points (Mixed strategies), graphical solution of $2 \times n$ and $m \times 2$ games, dominance property, arithmetic method of

$n \times n$ games, general solution of $m \times n$ rectangular games .Non Linear Programming Problem :-i.e one and multi variable unconstrained optimization Kuhn -Tucker conditions for constrained optimization .Quadratic , Convex, Non Convex Programming problem

Text & Reference Books:-

S. No	Name	Author(S)	Publisher
1	Linear Programming	S.L.Gass	McGraw Hill Book Company
2	Operations Research	K.K. Chawla	Kalyani Publication
3	Mathematical Programming	N.S. Kambo	East West Press
4	Operations Research	H.A.Taha	Taha, H.A
5	Operations Research	KantiSawrup	Sultan Chand & Sons

Course Code	MAT615
Course Title	Fluid Mechanics-I
Type of course	Discipline Specific Elective
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. with Mathematics or B.A with Mathematics
Course Objective (CO)	The objective of this course is to introduce the fundamentals of modern treatment of incompressible and compressible fluid flows.
Course Outcomes(CO)	Studenta will be able to: <ol style="list-style-type: none"> 1. identify derivation of basic equations of fluid mechanics. 2. describe the motion of fluids. 3. formulate the problems on buoyancy and solve them.

UNIT-I

Real fluids and ideal fluids, velocity of fluid at a point, streamlines, path lines, streak lines, velocity potential, vorticity vector, local and particle rates of change, equation of continuity, incompressible fluid flow, acceleration of fluid, conditions at a rigid boundary.

UNIT-II

Euler’s equation of motion, Bernoulli’s equation, their applications, some potential theorems, flows involving axial symmetry- stationary sphere in a uniform stream, impulsive motion, Kelvin’s theorem of circulation, equation of vorticity.

UNIT-III

Some three dimensional flows: sources, sinks and doublets, images in rigid planes, images in solid spheres, Stoke’s stream function.

UNIT-IV

Two dimensional flows: complex velocity potential, Milne Thomson circle theorem and applications, theorem of Blasius, Vortex rows, Karman Vortex Street.

Text & Reference Books:-

S. No	Name	Author(S)	Publisher
1	Text Book of Fluid Dynamics	F.Charlton	GK Publishers,
2	Fluid Mechanics, 2nd Edition	L.D. Landau and E. M. Lifshitz.	Pergamon Press Ltd
3	An Introduction to Fluid Mechanics	G.K. Batchelor	Cambridge University Press,
4	Fluid Mechanics	P.K. Kundu and I. M. Cohen.	Harcourt (India) Pvt. Ltd.

Course Code	MAT617
Course Title	Topological Vector Spaces
Type of course	Discipline Specific Elective
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. with Mathematics or B.A with Mathematics
Course Objective (CO)	To familiarize the students about topic of topological vector spaces
Course Outcomes(CO)	Students will be able to: <ol style="list-style-type: none"> 1. Define and solve topological vector spaces. 2. explain subspaces, product spaces and quotient space. 3. explain Convex, balanced and absorbing sets.

Unit-I

Definition and examples of topological vector spaces. Convex, balanced and absorbing sets and their properties. Minkowski's functional.

Unit-II

Subspace, product space and quotient space of a topological vector space.

Unit-III

Locally convex topological vector spaces.

Unit-IV

Normable and metrizable topological vector spaces, Complete topological vector spaces and Frechet space, Linear transformations and linear functional and their continuity.

Text & Reference Books:-

S. No	Name	Author(S)	Publisher
1	Functional Analysis	Walter Rudin	TMH Edition, 1974
2	Topological Vector Spaces	H.H. Schaefer	Springer, N.Y., 1971

Course Code	MAT619
Course Title	Discrete Mathematics
Type of course	Discipline Specific Elective
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc with Mathematics and B.A with Mathematics
Course Objective (CO)	The objective of this course is to acquaint the students with the concepts in Discrete Mathematics. It includes the topics like Logics, Graph Theory, Trees and Boolean algebra.
Course Outcomes(CO)	Students will be able to: <ol style="list-style-type: none"> 1. Understand the notion of mathematical thinking, mathematical proofs, and algorithmic thinking, and be able to apply them in problem solving. 2. Understand some basic properties of graphs and related discrete structures, and be able to relate these to practical examples. 3. use effectively algebraic techniques to analyse basic discrete structures and algorithms.

UNIT-I

Basic logical operations, conditional and bi-conditional statements, tautologies, contradiction, Quantifiers, propositional calculus, Recursively defined sequences, the characteristic polynomial. Solution of recurrence relations, generating function. Counting Techniques: The product rule, the sum rule, the inclusion–exclusion principle, The Pigeonhole Principle and examples. Simple arrangements and selections, Arrangements and selections with repetitions, Distributions, Binomial Coefficients.

UNIT-II

Language and Grammars: Computability and Formal Languages, Ordered sets, languages, Phrase structure grammars, Types of grammars and languages, Finite state machines-equivalent machines, Finite state machines as language recognizers, Analysis of algorithm-Time complexity.

UNIT-III

Introduction to Graph Theory: Basic Terminology, Special types of Graphs. The Handshaking Theorem, Paths and Circuits Shortest paths. Connectivity of Graphs. Isomorphism of Graphs. Homomorphism Graphs. Eulerian and Hamiltonian Graphs. Planar and Non Planar Graphs. Euler's formula. Graph Colouring. Adjacency and Incidence Matrices. Travelling Salesman Problem.

UNIT-IV

Trees: Basic Terminology. Binary Trees. Tree Traversing: Pre-order, Post-order and In-order Traversals. Minimum Spanning Trees, Prim's and Kruskal's Algorithm. Boolean algebra, Boolean Function, Switching circuit and Logic Gates, K-map. Lattice Theory: Lattices and Algebraic

Structures, Lattice as algebraic structures, complete lattices, Sub-lattices, Homomorphism on lattices, Modular lattices.

Text & Reference books:-

S.No	Name	Author(S)	Publisher
1	Discrete Mathematics and its Applications	K.H. Rosen	McGraw Hill
2	Foundation of Discrete Mathematics	K. D. Joshi	J. Wiley & Sons,
3	Discrete Mathematics	P.K.Sharma	Modern Publication
4	Discrete Mathematical Structures with Applications to Computer Science	J. P. Trembley and R. P. Manohar	McGraw Hill

COURSE CODE	MAT621
Course Title	Differential Geometry
Type of course	Discipline Specific Elective
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc with Mathematics and B.A with Mathematics
Course Objectives (CO)	The objective of this course is to provide knowledge of differential geometry of curves and surfaces in space, with special emphasis on a geometric point of view, as a basis for further study or for applications.
Course Outcomes(CO)	Students will be able to: <ol style="list-style-type: none"> 1. analyse the equivalence of two curves by applying some theorems. 2. defines surfaces and their properties. 3. list topological aspects of surfaces.

UNIT-I

Curves, Arc length, Re-parametrization, Level Curves vs Parametrized Curves, Curvature, Plane Curves, Space Curves, Simple Closed Curves, The Isoperimetric Inequality, The Four Vertex Theorem.

UNIT-II

Surfaces in three dimensions: Surface, Smooth Surfaces, Tangents, Normals and Orientability, Quadric Surfaces, Triply Orthogonal Systems, Application of Inverse Function Theorem.

UNIT-III

The First Fundamental Form: Lengths of Curves on Surfaces, Isometries of Surfaces, Conformal mappings of Surfaces, Surface Area, Equiareal maps and a Theorem of Archimedes, The Second Fundamental Form, The curvature of Curves on a Surface, The Normal and Principal Curvature, Geometrical interpretation of Principal Curvature.

UNIT-IV

The Gaussian and Mean Curvatures. The Pseudosphere.FlatSurfaces.Sufaces of constant Mean Curvature,Gaussian Curvature of compact Surfaces, The Gauss Map.Geodesic Equations.

Text & Reference Books:

Sr. No.	Name	Author(S)	Publisher
1	Elementary Differential Geometry	Andrew Pressley	Springer
2	Introduction to Differential Geometry	T. J. Willmore	Oxford University Press India, 1997.
3	Differential Geometry: An Integrated Approach.	N. Prakash	US: McGraw-Hill Inc, 1982.



COURSE CODE	MAT623
Course Title	Calculus of Several Variables
Type of course	Discipline Specific Elective
L T P	4 0 0
Credits	4
Course prerequisite	B.sc with Mathematics and B.A with Mathematics
Course Objectives (CO)	To extend the concepts from one variable calculus to functions of several variables and vector valued functions and study the continuity, differentiability and integrability of these functions.
Course Outcomes(CO)	Students will be able to: <ol style="list-style-type: none"> 1. explain differential forms of R^n. 2. do integration on R^n. 3. Define and express the continuity , differentiability on euclidian space.

UNIT-I

Functions, continuity, and differentiability on Euclidean space R^n : Vector space structure of R^n over R , norm and inner product, linear transformations, dual spaces; topology of R^n , limit points, continuity, compactness, connectedness, vector valued functions ($f: R^n \rightarrow R^m$), oscillation of functions and continuity; Frechet derivatives, results on chain rule, differentiability, partial derivatives and continuity of Frechet derivatives; the inverse function theorem, implicit function theorem.

Unit – II

Integration on R^n : Partition of a closed rectangle, lower and upper sums, Integral of a function ($f: R^n \rightarrow R$) on a closed rectangle, measure zero and content zero, integrable functions, characteristic function, Fubini's theorem; real-analytic functions, partitions of unity, change of variable.

Unit-III

Differential forms on R^n : Multilinear functions over a finite dimensional vector space V , k -tensors, tensor product, alternating k -tensors, wedge product, vector spaces of k -tensors over R , determinant, orientation and volume element; tangent spaces in R^n , vector fields, differential forms, linear maps between vector spaces of alternating k -tensors, closed differential forms, exact differential forms, Poincare lemma.

Unit-IV

Integration on Chains in R^n : Singular n -cubes and singular n -chains in R^n , results on boundary of a chain, definitions of integral of a function ($f: R^n \rightarrow R$) over a singular n -cube and n -chain, Stokes' theorem on chains.

Text & Reference Books:

S. No.	Name	Author(S)	Publisher
1	Calculus on Manifolds	M. Spivak	Addison Wesley, 1965
2	Introduction to Differentiable Manifolds	S. Lang	Springer, 2002
3	An Introduction to Manifolds	S. Axler, K.A. Ribet	Springer, 2008

Course Code	BOT001
Course Title	Natural Hazards and Disaster Management
Type of course	Theory Course
L T P	3 0 0
Credits	3
Course prerequisite	Graduation
Course Objective	To learn about natural hazards, risk assessment and disaster management
Course Outcomes	The students will be able to: 1. know the current overview of natural hazard materials 2. discuss the physical aspects of vulnerability and elements of risk mapping, assessment 3. know the development planning, sustainable development in the context of Climate Change

Syllabus

Unit I

Overview of natural hazards; Introduction to natural hazards, impact and mitigation in Global and Indian context; causes and consequences of geological hazards, flood, drought and climate change issues, forest hazard, tsunami and coastal hazards, cyclone hazards, snow avalanche, GLOF and glacier related hazards, extreme weather events, urban and industrial hazards.

Unit II

Introduction to vulnerability and risk assessment, socio-economic and physical aspects of vulnerability and elements of risk mapping, assessment, and reduction strategies.

Unit III

Earth observation: Data availability and key operational issues for DM: EO systems for natural hazards study: present (operational) and future systems; multi-temporal data sources, multi-temporal database organisation: Key operational issues, utilisation of geo-information products for disaster management (available through International cooperation e.g. International Charter etc.)

Unit IV

Disaster management framework of India and recent initiatives by Govt. of India with special emphasis on DRR HFA 2005-2015, MDG and SAARC comprehensive framework for DRR Disaster Management Support (DMS): Status in India for use of space inputs Mainstreaming DRR in Development Planning Sustainable development in the context of Climate Change Disaster Recovery-Strategy and case examples.

Text and Reference books:

S. No.	Name/Title	Author	Publisher
1	Environmental Hazards : Assessing Risk and Reducing Disaster	Keith Smith and Petley David, 2008.	Routledge
2	Geo-information for Disaster Management	van Oosterom Peter, Zlatanova Siyka and Fendel Elfriede, 2005	Springer-Verlag
3	Geospatial Techniques in Urban Hazards and Disaster Analysis	Showalter, Pamela S. and Lu, Yongmei, 2010.	John Wiley and Sons.
4	An International Perspective on Natural Disaster: Occurrence, Mitigation and Consequences	Stoltman JP, Lidstone J and Dechano LM., 2004.	Kluwer Academic Publishers





SEMESTER IV

Course Code	MAT 602
Course Title	Functional Analysis
Type of course	Core
L T P	5 0 0
Credits	5
Course prerequisite	B.Sc with Mathematics and B.A with Mathematics
Course Objective (CO)	This course is an introduction to Banach Spaces and Hilbert Spaces along with various operators/functional so as to enable the students to study advanced topics in Functional Analysis
Course Outcomes(CO)	Studenta will be able to: 1. Identify different fuctions and variables 2. learned about vector spaces endowed with some kind of limit-related structure 3. study of differential and integral equations

UNIT-I

Normed Linear Spaces, L P -Spaces: Holder's And Minkowski's Inequalities, Banach Spaces, Subspaces, Quotient Spaces,, Convergence And Completeness, Hahn Banach Theorem, Open Mapping Theorem, Closed Graph Theorem, Baire Category Theorem, Banachsteinhauns Theorem (Uniform Boundedness Principle), Boundedness And Continuity Of Linear Transformation, Riesz-Fischer Theorem

UNIT-II

Projections on a Hilbert space: Spectral Theorem for normal operators, Compact linear operators on normed spaces, properties of Compact linear operators.

UNIT-III

Natural Imbedding N into N^{**} :Dual Spaces, embedding in second dual.The conjugate space N^* .The Hahn-Banach theorem and its consequences. Natural imbedding of N into N^{**} , reflexivity of normed spaces, Open mapping theorem.

UNIT-IV

Hilbert and Banach Spaces: Hilbert space, orthonormal basis, Bessel's inequality, Riesz Fischer theorem, Parseval's identity, bounded Linear functionals; projections, Riesz Representation theorem, adjoint operators, self adjoint, normal, unitary and isometric operators.

Text & Reference books:-

S. No	Name	Author(S)	Publisher
1	Functional analysis	P K Sharma	Sharma publications
2	Functional Analysis	P K Jain , O P Ahuja	New Age International (P) Khalil Ahmed Ltd
3	Functional analysis	V Balmohan	New Age International Limited

Course Code	MAT 604
Course Title	Number Theory
Type of course	Core
L T P	5 0 0
Credits	5
Course prerequisite	B.Sc. with Mathematics or B.A with Mathematics
Course Objective (CO)	To give a simple account of classical number theory, prepare students in number theory and algebra and to demonstrate applications of number theory
Course Outcomes(CO)	Students will be able to: <ol style="list-style-type: none"> 1. recognise the importance of the Division Algorithm and be able to apply it in a variety of scenarios. 2. understand the term ‘prime number’, and be able to recall basic properties of integers relating to prime numbers 3. use, and understand the theoretical underpinnings of, mathematical induction

UNIT-I

Simultaneous Linear Congruence, Chinese Remainder theorem with applications, Wolsten-Holme’s theorem, Lagrange’s proof of Wilson theorem, Fermat numbers, The order of an integer modulo Primitive roots, Existence and number of primitive roots.

UNIT-II

Indices and their applications, Quadratic residues, Euler’s criterion, Product of quadratic residues and quadratic non-residues, The Legendre symbol and its properties, Gauss’s Lemma, Quadratic reciprocity law, Jacobian symbol and its properties.

UNIT-III

Criterion for an integer to be expressible as sum of two squares and sum of four squares, Farey series, Farey dissection of a circle and its applications to approximations of irrationals by rational.

UNIT-IV

Finite and Infinite simple continued fractions, periodic and purely periodic continued fractions, Lagrange’s Theorem on periodic continued fractions. applications to Pell’s equation. The fundamental solution of Pell’s equation.

Text & Reference Books

S. No	Name	Author(S)	Publisher
1	Theory of Numbers	Hardy and Wright	McGraw-Hill Ltd
2	An introduction to number theory	Niven and Zuckerman	S.Chand
3	Elementary Number Theory, McGraw Hill 2002.	Burton, M.David	McGraw Hill
4	Theory of Numbers	Randhir Singh	Sharma Publication

Course Code	MAT 606
Course Title	Field Extensions and Galois Theory
Type of course	Core
L T P	5 0 0
Credits	5
Course prerequisite	B.Sc. with Mathematics or B.A with Mathematics
Course Objective (CO)	To draw an attention on various results of the different algebraic structures, in particular, extension fields, splitting fields, separable and inseparable extension, Galois extensions and cyclotomic extensions.
Course Outcomes (CO)	Students will be able to: <ol style="list-style-type: none"> 1. understand Galois Theory properly. 2. Get Experience of interpreting the result. 3. Demonstrate mastery of the basic elements of Galois Theory.

UNIT-I

Fields, Characteristic of a field, prime fields, finite field extensions, degree of a field extension, Algebraic extensions, splitting fields: Existence & Uniqueness.

UNIT-II

Algebraic closure, Algebraically closed fields. Finite fields, Existence of $GF(p^n)$, Construction of finite fields. Separable and purely inseparable extensions, Perfect fields,

UNIT-III

Simple extensions, Primitive elements, Lagrange's theorem on primitive elements, Normal extensions, Roots of unity. Galois extensions, The fundamental theorem of Galois theory,

UNIT-IV

Cyclotomic extensions, Abelian extensions, cyclic extensions, Frobenius mapping, Galois groups of finite fields, Quintic equations and solvability by radicals, Constructive polygons.

Text & Reference Books

S. No	Name	Author(S)	Publisher
1	A first course in Abstract Algebra	J.B. Fraleigh	Narosa Publishing House, New Delhi.
2	Abstract Algebra	D.S. Dummit and R. M. Foote	John-Wiely and Sons Students Edition-1999
3	Basic Abstract Algebra	P.B. Bhattacharya, S. K. Jain and S. R. Nagpal	Cambridge University Press, 1997
4	Modern Algebra	S. Singh and Q. Zameeruddin	Vikas Publishing House, New Delhi



**DISCIPLINE SPECIFIC ELECTIVE
SUBJECTS
FOR 4TH SEMESTER**

Course Code	MAT616
Course Title	Operations Research-II
Type of course	Discipline Specific Elective
L T P	4 0 0
Credits	4
Course pre-requisite	B.Sc with Mathematics and B.A with Mathematics
Course Objective (CO)	To inculcate the traits of rational decision making. To develop the research proposal and also find out the optimal solution
Course Outcomes(CO)	Students will be able to: <ol style="list-style-type: none"> 1. use this knowledge to become entrepreneur 2. use different methods to solve different problems based in real life situations 3. reach the optimal solution to gain more profit

UNIT-I

Queuing Theory :-Introduction, Queuing System, elements of queuing system, distributions of arrivals, inter arrivals, departure and service times. Classification of queuing models, single service queueing model with infinite capacity (M/M/1): (/FIFO).Queuing Models: (M/M/1): (N/FIFO), Generalized Model: Birth-Death Process, (M/M/C)(/FIFO), (M/M/C) (N/FIFO), (M/M/R) (KIGD), Power supply model.

UNIT-II

Inventory Control:- The inventory decisions, costs associated with inventories, factors affecting Inventory control, economic order quantity (EOQ), Deterministic inventory problems with no shortage and with shortages, EOQ problems with price breaks, Multi item deterministic Problems

UNIT-III

Simulation Models:-Need of simulation, methodology of simulation. Simulation models, event-type simulation, generation of random numbers, Monto-Carlo simulation, simulation of inventory problems. queuing systems, maintenance problem, job sequencing.

UNIT-IV

Integer Programming:-Gomory's all I.P.P. method, constructions of Gomory's constraints, Fractional cut method-all integer and mixed integer, Branch-and-Bound method, applications of integer programming.

Text & Reference Books:-

S. No	Name	Author(S)	Publisher
1	Linear Programming	S.L. Gass	McGraw Hill Book Company
2	Operations Research	K.K.Chawla	Kalyani Publication
3	Mathematical Programming	N.S. Kambo	East West Press
4	Operations Research	H.A. Taha	
5	Operations Research	KantiSawrup	Sultan Chand & Sons

Course Code	MAT618
Course Title	Fluid Mechanics-II
Type of course	Discipline Specific Elective
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc with Mathematics and B.A with Mathematics
Course Objective (CO)	This course is designed to make the students learn to develop mathematical models of fluid dynamical systems and use mathematical techniques to find solutions to these models.
Course Outcomes(CO)	Students will be able to: 1. use Legendre's functions during research 2. get thorough knowledge of integral 3. get thorough knowledge of Bessel's functions.

UNIT-I

Stress components in a real fluid, relation between Cartesian components of stress, rate of strain quadric and principal stresses, relations between stress and rate of strain, coefficient of viscosity and laminar flow.

UNIT-II

The Navier-Stokes equations of motion of a viscous fluid, steady motion of viscous fluid between parallel planes, steady flow through tube of uniform circular cross-section, flow through tubes of uniform cross section in the form of circle, ellipse and equilateral triangle.

UNIT-III

Diffusion of vorticity. Energy dissipation due to viscosity, steady flow past a fixed sphere, dimensional analysis, Reynolds numbers, Prandtl's boundary layer, Karman integral equation.

UNIT-IV

Elements of wave motion, waves in fluids, Surface gravity waves, standing waves, group velocity, energy of propagations, path of particles, waves at interface of two liquids.

Text & Reference Books:-

S. No.	Name	Author(S)	Publisher
1	Text Book of Fluid Dynamics	F. Charlton	GK Publishers
2	Fluid Mechanics, 2nd Edition.	L.D. Landau and E. M. Lifshitz	Pergamon Press Ltd
3	An Introduction to Fluid Mechanics.	G. K. Batchelor	Cambridge University Press
4	Fluid Mechanics	P.K. Kundu and I. M. Cohen.	Harcourt (India) Pvt. Ltd

Course Code	MAT620
Course Title	Special Functions
Type of course	Discipline Specific Elective
L T P	4 0 0
Credits	4
Course prerequisite	B.sc with Mathematics and B.A with Mathematics
Course Objective (CO)	To provide an introduction to the different Bessel's functions, Legendre's functions.
Course Outcomes(CO)	Students will be able to : 1. use various methods to obtain accurate results in Engg. Problems 2. assess student learning in mathematics. 3. use this knowledge to create various software.

UNIT-I

Bessel's functions of first and second kind, Recurrence relations, Generating functions, Trigonometric expansions, Asymptotic expansion, Neumann Expansion theory.

UNIT-II

Legendre's functions, Laplace integral for the Legendre Polynomials, Generating functions, Recurrence relations, Orthogonality, solution of Legendre's equations, Hermite Polynomials, Recurrence relations, Rodrigue formula.

UNIT-III

Hypergeometric function, solution of hypergeometric equation, Kummer function and its asymptotic expansion, Barnes Contour Integral,

UNIT-IV

Integral representation, Gauss Theorem, Kummer's theorem, Vandermonde's theorem.

Text & Reference Books:-

S.No	Name	Author(S)	Publisher
1	The Special Functions and Their Approximation.	Y.P. Luke	Academic Press
2	Special Functions.	F. D. Rainville	Chelsea Pub Co
3	The Theory of Functions	E.C. Titchmarsh	Oxford Science Publications

Course Code	MAT622
Course Title	Advanced Numerical Analysis
Type of course	Discipline Specific Elective
L T P	4 0 0
Credits	4
Course prerequisite	B.sc with Mathematics and B.A with Mathematics
Course Objective (CO)	To provide an introduction to the different advanced classical numerical methods.
Course Outcomes(CO)	Students will be able to: 1. use various methods to obtain accurate results in Engg. Problems. 2. assess student learning in mathematics. 3. use this knowledge to create various software.

UNIT-I

Finite difference approximation to partial derivatives, parabolic equations: An explicit method, crank Nicolson Implicit method, solution of implicit equations by Gauss Elimination, derivative boundary conditions, local truncation error, Convergence and stability.

UNIT-II

Hyperbolic equations: Implicit difference methods for wave equation solution of advection equation by finite difference method and Maccormack method, stability analysis, Lax, Wendroff explicit method on rectangular mesh for 1st order equations, Iterative methods for elliptic equations.

UNIT-III

Finite element methods: Rayleigh Ritz Method, the collocation and Galerkin's Method, finite element methods for ODE's.

UNIT-IV

Finite element methods for one dimensional and two dimensional problems, Introduction to F. E. M. for partial differential equations.

Text & Reference Books:-

S.No	Name	Author(S)	Publisher
1	Numerical Solution of Partial Differential Equations	G. D. Smith	Oxford University Press, U.S.A
2	Friendly Introduction to Numerical Analysis	B. Bradie	Pearson
3	An Introduction to Finite Element Methods	N. Reddy	McGraw Hill Education

Course Code	MAT624
Course Title	Fuzzy Set theory
Type of course	Discipline Specific Elective
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc with Mathematics and B.A with Mathematics
Course Objective (CO)	The objective of this course is to teach the students the need of fuzzy sets, arithmetic operations on fuzzy sets, fuzzy relations, possibility theory, fuzzy logic, and its applications
Course Outcomes(CO)	Students will be able to: <ol style="list-style-type: none"> 1. use the knowledge of fuzzy mathematics in real life situations based on credit & debit. 2. use the knowledge of fuzzy mathematics in economics & Engg. 3. enhance reasoning ability in students

UNIT-I

Classical and Fuzzy Sets: Overview of classical sets, Membership function, A-cuts, Properties of a-cuts, Extension principle.

UNIT-II

Operations on Fuzzy Sets: Compliment, Intersections, Unions, Combinations of operations, Aggregation operations. Fuzzy Arithmetic: Fuzzy numbers, Linguistic variables, Arithmetic operations on intervals and numbers, Fuzzy equations.

UNIT-III

Fuzzy Relations: Crisp and fuzzy relations, Projections and cylindric extensions, Binary fuzzy relations, Binary relations on single set, Equivalence, Compatibility and ordering Relations, Morphisms, Fuzzy relation equations.

UNIT-IV

Fuzzy Logic: Classical logic, Multi-valued logics, Fuzzy propositions, Fuzzy qualifiers, Linguistic hedges. Applications of Fuzzy Logic: Washing machines, Control systems engineering, Power engineering and Optimization.

Text & Reference Books:-

S.No	Name	Author(S)	Publisher
1	Fuzzy Sets	G. J. Klir and T.A. Folger	Uncertainty and Information, PHI
2	Fuzzy Set Theory and its Applications	H.J. Zimmermann	Allied Publishers
3	Fuzzy Sets and Fuzzy logic	G.J. Klir and B. Yuan	Theory and Applications, PHI

Course Code	MAT626
Course Title	Advanced Complex Analysis
Type of course	Discipline Specific Elective
L T P	5 0 0
Credits	5
Course prerequisite	B.Sc. with Mathematics or B.A with Mathematics
Course Objective (CO)	The course will continue the study of complex analysis and introduce more advance methods like the Greens functions, MittagLefflers Expansion, Monodromy theorem and the Harmonic methods.
Course Outcomes (CO)	Students will be able to: <ol style="list-style-type: none"> 1. solve problems based upon Engg field. 2. work with multi-valued functions 3. compute the residue of a function and use the residue theory to evaluate a contour integral or an integral over the real line

UNIT-I

Normal families of analytic functions. Montel's theorem, Hurwitz's theorem, Riemann Mapping theorem, Univalent functions. Distortion and growth theorems for the class S of normalized univalent functions, Koebe $1/4$ theorem, Bieberbach Conjecture (statement only) Littlewood's inequality for the class S . Coefficient inequalities for functions in S in case of real coefficients only.

UNIT-II

Principle of analytic continuation, The general definition of an analytic function. Analytic continuation by power series method. Natural boundary. Schwarz reflection principle, Monodromy theorem. Mittag-Leffler's theorem (only in the case when the set of isolated singularities admits the point at infinity alone as an accumulation point). Cauchy's method of expansion of meromorphic functions. Partial fraction decomposition of $\operatorname{cosec} z$, Representation of an integral function as an infinite product. Infinite product for $\sin z$.

UNIT-III

The factorization of integral functions, Weierstrass theorem regarding construction of an integral function with prescribed zeros. The minimum modulus of an integral function, Hadamard's three circle theorem, The order of an integral function, Integral functions of finite order with no zeros. Jensen's inequality. Exponent of convergence.

UNIT-IV

Borel's theorem on canonical products, Hadamard's factorization theorem, Basic properties of harmonic functions, maximum and minimum principles, Harmonic functions on a disc, Harnack's inequality and theorem, Subharmonic and superharmonic functions, Dirichlet problem, Green's function.

Text & Reference Books:-

S. No	Name	Author(S)	Publisher
1.	Functions of one complex variable. Springer-Verlag	J. B. Conway	International student edition, Narosa Publishing House, 1980 (Chap.X only)
2.	Theory of Functions of a Complex Variable	E. T. Copson	(Oxford University Press), Chapter IV (4.60, 4.61, 4.62) Chap. VII (excl. Section 7.7) Chap. VIII (Section 8.4)

