SCHEME & SYLLABUS

B.Sc (Hons.) Mathematics

(Choice Based Credit System)

Department of Physical Sciences
UISH
Sant Baba Bhag Singh University
2020

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 to contribute substantially to the goal of SBBSU and becoming a 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.

SALIENT FEATURES OF THE DEPARTMENT

- The Department has highly qualified, young, dynamic and dedicated Faculty in various fields of Physical Sciences *viz.* Chemistry, Physics, Mathematics.
- The Department has well equipped laboratories with a number of instruments and facilities like, UV- Visible Spectrophotometer, High Speed Centrifuge, Muffle furnance, Digital water bath, Polarimeter , Turbiditimeter, AbbsRefractrometer, Digital weighing balance, Magnetic plate with stirrer, pH meter, Conductometer, Flame Photometer, colorimeter and a double distillation plant, Spring balance , Sodium Lamp Transformer , Young's modulus,Ultrasonic interferometer , Rheostat , Maxwell needle apparatus kit , Magnetic field of solenoid , Ballistic Galvanometer , Deflection and vibration Magnetometer , Electron spin resonance
- 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.
- The department updates curricula on a regular basis to ensure that the students keep up with the changing trends of education and research globally. The syllabi of courses are designed to equip students to qualify exams such as GATE, UGC- NET / SLET, etc.
- Student centric, ICT enabled and interactive teaching
- Students and teachers participation in International, National, State and Regional seminars and conferences.
- Curricular and the co-curricular activities are well balanced in the Teaching Learning environment to provide holistic education to the students.
- Flexiblility in course curriculum as per the needs of students & PG Programmes with Project as research component.
- 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.
- Along with Industry aligned academia, expert interaction, is the key features of the department.

B.Sc (Honours)Mathematics

B.Sc. Math Honours is a UG degree program awarded on successful completion of three-year degree program of study in mathematics. Mathematics is the study and investigation of structure, quantity, and space. The program is designed to Construct basic mathematical aptitude for crafting researchers and scientists of tomorrow for addressing the needs of the next century.

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 graduatess into responsible citizens and competent professionals.

MISSION

To explore and advance new frontiers in physical sciences and integration with interdisciplinary sciences through visionary research for the benefit of society,
Holistic development of learner through academic excellence, employability, acquisition of analytical skills and higher research.
To develop graduates for lifelong learning and professional growth.

ELIGIBILITY CRITERIA

10+2 or its equivalent examination with Mathematics,Physics and Chemistry as core subjects, conducted by a recognized Board/ University/Council

DURATION

3 Years

CAREER PATHWAYS

A set of four to six courses that allow students to develop specific skill and value package for a chosen career.

CORPORATE JOBS

Multiple options or sub-pathways designed according to the competency of the students to prepare them for specific sectors/job profiles as per needs of industry.

GOVERNMENT JOBS

Courses to prepare students for Civil services, Public Sector Undertakings and jobs in the Government sector.

HIGHER STUDIES

This pathway prepares students for competitive examinations such as GATE, UGC-NET, CAT, MAT etc. and helps in their progression in higher studies / research.

PROGRAMME EDUCATIONAL OBJECTIVE (PEO)

- **PEO1:** Apply principles of basic science concepts in understanding, analysis and prediction of mathematical systems.
- **PEO2:** Develop human resource with knowledge, abilities and insight in Mathematics and related fields required for career in academia and industry.
- **PEO3:** Engage in lifelong learning and adapt to changing professional and societal needs.
- **PEO4:**Empower students with substantial knowledge in mathematics, scientific and primitive engineering concepts required to solve computing problems and pursue higher studies.

PROGRAMME OUTCOMES (PO)

- **PO1** : **Scientific exploration** : Capability of comprehending basic scientific principles, mathematical aptitude and theories to propose solutions.
- **PO2: Knowledge Enhancement:**Develop human resource with knowledge, abilities and insight in Mathematics and related fields required for career in academia and industry .Empower students with substantial knowledge in mathematics, scientific and primitive engineering concepts required to solve computing problems and pursue higher studies.
- **PO3** : **Ethics** : Apply ethical principles and commit to professional ethics and responsibilities for societal benefits
- **PO4** : **Communication** : Communicate effectively scientific findings, and to be able to assimilate, write and present effective reports to give and receive clear instruction.
- **PO5** : **Environment and sustainability** : Capability of visualizing environmental issues and based upon scientific principles propose sustainable solutions.
- **PO6** : **Individual and team work** : Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- **PO7** : **Blending of science and information technology** : Ability to amalgamate theories, experimentation in science and Information Technology to draft efficient and effective conclusions.
- **PO8** : **Life-long learning** : Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of upcoming scientific change.Engage in lifelong learning and adapt to changing professional and societal needs.
- **PO9** : **Conduct experimentation** : Use explorative aptitude and analytical methods for design of experiments, analysis and interpretation of data and synthesis of information to provide effective conclusions.

PROGRAMME SPECIFIC OUTCOMES (PSO)

- **PSO1** : Develop mathematical thinking, reasoning and an appreciation of mathematics as a primary language of science.

- **PSO2** : Amalgamate the principles of mathematical concepts and computational techniques for simulation and modelling.
- **PSO3** : Ability to proposed mathematical models for natural phenomenon and processes.
- **PSO4**: Encourage the students to develop a range of generic skills helpful in employment, internships and social activities.
- **PSO5**: Provide students/learners sufficient knowledge and skills enabling them to undertake further studies in mathematics and its allied areas on multiple disciplines concerned with mathematics.
- **PSO6**: To develop interest in specialization.

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:**B.Sc(Hons)Math degree programme will have a curriculum with Syllabi consisting of following type of courses:
   - **I.** **Core Courses (CR):**A course, which should compulsorily by 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.
   - **II.** **Generic Elective (GE) Course**: An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective.
     P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Generic Elective.
   - **III.** **Discipline Elective Courses:**Discipline 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 with provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill.
   - **IV.** **Ability Enhancement Courses (AEC)**: The Ability Enhancement (AE) Courses 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; i. Environmental Science and ii. English/MIL Communication. 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.

     - **Ability Enhancement Courses (AECC):**The Ability Enhancement Compulsory Courses (AECC) courses are the courses based upon the content that leads to Knowledge enhancement; these are mandatory for all disciplines.
       For example,Environmental Science, English Communication etc.

- **Skill Enhancement Courses(SEC):**SEC courses are value-based and/or skill-based and are aimed at providing hands-on-training, competencies, skills, etc. These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based knowledge

2. NOMENCLATURE USED:

A.Graduate Core Courses(CR)

B. Generic Elective Course(GE)

- Generic Elective Theory(T)
- Generic Elective Practical(P)

C. Ability Enhancement Courses (AEC)

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

D. Discipline Specific Elective(DSE)

E. Physical Training Course(PT)

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21.	**GE**	**PHY202/ CHM202**	Waves and Optics/ Coordination Chemistry, States of Matter & Chemical Kinetics	**IV**	**48-50**
22.	**GE**	**PHY204/ CHM204**	Waves and Optics(Practical)/ Coordination Chemistry, States of Matter & Chemical Kinetics(Practical)	**IV**	**53-55**
23.	**CR**	**MAT311**	Multivariate Calculus	**V**	**57**
24.	**CR**	**MAT313**	Group Theory-II	**V**	**58**
25.	**CR**	**MAT314**	Metric Spaces and Complex Analysis	**VI**	**67**
26.	**CR**	**MAT316**	Ring Theory and Linear Algebra-II	**VI**	**68**

	Subject Type	**Subject Code**	**Ability enhancement courses**		
27.	**AECC**	**ENG 101**	General English-I	**I**	**14**
28.	**AECC**	**PBI 101/ HCP 101**	General Punjabi-I/HCP-I	**I**	**15-16**
29.	**AECC**	**ENG 102**	General English-II	**II**	**25**
30.	**AECC**	**PBI 102/ HCP 102**	General Punjabi-II/HCP	**II**	**26-27**
31.	**SEC**	**MAT207**	Logics and sets	**III**	**37**
32.	**SEC**	**CSE 233**	Computer Graphics	**III**	**38**
33.	**AECC**	**EVS 001**	Environmental Science	**III**	**39**
34.	**SEC**	**MAT226**	Graph Theory	**IV**	**51**
35.	**SEC**	**CSE 234**	Operating System: Linux	**IV**	**52**
36.	**SEC**	**MAT327**	Introduction to R Programming	**V**	**65**
37.	**SEC**	**MAT330**	Fundamental of Python	**VI**	**75**
			Discipline Subject Elective courses (semester-V,VI)		
38.	**DSE**	**MAT315**	Portfolio Optimization	**V**	**59**
39.	**DSE**	**MAT317**	Number Theory	**V**	**60**
40.	**DSE**	**MAT319**	Analytical Geometry	**V**	**61**
41.	**DSE**	**MAT321**	Industrial Mathematics	**V**	**62**
42.	**DSE**	**MAT323**	Boolean Algebra and Automata Theory	**V**	**63**
43.	**DSE**	**MAT325**	Probability and Statistics	**V**	**64**
44.	**DSE**	**MAT318**	Theory of Equations	**VI**	**69**
45.	**DSE**	**MAT320**	Bio-Mathematics	**VI**	**70**
46.	**DSE**	**MAT322**	Linear Programming	**VI**	**71**
47.	**DSE**	**MAT324**	Mathematical Modeling	**VI**	**72**
48.	**DSE**	**MAT326**	Static and Dynamic Mechanics	**VI**	**73**
49.	**DSE**	**MAT328**	Differential Geometry	**VI**	**74**

COURSE CLASSIFICATION

1. Professional Core Courses (Theory)		L	T	P	Credits
1.	Calculus	5	1	0	6
2.	Algebra	5	1	0	6
3.	Differential Equations	5	1	0	6
4.	Real Analysis	5	1	0	6
5.	Group Theory -I	5	1	0	6
6.	PDE and System of ODE	5	1	0	6
7.	Theory of real functions	5	1	0	6
8.	Numerical Methods	4	0	0	4
9.	Riemann Integeraion and series of functions	5	1	0	6
10.	Ring Theory and Linear Algebra-I	5	1	0	6
11.	Multivariate Calculus	5	1	0	6
12.	Group Theory-II	5	1	0	6
13.	Metric Space and Complex Analysis	5	1	0	6
14.	Ring Theory and Linear Algebra-II	5	1	0	6
Total Credits					82

2. Professional Core Courses (Practical)		L	T	P	Credits
1.	Numerical Method	0	0	2	2
Total Credits					2

3.Generic Elective Courses(Theory)		L	T	P	Credits
1.	Mechanics/ Atomic structures , bonding , general organic chemistry and aliphatic hydrocarbons	4	0	0	4
2.	Electricity and Magnetism/ Chemical Energetic, Equilibrium and Functional Group Organic chemistry – I	4	0	0	4
3.	Thermal Physics and Statistical Mechanics/Solutions, Phase equilibrium, Conductance, Electrochemistry& Functional Group Organic Chemistry-II	4	0	0	4
4.	Waves and Optics/Coordination Chemistry, States of Matter & Chemical Kinetics	4	0	0	4
Total Credits					16

4.Generic Elective Courses(Practical)		L	T	P	Credits
1.	Mechanics(Practical)/ Atomic structures , bonding , general organic chemistry and aliphatic hydrocarbons(Prcatical)	0	0	2	2
2.	Electricity and Magnetism(Practical)/ Chemical Energetic, Equilibrium and Functional Group Organic chemistry – I(Practical)	0	0	2	2
3.	Thermal Physics and Statistical Mechanics/Solutions, Phase equilibrium, Conductance, Electrochemistry& Functional Group Organic Chemistry-II	0	0	2	2
4.	Waves and Optics/Coordination Chemistry, States of Matter & Chemical Kinetics	0	0	2	2
Total Credits					8

5. Ability Enhancement Course(AECC/SEC)		L	T	P	Credits
1.	General English -I	3	0	0	3
2.	General Punjabi -I/HCP-I	3	0	0	3
3.	General English -II	3	0	0	3
4.	General Punjabi -II/HCP-II	3	0	0	3
5.	Environmental Science	3	0	0	3
6.	Introduction to R Programming	2	0	1	3
7.	Fundamental of Python	2	0	1	3
Total Credits					21

Table 1: Skill Enhancement Elective Subjects

Sr. No.	Course Type	Course Title	Remark
1.	SEC-1	Logic and Sets	Student can chose one subject out of these two subjects in 3rd Semester.
2.	SEC-1	Computer Graphics	
3.	SEC -2	Graph Theory	Student can chose one subject out of these two subjects in 4th Semester.
4.	SEC -2	Opearting System :LINUX	

Table 2: Discipline Specific Elective Subjects

Sr. No.	Course Type	Course Title	Remark
1.	DSE-1	Portfolio Optimization	Student can chose one subject out of these three Elective subjects in 5th Semester.
2.	DSE-1	Number Theory	
3.	DSE-1	Analytical Geometry	
4.	DSE-2	Industrial Mathematics	Student can chose one subject out of these three Elective subjects in 5th Semester.
5.	DSE-2	Boolean Algebra and Automata Theory	
6.	DSE-2	Probability and Statistics	
7.	DSE-3	Theory of Equations	Student can chose one subject out of these three Elective subjects in 6th Semester.
8.	DSE-3	Bio Mathematics	
9.	DSE-3	Linear Programming	
10.	DSE-4	Mathematical Modeling	Student can chose one subject out of these three Elective subjects in 6th Semester.
11.	DSE-4	Static & Dynamic Mechanics	
12.	DSE-4	Differential Geometry	

Scheme for B.Sc. (Hons.) Mathematics 2020

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	MAT 101	Calculus	5:1:0	5:1:0	6	6
2	CR	MAT109	Algebra	5:1:0	5:1:0	6	6
3	GE	PHY 101/ CHM 101	Mechanics/ Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons	4:0:0	4:0:0	4	4
4	AECC	ENG 101	General English-I	3:0:0	3:0:0	3	3
5	AECC	PBI 101/ HCP 101	General Punjabi-I/HCP	3:0:0	3:0:0	3	3
6		PT101/PT103/PT105	NSO /NCC/NSS	2:0:0	Non-credit	2	NC

II. Practical Subjects

1	GE	PHY103/ CHM 103	Mechanics/ Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons	0:0:4	0:0:2	4	2
Total						28	24

Total Contact Hours: 28

Total Credit Hours: 24

CR- Core Course

GE- Generic Elective

AECC-Ability Enhancement Compulsory course

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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	MAT 102	Differential Equations	5:1:0	5:1:0	6	6
2	CR	MAT110	Real Analysis	5:1:0	5:1:0	6	6
3	GE	PHY 102/CHM102	Electricity and Magnetism/ Chemical Energetics, Equilibria & Functional Groups Organic Chemistry-I	4:0:0	4:0:0	4	4
4	AECC	ENG 102	General English-II	3:0:0	3:0:0	3	3
5	AECC	PBI 102/ HCP 102	General Punjabi-II/HCP	3:0:0	3:0:0	3	3
6	PT	PT102/PT104/ PT106	NSO /NCC/NSS	2:0:0	Non-credit	2	NC

II. Practical Subjects

1	GE	PHY 104/CHM104	Electricity and Magnetism/ Chemical Energetics, Equilibrium &functional Group Organic Chemistry-I	0:0:4	0:0:2	4	2
Total						**28**	**24**

Total Contact Hours: 28

Total Credit Hours: 24

CR- Core Course

GE- Generic Elective

AECC-Ability Enhancement compulsory course

Scheme for B.Sc. (Hons) Mathematics 2020

Semester-III

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	MAT209	Group Theory-I	5:1:0	5:1:0	6	6
2	CR	MAT213	Partial Differential Equations and System of Ordinary Differential Equations	5:1:0	5:1:0	6	6
3	CR	MAT215	Theory of Real functions	5:1:0	5:1:0	6	6
4	GE	PHY 201/CHM201	Thermal Physics and Statistical Mechanics/Solutions, Phase equilibrium, Conductance, Electrochemistry& Functional Group Organic Chemistry-II	4:0:0	4:0:0	4	4
5	SEC	MAT207/ CSE233	Logics and Gates/ Computer Graphics	2:0:0	2:0:0	2	2
6	AECC	EVS001	Environmental Science	3:0:0	3:0:0	3	3

II. Practical Subjects

1	GE	PHY 203/CHM203	Thermal Physics and Statistical Mechanics/Solutions, Phase equilibrium, Conductance, Electrochemistry& Functional Group Organic Chemistry-II	0:0:4	0:0:2	4	2
Total						**31**	**29**

Total Contact Hours: 31

Total Credit Hours: 29

CR- Core Course

SEC-Skill Enhancement course

GE-Generic Elective

Scheme for B.Sc. (Hons) Mathematics 2020

Semester-IV

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	MAT218	Numerical Methods (Theory)	4:0:0	4:0:0	4	4
2	CR	MAT220	Numerical Methods (Practical)	0:0:4	0:0:2	4	2
3	CR	MAT222	Riemann Integration and Series of functions	5:1:0	5:1:0	6	6
4	CR	MAT224	Ring Theory and Linear Algebra-I	5:1:0	5:1:0	6	6
4	GE	PHY202/ CHM202	Waves and Optics/ Coordination Chemistry, States of Matter & Chemical Kinetics	4:0:0	4:0:0	4	4
5	SEC	MAT226/CSE234	Graph Theory/ Operating System: Linux	2:0:0	2:0:0	2	2

II. Practical Subjects

1	GE	PHY 204/CHM204	Waves and Optics/Coordination Chemistry, States of Matter & Chemical Kinetics	0:0:4	0:0:2	4	2
Total						**30**	**26**

Total Contact Hours: 30

Total Credit Hours: 26

CR- Core Course

GE-Generic Elective

SEC-Skill Enhancement course

Scheme for B.Sc (Hons.) Mathematics 2020

Semester-V

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	MAT311	Multivariate Calculus	5:1:0	5:1:0	6	6
2	CR	MAT313	Group Theory-II	5:1:0	5:1:0	6	6
35	DSE	MAT315/MAT317/MAT319	Portfolio Optimization/ Number Theory/ Analytical Geometry	5:1:0	5:1:0	6	6
4	DSE	MAT321/MAT323/MAT325	Industrial Mathematics/ Boolean Algebra and Automata Theory/ Probability and Statistics	5:1:0	5:1:0	6	6
6	SEC	MAT327	Introduction to R Programming	2:0:2	2:0:1	4	3
Total						28	27

Total Contact Hours: 28

Total Credit Hours: 27

CR- Core Course

AECC-Ability Enhancement Compulsory Course

DSE-Discipline Subject course

Scheme for B.Sc (Hons.) Mathematics 2020

Semester-VI

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	MAT314	Metric Spaces and Complex Analysis	5:1:0	5:1:0	6	6
2	CR	MAT316	Ring Theory and Linear Algebra-II	5:1:0	5:1:0	6	6
3	DSE	MAT318/ MAT320/ MAT322	Theory of Equations/ Bio-Mathematics/ Linear Programming	5:1:0	5:1:0	6	6
4	DSE	MAT324/ MAT326/ MAT328	Mathematical Modeling/ Static and Dynamic Mechanics/ Differential Geometry	5:1:0	5:1:0	6	6
5	SEC	MAT330	Fundamental of Python	2:0:2	2:0:1	4	3
			Total			28	27

Total Contact Hours: 28

Total Credit Hours: 27

CR- Core Course

AECC-Ability Enhancement Compulsory Course

DSE-Discipline Subject course

Summarized report of Course Scheme for B.Sc (Hons.) Mathematics

Sem	L	T	P	Contact hrs/wk	Credits hrs/wk	CR	GE	AECC	SEC	DSE
1	22	2	2	28	24	12	6	6		
2	22	2	2	28	24	12	6	6		
3	24	3	2	31	29	18	6	3	2	
4	20	2	2	30	26	18	6		2	
5	22	4	1	28	27	12			3	12
6	22	4	1	28	27	12			3	12
Total	132	17	10	173	157	84	24	15	10	24

SEMESTER -I

Course Code	**MAT101**
Course Title	**Calculus**
Type of course	Core
L T P	5:1:0
Credits	6
Course prerequisite	10+2 with Mathematics as core subject
Course Objective	It develops the techniques to simplify algebraic expressions. In addition, it encourages students to expand their knowledge through practical application in their daily life.
Course Outcomes	• Students will be able to locate the x and y intercepts, any undefined points, and any asymptotes. • Students will demonstrate the ability to compute derivatives and integrals of real valued and vector valued functions of several variables. • Students will be able to identify areas in mathematics and other fields where Calculus is useful.

Unit-I

Hyperbolic functions, higher order derivatives, Leibnitz rule and its applications, concavity and inflection points, asymptotes, curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves.

Unit-II

Reduction formulae, derivations and illustrations of reduction formulae of the type $\int \sin nx\, dx$, $\int \cos nx\, dx$, $\int \tan nx\, dx$, $\int \sec nx\, dx$, $\int (\log x)^n\, dx$, $\int \sin nx \sin mx\, dx$, parametric equations, parameterizing a curve, arc length, arc length of parametric curves, area of surface of revolution.

Unit-III

Rolle's theorem, Mean value theorems, Taylor's theorem with Lagrange's and Cauchy's form of remainder, Taylor's series, Maclaurin's series of sin x, cos x, e^x, log(1+x),$(1+x)^m$, Maxima and Minima, Indeterminate forms. L' Hospital's rule.

Unit-IV

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, modeling ballistics and planetary motion, Kepler's second law.

Text and Reference Books

S. NO	NAME	AUTHOR(S)	PUBLISHER
1	Calculus	H. Anton, I. Birens And S. Davis	John Wiley And Sons
2	Calculus	G.B. Thomas And R.L. Finney	Pearson Education

Course Code	**MAT109**
Course Title	**Algebra**
Type of course	Core
L T P	51 0
Credits	6
Course prerequisite	10+ 2 with Mathematics as core subject
Course Objective (CO)	It develops the knowledge about complex number system, Systems of linear equations and linear transformations.
Course outcomes	• Students will be able to simplify and evaluate algebraic expressions. • Students will able to form and solve linear equations in one variable. • Students will be able to solve equations involving linear, polynomial, radical, rational, exponential, or logarithmic expressions.

Unit-I

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

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.

Unit-III

Systems of linear equations, row reduction and echelon forms, vector equations,the matrixequation Ax=b, solution sets of linear systems, applications of linear systems, linear independence.

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.

Text and Reference Books

S. NO	NAME	AUTHOR(S)	PUBLISHER
1	*Complex Numbers from A to Z,*	. Titu Andreescu and Dorin Andrica	Birkhauser, 2006
2	*Discrete Mathematics with Graph Theory*	Edgar G. Goodaire and Michael M. Parmenter	Pearson Education (Singapore) P. Ltd
3	*Linear Algebra and its Applications*	David C. Lay	Pearson Education Asia,

Course Code	**PHY101**
Course Title	**Mechanics**
Type of course	Generic Elective
L T P	4:0:0
Credits	4
Course prerequisite	10+2 with PHYSICS as core subject
Course Objective	The aim of the subject is to enhance the knowledge of students in electrostatics, electrodynamics and mechanics.
Course Outcomes	Students will be able to • demonstrate a scientific knowledge of the core physics principles in Mechanics. • have a deep understanding of Newton's laws and able to solve the Newton equations for simple configurations using various methods. • understand the foundations of chaotic motion.

Unit -I

Vectors: Vector algebra, Scalar and vector products Derivatives of a vector with respect to a parameter, Ordinary Differential Equations: 1st order homogeneous differential equations. 2nd order homogeneous differential equations with constant coefficients, Laws of Motion: Frames of reference, Newton's Laws of motion. Dynamics of a system of particles, Centre of Mass. Momentum and Energy: Conservation of momentum.

Unit-II

Work and Energy, Conservation of energy, Motion of rockets, Rotational Motion: Angular velocity and angular momentum, Torque, Conservation of angular momentum. Gravitation: Newton's Law of Gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is 3conserved, areal velocity is constant), Kepler's Laws (statement only), Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness, Basic idea of global positioning system (GPS).

Unit-III

Oscillations: Simple harmonic motion, Differential equation of SHM and its solutions, Kinetic and Potential Energy, Total Energy and their time averages, Damped oscillations. Elasticity: Hooke's law – Stress - strain diagram - Elastic moduli - Relation between elastic constants - Poisson's Ratio-Expression for Poisson's ratio in terms of elastic constants - Work done in stretching and work done in twisting a wire - Twisting couple on a cylinder - Determination of Rigidity modulus by static torsion

Unit-IV

Torsional pendulum - Special Theory of Relativity: Constancy of speed of light, Postulates of Special Theory of Relativity, Length contraction, Time dilation, Relativistic addition of velocities.

Text and Reference Books

S. NO	NAME	AUTHOR(S)	PUBLISHER
1	Introduction To Electrodynamics	D J Griffith	Prentice-Hall Of India
2	Physics- Vol 2	Halliday And Resnik	
3	Electricity And Magnetism	A S Mahajan And A A Rangwala	Tata Mcgraw-Hill
4	Berkeley Physics Course, Vol. 1, Mechanics	E M Purcell, Ed	Tata Mcgraw-Hill
5	Introduction To Classical Mechanics	R G Takwale & P S Puranik	Tata Mcgraw-Hill

Course Code	CHM 101
Course Title	**Atomic structures , bonding , general organic and chemistry and aliphatic hydrocarbons**
Type of course	Generic Elective
L T P	4:0:0
Credits	4
Course prerequisite	10+2 with Chemistry as core subject
Course Objective	The aim of the subject is to enhance the knowledge of students in Chemical bonding atomic / molecular structure, About basic concepts of organic chemistry.
Course Outcomes	Students will able to • Predict electronic properties of atoms using current models and theories in chemistry. • Explains de-Broglie's dual behaviour of matter and Heisenberg's uncertainty principle and solve numerical problems. • Explain the significance of quantum numbers.

Unit-I

Atomic Structure**:** Review of: Bohr's theory and its limitations, dual behavior ofmatter and radiation, de Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure. What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydogenic wavefunctions (atomic orbitals) and their variations for 1s, 2s , 2p, 3s, 3p and 3d orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers ml and ms . Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (ms). Rules for filling electrons in various orbitals, Electronic configurations of the atoms.Stability of half-filled and completely filled orbitals, concept of exchange energy. Energies of atomic orbitals, Anomalous electronic configurations.

Unit-II

Chemical Bonding and Molecular Structure Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO^+. Comparison of VB and MO approach

Unit-III

Fundamentals of Organic Chemistry: Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyper-conjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals. Strength of organic acids and bases:

Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule.

Stereochemistry:Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; cis - trans nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems).

Unit-IV

Aliphatic Hydrocarbons Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure. Alkanes: (Upto 5 Carbons). Preparation: Catalytic hydrogenation, Wurtz reaction,Kolbe's synthesis, from Grignard reagent. Reactions: Free radical Substitution : Halogenation. Alkenes: (Upto 5 Carbons) Preparation: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). Reactions: cis-addition (alk. $KMnO_4$) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidatioN Alkynes: (Upto 5 Carbons) Preparation: Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides.Reactions: formation of metal acetylides, addition of bromine and alkaline KMnO4, ozonolysis and oxidation with hot alk. $KMnO_4$

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Concise Inorganic Chemistry	1.D. Lee	ELBS
2	Inorganic Chemistry	A.G. Sharpe	ELBS
3	Organic Chemistry	Morrison and Boyd	Prentice Hall
4	Fundamentals of Organic Chemistry	Solomons	John Wiley
5	Stereochemistry	P.S. Kalsi	New age International
6	Organic reaction mechanism	Singh and Mukharje	New age International

Course Code	ENG101
Course Title	**General English-I**
Type Course	Ability Enhancement Compulsory course
L T P	3 0 0
Credits	3
Course Pre-requisite	**NA**
Course Objective (CO)	1. The students will critically read and analyze the prescribed texts. 2. The students will demonstrate effective word choice, vocabulary, idioms, grammar and sentence structure allowing accurate communication of meaning in written work. 3. The students will recognize the correct usage of present/past/future tenses in contextualized speech.
Course Outcomes	• The students will critically read and analyze the prescribed texts • The students will demonstrate effective word choice, vocabulary, idioms, grammar and sentence structure allowing accurate communication of meaning in written work. • The students will recognize the correct usage of present/past/future tenses in contextualized speech.

UNIT I

Tales of Life :

a. The Umbrella (Henry Rene Albert Guy de Maupassant)
b. The Story Teller (H.H. Munro Saki)
c. The Lament (Anton Pavlovich Chakhov)

UNIT II

Prose for Young Learners:

a. Universal Declaration Of Human Rights (U.N. Charter)
b. Symptoms (Jerome K. Jerome)

Exploring Tenses in English:

a. Present and Past
b. Present Perfect and Past

UNIT III

Tales of Life:

a.The Luncheon (William Somerset Maugham)
b.The Shroud (Prem Chand)

UNIT IV

Prose for Young Learners:

a. On Spendthrifts(A.G.Gardinar)
b. The Power of Women(Richard Gardon)
c. A Dialogue On Democracy (Albert Sydney Horby)

Exploring Tenses in English:

a. Future

Text and Reference Books:

S.No.	Names	Author(S)	Publisher
1	Tales of Life	Singh, S	Press and Publication Department, Guru Nanak Dev University, Amritsar.
2	Prose For Young Learners	Tewari, A. K, Midha,V.K, Sharma, R.K	Publication Bureau, Guru Nanak Dev University, Amritsar
3	English Grammar in Use	Murphy, R	Cambridge University Press

Course Code	**PBI101**
Course Title	**General Punjabi-I**
Type of Course	Ability Enhancement Compulsory course
L T P	3 0 0
Credits	3
Course Prerequisite	NA
Course Objectives	1. ividAwrQI AwDuink pMjwbI kvIAW dI jIvnI qoN jwxU hoxgy[2. ividAwrQIAW nUM AwDuink pMjwbI kivqw dI ivSYgq jwxkwrI ho jwvygI[3. ividAwrQIAW iv`c ryKw ic`qrW dw Alocnwqmk AiDAYn krn dw hunr auqpMn hovygw[4. ividAwrQIAW nUM pMjwbI DunIN ivauNqbMdI sMbMDI igAwn hwisl ho jwvygw[5. ividAwrQI pMjwbI aup- BwSwvW nUM pCwnxXog ho jwxgy[
Course Outcomes	• ividAwrQI AwDuink pMjwbI kvIAW dI jIvnI qoN jwxU hoxgy[• ividAwrQIAW nUM AwDuink pMjwbI kivqw dI ivSYgq jwxkwrI ho jwvygI[

iekweI- a

1. **AwDuink pMjwbI kivqw:** BweI vIr isMG (rauN ru^, smW, ie`Cw bl qy fUMGIAW SwmW), DnI rwm cwiqRk(rwDw sMdyS, isdkW vwilAW dy byVy pwr ny), pRo. pUrn isMG(purwxy pMjwb nUM AwvwzW), &IrozdIn Sr&(kurbwnI, ^Yr pMjwbI dI), pRo. mohn isMG(Awau n`cIey, nvW kOqk), nMd lwl nUrpurI(cuMm cuMm r`Ko, mzdUr), AMimRqw pRIqm(bwrW mwh, sMXog ivXog), fw. hrBjn isMG(qyry hzUr myrI hwizrI dI dwsqW), iSv kumwr btwlvI(ibrhoN dI rVHk, z^m), surjIq pwqr(cONk ShIdW ‘c ausdw Awi^rI BwSx, Zzl)
2. **pMjwb dy mhwn klwkwr(lyK):** ky. AY~l. sihgl, bVy gulwm AlI KW, soBw isMG, ipRQvIrwj kpUr, BweI smuMd isMG[

iekweI- A

1. pMjwbI DunI ivauNq : aucwrn AMg, aucwrn sQwn qy ivDIAW, svr, ivAMjn[
2. BwSw vMngIAW: BwSw dw tkswlI rUp, BwSw Aqy aup- BwSw dw AMqr, pMjwbI aupBwSwvW dy pCwx icMnH[

pusqk sUcI

pwT- pusqkW

lyKk	Swl	Pusqk	pbilSr
sMpwdk, iF`loN; h.s. Aqy srgoDIAw; p.s.	2014	do rMg	pblIkySn ibaUro, gurUu nwnk dyv XUnIvristI, AMimRqsr
gwrgI; b.	1995	pMjwb dy mhwn klwkwr	pblIkySn ibaUro, gurUu nwnk dyv XUnIvristI, AMimRqsr

sMbMiDq pusqkW

lyKk	Swl	Pusqk	pbilSr
isMG; h.	1966	pMjwbI bwry	pMjwbI XUnIvristI, pitAwlw
isMG; qIrQ (fw.)	2014	pMjwbI AiDAwpn	AY~s. jI. pbilSrz, jlMDr
syKoN; suKivMdr isMG (fw.) Aqy syKoN; mndIp kOr	2015	pMjwbI BwSw dw AiDAwpn	kilAwxI pbilSrz, luiDAwxw

Course code	HCP101
Course title	**History and Culture of Punjab -I**
Type of course	Ability Enhancement Compulsory Course
L T P	3:0:0
Credits	3
Course prerequisite	NA
Course objectives (CO)	1. The Student will acquire the knowledge about Punjab and its Historical Resources. 2. The Student will understand the Harppan Culture and different Vedic Periods. 3. The Students will analyze the Alexander's invasions.
Course Outcomes	• The Student will understand the Harppan Culture and different Vedic Periods. • The Students will analyze the Alexander's invasions. • The Student will acquire the knowledge about Punjab and its Historical Resources.

Unit I

Ancient Punjab: Physical features, Political, Social, Economic, Geographical, Religious impact on History, Historical Sources: Literacy, Archaeological, Harappan Culture: Extent and Town Planning.

Unit II

Harppan Culture: Social, Economic and Religious life; Causes and Disappearance, Rig Vedic Age: The rise of Indo Aryans, Main features of the life in Early Vedic Age, Later Vedic Age: Political, Economic, Social, and Religious life of Later Vedic Aryans.

Unit III

Caste system: Origin and Evolution, The Epics: Historical importance of Ramayan and Mahabharat, Political condition on eve Alexander's Invasion.

Unit IV

Impact of Alexander's Invasion on Social and Culture Life., Position of Women: Harppan, Early Vedic and Later Vedic Age.

Important Historical places of Punjab: Mohenjodaro, Harappa, kotla Nihang khan, Sanghol, Banawali, Taxila, Hastinapur,Indraprastha,Srinagar, Sakala,Purusapura

Text and References Books:

S.No.	Names	Author(S)	Publisher
1	History And Culture Of Punjab	Sukhdev Sharma	New Academic Publisher
2	A History of India, Vol. I	Romila Thapar	Penguin Books

Course Code	**PHY103**
Course Title	**Mechanics Practical**
Type of course	GE Practical
L T P	0 0 4
Credits	2
Courseprerequisite	10+2 with physics as core subject
Course Objective (CO)	The aim of this course is to impart practical knowledge to the students and provide them with exposure of basic measuring instruments, electricity and electronics apparatuses
Course outcomes	Understand basic units of measurement, convert units, and appreciate their magnitudes. Demonstrate the ability to produce a working model through hands-on experience in fluid mechanics. Measure fluid pressure and relate it to flow velocity.

1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.
2. To determine the Height of a Building using a Sextant.
3. To determine the Moment of Inertia of a Flywheel.
4. To determine the Young's Modulus of a Wire by Optical Lever Method.
5. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
6. To determine the Elastic Constants of a Wire by Searle's method.
7. To determine g by Bar Pendulum.
8. To determine g by Kater's Pendulum.
9. To determine **g** and velocity for a freely falling body using Digital Timing Technique
10. To study the Motion of a Spring and calculate (a) Spring Constant (b) Value of g

Text and Reference Books

S. No	Name	Author(S)	Publisher
01	*Practical Physics*	C. L. Arora	S. Chand

Course Code	CHM 103
Course Title	**Atomic structures , bonding , general organic and chemistry and aliphatic hydrocarbons-Practical**
Type of course	GE Practical
L T P	0:0:4
Credits	2
Course prerequisite	10+2 with chemistry as core subject
Course Objective	The aim of this course is to impart practical knowledge to the students about the separation of organic molecules and estimation of inorganic salt and metal ions.
Course Outcomes	Students will • understand basic concepts of chemical estimations through volumetric analysis • able to use various separation techniques for organic compounds. • able to Detect of functional groups (phenolic, carboxylic, carbonyl, esters, carbohydrates, amines,amides, nitro and anilide) in simple organic compounds

Volumetric Analysis

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with KMnO4.
3. Estimation of water of crystallization in Mohr's salt by titrating with KMnO4.
4. Estimation of Fe (II) ions by titrating it with K2Cr2O7 using internal indicator.
5. Estimation of Cu (II) ions iodometrically using Na2S2O3.

Organic Chemistry

1. Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements)
2. Separation of mixtures by Chromatography: Measure the Rf value in each case (combination of two compounds to be given)

(a) Identify and separate the components of a given mixture of two amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography

(b) Identify and separate the sugars present in the given mixture by paper chromatography.

Text and References Books

S.No.	Names	Author(S)	Publisher
1	Vogel's Qualitative Inorganic Analysis (7th Edition).	G Svehla	Prentice Hall
2	Laboratory Manual in Organic Chemistry	R.K. Bansal,	Wiley Eastern
3	Advanced Experimental Chemistry. Vol. I	Physical, J.N. Gurtu and R. Kapoor	S. Chand & CO.

SEMESTER -II

Course Code	**MAT102**
Course Title	**Differential equations**
Type of course	Core
L T P	6 0 0
Credits	6
Course prerequisite	10+ 2 with Mathematics as core subject
Course Objective (CO)	It develop the knowledge about Differential Equations and partial equations.
Course outcomes	• Students will be able to find solution of higher-order linear differential equations. • Students can classify the differential equations with respect to their order and linearity. • Students will be able to solves the homogeneous linear systems with constant coefficients.

Unit-I

First order exact differential equations. Integrating factors, rules to find an integrating factor. First order higher degree equations solvable for x, y, p. Methods for solving higher-order differential equations. Basic theory of linear differential equations, Wronskian, and its properties. Solving a differential equation by reducing its order.

Unit -II

Linear homogenous equations with constant coefficients, Linear non-homogenous equations, The method of variation of parameters, The Cauchy-Euler equation, Simultaneous differential equations, Total differential equations.

Unit-III

Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations, Linear partial differential equation of first order, Lagrange's method, Charpit's method.

Unit-IV

Classification of second order partial differential equations into elliptic, parabolic and hyperbolic through illustrations only.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	*Differential Equations*	Shepley L. Ross	John Wiley and Sons
2	*Elements of Partial Differential Equations*	Sneddon	McGraw-Hill

Course Code	MAT110
Course Title	**Real analysis**
Type of course	Core
L T P	51 0
Credits	6
Course prerequisite	10+2 with mathematics as core subject
Course Objective (CO)	To have the knowledge of basic properties of field of real numbers and convergence
Course Outcomes	• Students will be able to describe fundamental properties of the real numbers that lead to the formal development of real analysis. • Students will be able to demonstrate an understanding of limits and how they are used in sequences, series, differentiation and integration • Students will be able to construct rigorous mathematical proofs of basic results in real analysis.

Unit-I

Finite and infinite sets, examples of countable and uncountable sets. Real line, bounded sets, Suprema and infima, completeness property of R, Archimedean property of R, intervals. Concept of cluster points and statement of Bolzano-Weierstrass theorem.

Unit-II

Real Sequence, Bounded sequence, Cauchy convergence criterion for sequences. Cauchy's theorem on limits, order preservation and squeeze theorem, monotone sequences and their convergence (monotone convergence theorem without proof).

Unit-III

Infinite series. Cauchy convergence criterion for series, positive term series, geometric series, comparison test, convergence of p-series, Root test, Ratio test, alternating series, Leibnitz's test (Tests of Convergence without proof). Definition and examples of absolute and conditional convergence.

Unit-IV

Sequences and series of functions, Pointwise and uniform convergence. Mn-test, M-test, Statements of the results about uniform convergence and integrability and differentiability of functions, Power series and radius of convergence

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Introduction to Real Analysis	R.G. Bartle and D. R Sherbert	John Wiley and Sons
2	Elementary Analysis	K.A. Ross	Springer Verlag,
3	Intermediate Real Analysis	E. Fischer	Springer Verlag

Course Code	PHY102
Course Title	**Electricity and Magnetism**
Type of course	Generic Elective
L T P	4 0 0
Credits	4
Course prerequisite	10+2 with PHYSICS as core subject
Course Objective (CO)	The subject will add one more step to the students of first year in the fields of magnetism, electromagnetic theory, & properties of matter.
Course Outcomes	• Students will have a fundamentalunderstanding of electromagnetic phenomena. • Students will learn how to analyze various problems in electromagnetism with mathematical methods. • Students will gain experience in analyzing problems within electromagnetism.

Unit-I

Vector Analysis: Review of vector algebra (Scalar and Vector product), gradient, divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors(statement only).

Unit-II

Electrostatics: Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Calculation of electric field from potential. Capacitance of an isolated spherical conductor. Parallel plate, spherical and cylindrical condenser. Energy per unit volume in electrostatic field. Dielectric medium, Polarisation, Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor completely filled with dielectric.

Unit-III

Magnetism:Magnetostatics: Biot-Savart's law & its applications- straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law.Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para- and ferro-magnetic materials

Unit-IV

Electromagnetic Induction: Faraday's laws of electromagnetic induction, Lenz's law,self and mutual inductance, L of single coil, M of two coils. Energy stored in magnetic field.Maxwell`s equations and Electromagnetic wave propagation: Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization.

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Text and Reference Books

S. No	Name	Author(S)	Publisher
1	*Introduction to Electrodynamics*	D J Griffith	Prentice-Hall of India
2	*Physics Vol 2*	Halliday and Resnik	

Course Code	CHM 102
Course Title	**Chemical Energetic, Equilibrium and Functional Group Organic chemistry – I**
Type of course	Generic Elective
L T P	4:0:0
Credits	4
Course prerequisite	10+2 with Chemistry as core subject
Course Objective	The aim of the subject is to enhance the knowledge of students regarding Physical concepts of chemistry like Chemical Energetic, Chemical Equilibrium. General organic chemistry of aromatic systems and functional groups.
Course outcomes	Students will able to • identify thermodynamic property of any system to apply it for various systems. • acquire the knowledge of phase equilibria of various systems. • demonstrate various solution properties of completely miscible, partially miscible and immiscible liquids.

Unit-I

Chemical Energetics: Review of thermodynamics and the Laws of Thermodynamics. Important principles and definitions of thermo-chemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation. Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

Unit-II

Chemical Equilibrium: Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between *G* and G^{o}, Le Chatelier's principle. Relationships between *Kp, Kc* and *Kx* for reactions involving ideal gases.

Ionic Equilibria:Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions.

Unit-III

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure. Aromatic hydrocarbons Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (upto 4 carbons on benzene). Side chain oxidation of alkyl benzenes (upto 4 carbons on benzene).

Alkyl and Aryl Halides,Alkyl Halides (Upto 5 Carbons) Types of Nucleophilic Substitution (SN1, SN2 and SNi) reactions Preparation: from alkenes and alcohols. Reactions: hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson's ether synthesis: Elimination vs substitution.

Aryl Halides Preparation: (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions. Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent. Benzyne Mechanism: KNH_2/NH_3 (or $NaNH_2/NH_3$).Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.

Unit-IV

Alcohols, Phenols and Ethers (Up to 5 Carbons) Alcohols: Preparation: Preparation of 1°, 2° and 3° alcohols: using Grignard reagent,Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters. Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk.KMnO4, acidic dichromate, conc. HNO3). Oppeneauer oxidation Diols: (Upto 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.

Phenols: (Phenol case) Preparation: Cumene hydroperoxide method, from diazonium salts. Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Houben– Hoesch Condensation, Schotten – Baumann Reaction.

Ethers (aliphatic and aromatic): Cleavage of ethers with HI.

Aldehydes and ketones (aliphatic and aromatic): (Formaldehyde, acetaldehyde, acetone and benzaldehyde)Preparation: from acid chlorides and from nitriles. Reactions – Reaction with HCN, ROH, NaHSO3, NH2-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemensen reduction and Wolff Kishner reduction. Meerwein-Pondorff Verley reduction.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Organic reaction mechanism, 3rd ed. Latest edition	V. K. Ahluwalia	Narosa publishing house, New Dehli
2	Organic Chemistry	Morrison and Boyd	Prentice Hall
3	Fundamentals of Organic Chemistry	Solomons	John Wiley
4	The Elements of Physical Chemistry	P.w. Aikins	Oxford
5	Physical Chemistry	R.A. Alberty	Wiley Eastern Ltd

Course Code	ENG102
Course Title	**General English-II**
Type Course	Ability Enhancement Compulsory Course
L T P	3 0 0
Credits	3
Course Pre-requisite	**10+2**
Course Objective (CO)	To develop understanding of the significance of English as a subject in the present context, to feel pleasure and to develop the understanding of the significance of basic competencies in language acquisition.
Course outcomes	• The students will do intensive and extensive reading of the prescribed texts. • The students will assimilate new words and use them in communicative context. • The students will apply the knowledge of modals, voice, reported speech and auxiliary verbs in written and oral context.

Texts Prescribed:

Unit-I Tales of Life

a. The Doll's House(Katherine Mansfield)
b. Eveline (James Joyce)
c. Toba Tek Singh (Saadat Hassan Manto)
d. The Taboo (Victor Astafyev)
e. A Strand of Cotton (Suneet Chopra)

Unit-II Prose for Young Learners

a. Beauty And The Beast(R.K.Narayan)
b. With A Song On Their Lips (Hugh & Colleen Gantzer)
c. My Financial Careers (Stephen Leacock)
d. The School For Sympathy (E.V. Lucas)
e. AIDS (U.N.Report)

UNIT-III Exploring Grammar

a. Modals
b. Passive

UNIT-IV

c. Reported Speech
d. Questions and Auxiliary verbs

Text and Reference Books:

S.No.	Author(S)	Year	Title	Publisher
1	Singh, S	2008	Tales of Life	Press and Publication Department, Guru Nanak Dev University, Amritsar.
2	Tewari, A. K, Midha,V.K, Sharma, R.K	2011	Prose For Young Learners	Publication Bureau, Guru Nanak Dev University, Amritsar

Course Code	**PBI102**
Course Title	**General Punjabi-II**
Type of Course	Ability Enhancement Compulsory Course
L T P	3 0 0
Credits	3
Course Prerequisite	NA
Course Objectives	1. ividAwrQI AwDuink pMjwbI khwxIkwrW dI jIvnI qoN jwxU hoxgy[2. ividAwrQIAW nUM AwDuink pMjwbI khwxI dI ivSYgq jwxkwrI ho jwvygI[3. ividAwrQIAW iv`c ryKw ic`qrW dw Alocnwqmk AiDAYn krn dw hunr auqpMn hovygw[4. ividAwrQI muhwvry, AKwxW dI Fu`kvIN vrqoN krnW is`K jwxgy
Course outcomes	• ividAwrQIAW iv`c ryKw ic`qrW dw Alocnwqmk AiDAYn krn dw hunr auqpMn hovygw[• ividAwrQIAW nUM AwDuink pMjwbI khwxI dI ivSYgq jwxkwrI ho jwvygI[• ividAwrQI AwDuink pMjwbI khwxIkwrW dI jIvnI qoN jwxU hoxgy[

iekweI- a

1. pMjwbI in`kI khwxI: BUAw (nwnk isMG), bwZI dI DI (gurmuK isMG muswi&r), pymI dy inAwxy(sMq isMG syKoN), bwgW dw rwKw(sujwn isMG), qYN kI drd nw AwieAw(krqwr isMG du`gl), DrqI hyTlw bOlD(kulvMq isMG ivrk), dUjI vwr jyb k`tI geI(nvqyj isMG), lCmI(pRym pRkwS), bu`q iSkn(AjIq kOr), b`s kMfktr(dlIp kOr itvwxw)[
2. pMjwb dy mhwn klwkwr (lyK): sqIS gujrwl, gurcrn isMG, Twkur isMG,blrwj swhnI, suirMdr kOr[

iekweI- A

1. Sbd bxqr Aqy Sbd rcnw: pirBwSw Aqy mu`Fly sMklp
2. (a) pYrHw rcnw, muhwvry Aqy AKwx[
   (A) pYrHw pVH ky pRSnW dy au~qr dyxw[

pusqk sUcI

pwT- pusqkW

LyKk	Swl	Pusqk	pbilSr
sMpwdk, iF`loN; h.s. Aqy srgoDIAw, p.s.	2014	do rMg	pblIkySn ibaUro, gurUu nwnk dyv XUnIvristI, AMimRqsr
gwrgI, b.	1995	pMjwb dy mhwn klwkwr	pblIkySn ibaUro, gurUu nwnk dyv XUnIvristI, AMimRqsr

sMbMiDq pusqkW

LyKk	Swl	Psqk	pbilSr
isMG, h.	1966	pMjwbI bwry	pMjwbI XUnIvristI, pitAwlw
isMG, q.	2014	pMjwbI AiDAwpn	AY~s. jI. pbilSrz, jlMDr
syKoN, s.s. Aqy syKoN, m.k.	2015	pMjwbI BwSw dw AiDAwpn	kilAwxI pbilSrz, luiDAwxw

Course ode	HCP 102
Course title	**History And Culture Of Punjab –II**
Type of course	Ability Enhancement Compulsory Course
L T P	3:0:0
Credits	3
Course prerequisite	NA
Course objectives (CO)	1. The Student will acquire the knowledge Of Mauryan Empire. 2. The Student will understand the impact of Buddhism & Jainism on Punjab. 3. To aware the learners Depiction of Punjab in the accounts of Chinese travelers.
Course outcomes	• The Student will acquire the knowledge about Punjab and its Historical Resources. • The Student will understand the Harppan Culture and different Vedic Periods. • The Students will analyze the Alexander's invasions.

Unit-I

The Mauryan Empire: Social, Economic and Religious life, Buddhism and Jainism: Impact on Punjab with special reference to 4th Buddhist Council., The Kushanas: Impact of Kanishka's rule on Punjab.

Unit-II

Gandhara School of Art: Salient features, The Guptas: Cultural and Scientific Developments. Position of Women: Under the Mauryas, the Guptas and the Vardhanas.

Unit-III

Depiction of Punjab in the accounts of Chinese travelers. Fahien and Hwen Tsang. Main developments in literature, Education: Significant Developments: Taxila.

UNIT IV

Society and Culture on the eve of the Turkish invasion of Punjab,Punjab in the Kitab-ul-Hind of Alberuni,Important Historical places: Lahore, Multan Bathinda, Uchh, Jalandhar, Thanesar, Kangra, Taxila, Kundalvana, Pehowa, Thatta.

Text and References Books:

S.NO.	Name	Author's	Publisher
1	History And Culture Of Punjab	Sukhdev Sharma	New Academic Publisher
2	A History of India, Vol. I	Romila Thapar	Penguin Books
3	History and Culture of the Punjab, Vol. I	L.M.Joshi	Punjabi University, Patiala

Course Code	PHY104
Course Title	**Electricity and Magnetism-Practical**
Type of course	GE Practical
L T P	0 0 2
Credits	2
Course prerequisite	10+ 2 with Physics as core subject
Course Objective (CO)	The course is to impart practical knowledge to the students and provide them with practical exposure of electricity and magnetism
Course outcomes	To understand the importance of experiment as the basis of the scientific method. Better understand physics concepts covered in lecture by seeing their application in expt. analyzing data and drawing conclusions from "real world" experiments.

1. To use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, and (d) checking electrical fuses.
2. Ballistic Galvanometer:
   (i) Measurement of charge and current sensitivity
   (ii) Measurement of CDR
   (iii) Determine a high resistance by Leakage Method
   (iv) To determine Self Inductance of a Coil by Rayleigh's Method.
3. To compare capacitances using De'Sauty's bridge.
4. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx).
5. To study the Characteristics of a Series RC Circuit.
6. To study the a series LCR circuit and determine its (a) Resonant Frequency, (b) Quality Factor
7. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and
   (b) Quality factor Q
8. To determine a Low Resistance by Carey Foster's Bridge.
9. To verify the Thevenin and Norton theorem
10. To verify the Superposition, and Maximum Power Transfer Theorem

Text and Reference Books

S. No	Name	Author(S)	Publisher
01	*Practical Physics*	C. L. Arora	S. Chand

Course Code	CHM 104
Course Title	**Chemical energetic, Chemical Equilibrium and Functional Group organic chemistry-Practical**
Type of course	GE Practical
L T P	0:0:2
Credits	2
Course prerequisite	10+2 with chemistry as core subject
Course Objective	The aim of this course is to provide practical knowledge about the preparation of organic compounds, Thermo-chemistry and Ionic equilibrium.
Course outcomes	Students will be able to • analyze basic Physical Properties such as melting and boiling point of organic compounds. • students will be able to Find out the acidity, Basicity and PKa Value on pH meter. • apply Different separation techniques of chemistry.

Thermochemistry

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Determination of integral enthalpy of solution of salts (KNO_3, NH_4Cl).
5. Determination of enthalpy of hydration of copper sulphate.

Ionic equilibria

a) Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter.

b) Preparation of buffer solutions:

(i) Sodium acetate-acetic acid

(ii) Ammonium chloride-ammonium hydroxide

Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

1. Purification of organic compounds by crystallization (from water and alcohol) and distillation.

2 Criteria of Purity: Determination of melting and boiling points.

3 Preparations: Mechanism of various reactions involved to be discussed. Recrystallisation, determination of melting point and calculation of quantitative yields to be done.

(a) Bromination of Phenol/Aniline

(b) Benzoylation of amines/phenols

(c) Oxime and 2,4-dinitrophenylhydrazone of aldehyde/ketone

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Electrochemical methods, Fundamentals and Methods	A.J. Bard, L.R. Faulkner,	Wiley, 1980.
2	Experimental Physical Chemistry	C. Das, B. Behera	Tata McGraw Hill Publishing Company Limited.

SEMESTER-III

Course Code	MAT209
Course Title	**Group Theory –I**
Type of course	Core
L T P	5 1 0
Credits	6
Course prerequisite	10+ 2 with Mathematics as core subject
Course Objective (CO)	The aim of this course is to provide knowledge about the group theory.
Course outcomes	• Students will understand and use the properties of group actions. • understand and use the terms homomorphism and isomorphism. • Students will be able to recall and use the definitions and properties of dihedral, symmetric and alternating groups.

Unit-I
Symmetries of a square, Dihedral groups, definition and examples of groups including permutation groups and quaternion groups (illustration through matrices), elementary properties of groups.

Unit-I
Subgroups and examples of subgroups, centralizer, normalizer, center of a group, product of two subgroups. Properties of cyclic groups, classification of subgroups of cyclic groups.

Unit-I
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. External direct product of a finite number of groups, normal subgroups, factor groups, Cauchy's theorem for finite abelian groups.

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

Text and Reference Books:

S. No	Name	Author(S)	Publisher
1	*A First Course in Abstract Algebra*	John B. Fraleigh	7th Ed., Pearson, 2002
2	*Abstract Algebra*	M. Artin	2nd Ed., Pearson, 2011,
3	*An Introduction to the Theory of Groups*	Joseph J. Rotman	4th Ed., Springer Verlag, 1995
4	*Topics in Algebra*	I.N. Herstein	Wiley Eastern Limited, India, 1975

Course Code	MAT213
Course Title	**Partial Differential Equations and System of Ordinary Differential Equations**
Type of course	Core
L T P	5 1 0
Credits	6
Course prerequisite	10+ 2with Mathematics as core subject
Course Objective (CO)	The aim of this course is to provide knowledge about the advancement in differential equation.
Course Outcomes	• Students will be able to classify partial differential equations and transform into canonical form. • Students will be to apply partial derivative equation techniques to predict the behaviour of certain phenomena. • Student will be able to solve first order differential equations utilizing the standard techniques for separable, exact, linear, homogeneous, or Bernoulli cases.

Unit-I

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.

Unit-II

Derivation of Heat equation, Wave equation and Laplace equation. Classification of second order linear equations as hyperbolic, parabolic or elliptic. Reduction of second order Linear Equations to canonical forms.

Unit-II

The Cauchy problem, the Cauchy-Kowaleewskaya theorem, Cauchy problem of an infinite string. Initial Boundary Value Problems, Semi-Infinite String with a fixed end, Semi-Infinite String with a Free end, Equations with non-homogeneous boundary conditions, Non- Homogeneous Wave Equation. Method of separation of variables, Solving the Vibrating String Problem, Solving the Heat Conduction problem

Unit-IV

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.

Text and Reference Books:

S. No	Name	Author(S)	Publisher
1	*Linear Partial Differential Equations for Scientists and Engineers*	Tyn Myint-U and Lokenath Debnath	4th edition, Springer, Indian reprint, 2006.
2	*Differential equations*	S.L. Ross	3rd Ed., John Wiley and Sons, India, 2004,

Course Code	**MAT215**
Course Title	**Theory of Real Functions**
Type of course	Core
L T P	5 1 0
Credits	6
Course prerequisite	10+2 with mathematics as core subject
Course Objective (CO)	It is a basic course on the study of real valued functions that would develop an analytical ability to have a more matured perspective of the key concepts of calculus, namely, limits, continuity, differentiability and their applications.
Course Outcomes	This course will enable the students to: • i) Have a rigorous understanding of the concept of limit of a function. • ii) Learn about continuity and uniform continuity of functions defined on intervals. • iii) Understand geometrical properties of continuous functions on closed and bounded intervals.

SYLLABUS

Unit I:
Limit of a function (epsilon-delta approach), limit theorems, sequential criterion for limits, Onesided limits, Infinite limits, limits at infinity, Continuous functions, sequential criterion for continuity & discontinuity, Algebra of continuous functions, Composition of continuous functions.

Unit II
Intermediate Value Theorem and its Applications, Extreme Value Theorem, Uniform Continuity, Continuity and Uniform Continuity. Differentiability, Carathéodory's theorem, Algebra of differentiable functions, Chain Rule, Lipschitz Functions and Uniform Continuity, Inverse of Strictly Monotone Functions.

Unit III
Local Extrema, Interior Extremum Theorem, Rolle's theorem, Mean Value Theorem and its Applications to inequalities & approximation of polynomials, Darboux's Theorem.

Unit IV
Continuity of a Monotone function, functions of Bounded Variation, Total Variation of a function, the Total Variation Function, Rectifiable Curves.

RECOMMENDED BOOKS

Sr. no.	Name	AUTHOR(S)	PUBLISHER
1.	Introduction to Real Analysis	R.G. Bartle and D. R. Sherbert	Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.,
2.	Principles of Mathematical Analysis	W. Rudin	McGraw Hill, 1976
3.	Mathematical Analysis	T. M. Apostol	Narosa Publishing House

Course Code	PHY201
Course Title	**Thermal physics and statistical mechanics**
Type of course	Theory (GE)
L T P	4:0:0
Credits	4
Course prerequisite	BSc. 1st with physics as core subject
Course Objective (CO)	The aim of this course is to impart theoretical knowledge to the students in thermal, statistical and atomic physics.

Unit-I

Thermodynamic Description of system: Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, Various Thermo dynamical Processes, Applications of First Law: General Relation between CP & CV, Work Done during Isothermal and Adiabatic Processes, Compressibility & Expansion Coefficient, Reversible & irreversible processes, Second law & Entropy, Carnot's cycle & theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero.

Unit-II

Thermodynamic Potentials: Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations & applications - Joule-Thompson Effect, Clausius-Clapeyron Equation, Expression for (CP – CV), CP/CV, TdS equations.

Unit-III

Kinetic Theory of Gases: Derivation of Maxwell's law of distribution of velocities and its experimental verification, Mean free path (Zeroth Order), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Law of equipartition of energy (no derivation) and its applications to specific heat of gases; mono-atomic and diatomic gases.

Theory of Radiation: Blackbody radiation, Spectral distribution, Concept of Energy Density, Derivation of Planck's law, Deduction of Wien's distribution law, Rayleigh-Jeans Law, Stefan Boltzmann Law and Wien's displacement law from Planck's law.

Unit-IV

Statistical Mechanics: Phase space, Macrostate and Microstate, Entropy and Thermodynamic probability, Maxwell-Boltzmann law - distribution of velocity - Quantum statistics - Fermi-Dirac distribution law - electron gas - Bose-Einstein distribution law - photon gas - comparison of three statistics.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	*Statistical Physics and Thermodynamis*	V S Bhatia	
2	*A Treatise on Heat*	Saha and Srivastava	Indian Press, Ahmedabad
3	*Thermal Physics*	C. Kittel & H. Kroemer	CBS Pub.
4	*Thermal Physics*	S C Garg, R M Bansal & C K Ghosh	TMH

Course Code	CHM 201
Course Title	**Solutions , Phase Equilibrium, conductance, electrochemistry and functional group organic chemistry-II**
Type of course	Theory(GE)
L T P	4:0:0
Credits	4
Course prerequisite	B.Sc. 1st with chemistry as core subject
Course Objective	The aim of this course is to impart knowledge to the students about basic of solution chemistry, phase equilibia, Electrochemistry and organic chemistry and natural polymers.

Unit-I

Solutions: Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions. Vapour pressure-composition and temperature-composition curves of ideal and non-ideal solutions. Distillation of solutions. Lever rule. Azeotropes. Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids. Immiscibility of liquids- Principle of steam distillation. Nernst distribution law and its applications, solvent extraction.

Phase Equilibrium: Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule and its thermodynamic derivation. Derivation of Clausius – Clapeyron equation and its importance in phase equilibria. Phase diagrams of one-component systems (water and sulphur) and two component systems involving eutectics, congruent and incongruent melting points (lead-silver, $FeCl_3$-H2O and Na-K only).

Unit-II

Conductance: Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Kohlrausch law of independent migration of ions Transference number and its experimental determination using Hittorf and Moving boundary methods. Ionic mobility. Applications of conductance measurements: determination of degree of ionization of weak electrolyte, solubility and solubility products of sparingly soluble salts, ionic product of water, hydrolysis constant of a salt. Conductometric titrations (only acid-base).

Electrochemistry: Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance. Types of electrodes. Standard electrode potential. Electrochemical series. Thermodynamics of a reversible cell, calculation of thermodynamic properties: G, H and S from EMF data. Calculation of equilibrium constant from EMF data. Concentration cells with transference and without transference. Potentiometric titrations -qualitative treatment (acid-base and oxidation-reduction only).

Unit-III

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure. Carboxylic acids and their derivatives Carboxylic acids (aliphatic and aromatic) Preparation: Acidic and Alkaline hydrolysis of esters. Reactions: Hell – Vohlard - Zelinsky Reaction. Carboxylic acid derivatives (aliphatic): (Upto 5 carbons) Preparation: Acid chlorides, Anhydrides, Esters and Amides from acids and their interconversion. Reactions: Comparative study of nucleophilicity of acyl derivatives. Reformatsky Reaction, Perkin condensation. Amines and Diazonium Salts Amines (Aliphatic and Aromatic): (Upto 5 carbons)Preparation : from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction. Reactions: Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, with HNO_2, Schotten – Baumann Reaction. Electrophilic substitution (case aniline): nitration, bromination, sulphonation.

Unit-IV

Amino Acids, Peptides and Proteins: Preparation of Amino Acids: Strecker synthesis using Gabriel's phthalimide synthesis. Zwitterion, Isoelectric point and Electrophoresis Reactions of Amino acids: ester of –COOH group, acetylation of –NH2 group, complexation with Cu^{2+} ions, ninhydrin test. Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins. Determination of Primary structure of Peptides by degradation Edmann degradation (N-terminal) and C–terminal (thiohydantoin and with carboxypeptidase enzyme).

Carbohydrates: Classification, and General Properties, Glucose and Fructose (openchain and cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in mono-saccharides. Structure of disaccharides (sucrose, cellobiose, maltose, lactose) and polysaccharides (starch and cellulose) excluding their structure elucidation.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Natural Products: Chemistry and Biological Significance,	Mann, J.; Davidson, R.S.; Hobbs, J.B.; Banthrope, D.V.; Harborne, J.B.	Longman, Esse
2	Organic reaction mechanism, 3rd ed. Latest edition	V. K. Ahluwalia	Narosa publishing house, New Dehli
3	Organic Chemistry	Morrison and Boyd	Prentice Hall
40	Fundamentals of Organic Chemistry	Solomons	John Wiley
5	The Elements of Physical Chemistry	P.w. Aikins	Oxford
6	Physical Chemistry	R.A. Alberty	Wiley Eastern Ltd
7	Physical Electrochemistry-Fundamentals, Techniques and Applications	Eliezer Gileadi,	Wiley-VCH

Course Code	MAT207

Course Title	Logic and Sets
Type of course	SEC
L T P	2 0 0
Credits	2
Course prerequisite	10+ 2 with Mathematics as core subject
Course Objective (CO)	The aim of the subjects that students have basic knowledge of sets, relation and basic operators.
Course outcomes	• Students will become able to learn sets, subsets law of theory and venn diagram. • Students can understand Propositinal equivalewnce. • Students will become able to understand the concept of Truth table ,conjunction and disjunction, Biconditional and propostions.

Unit-I

Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators.

Unit-II

Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations.

Unit-III

Sets, subsets, Set operations and the laws of set theory and Venn diagrams. Examples of finite and infinite sets. Finite sets and counting principle. Empty set, properties of empty set. Standard set operations. Classes of sets. Power set of a set.

Unit-IV

Difference and Symmetric difference of two sets. Set identities, Generalized union and intersections. Relation: Product set, Composition of relations, Types of relations, Partitions, Equivalence Relations with example of congruence modulo relation, Partial ordering relations, nary relations.

Text and Reference Books:

S. No	Title	Author(S)	Publisher
1	*Discrete Mathematics and Combinatorial Mathematics*	R.P. Grimaldi	Pearson Education, 1998.
2	*Naive Set Theory*,	*Naive Set Theory*	Springer, 1974
3	*Theory of Sets*	E. Kamke	Dover Publishers, 1950

Course Code	CSE 233

Course Title	Computer Graphics
Type of course	**SEC**
L T P	2 0 0
Credits	2
Course prerequisite	10+ 2 with Mathematics as core subject
Course Objective (CO)	The aim of the subjects that students have basic knowledge of computer Graphics
Course outcomes	• Demonstrate various algorithms for scan conversion and filling of basic objects and their comparative analysis. • Apply geometric transformations, viewing and clipping on graphical objects. • Understand a typical graphics pipeline and have made pictures with their computer.

Development of computer Graphics: Raster Scan and Random Scan graphics storages, displays processors and character generators, colour display techniques, interactive input/output devices. Points, lines and curves: Scan conversion, line-drawing algorithms, circle and ellipse generation, conic-section generation, polygon filling anti aliasing. Two-dimensional viewing: Coordinate systems, linear transformations, line and polygon clipping algorithms.

Text and Reference Books

S. No	Names	Author(S)	Publisher
1	*Computer Graphics*	. D. Hearn and M.P. Baker	Prentice–Hall of India, 2004
2	*Computer Graphics: Principals and Practices*	J.D. Foley, A van Dam, S.K. Feiner and J.F. Hughes	Addison-Wesley, MA, 1990
3	*Procedural Elements in Computer Graphics*	. D.F. Rogers and A.J. Admas	McGraw Hill Book Company, 2001.

Course Code	EVS001

Course Title	Environmental Science
Type of course	Theory (AECC)
L T P	3 0 0
Credits	3
Course prerequisite	NA
Course objective	To connect and sensitize the students towards the environment and prevailing environmental issues (natural, physical, social and cultural).
Course Outcome	An Environmental Studies major will Prepare students to critically examine all sides of environmental issues and apply understanding from disciplines such as history, economics, psychology, law, literature, politics, sociology, philosophy, and religion to create informed opinions about how to interact with the environment on both a personal and a social level. Understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales. Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.

SYLLABUS

UNIT I:Introduction: Definition and scope and importance of multidisciplinary nature of environment. Need for public awareness.

Natural Resources: Natural Resources and associated problems, use and over exploitation, case studies of forest resources and water resources.

Ecosystems: Concept of Ecosystem, Structure, interrelationship, producers, consumers and decomposers, ecological pyramids-biodiversity and importance. Hot spots of biodiversity

UNIT II :Environmental Pollution: Definition, Causes, effects and control measures of air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards. Solid waste Management: Causes, effects and control measure of urban and industrial wastes. Role of an individual in prevention of pollution, Pollution case studies, Disaster Management: Floods, earthquake, cyclone and landslides.

UNIT III:Social Issues and the Environment: From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people; its problems and concerns. Case studies. Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies. Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of pollution) Act. Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation Public awareness.

UNIT IVHuman Population and the Environment: Population growth, variation among nations. Population explosion –Family Welfare Programme. Environment and human health, Human Rights, Value Education, HIV/AIDS. Women and child Welfare. Role of Information Technology in Environment and human health.

Text and Reference Books:

S. No	Name	Author(S)	Publisher
1	Environmental Biology	Agarwal, K.C. 2001	Nidi Publ. Ltd. Bikaner.
2	Environmental Science	Miller T.G. Jr.	Wadsworth
3	Perspectives in Environmental Studies	Anubha Kaushik and Gaurav Garg	New Age International Publishers

Course Code	PHY203
Course Title	**Thermal physics and statistical mechanics Practical**
Type of course	Practical (GE)
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. 1st with physics as core subject
Course Objective (CO)	The aim of this course is to impart practical knowledge to the students and provide them with exposure of thermodynamics.

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
2. Measurement of Planck's constant using black body radiation.
3. To determine Stefan's Constant.
4. To determine the coefficient of thermal conductivity of copper by Searle's Apparatus.
5. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
6. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method.
7. To determine the temperature co-efficient of resistance by Platinum resistance thermometer.
8. To study the variation of thermo emf across two junctions of a thermocouple with temperature.
9. To record and analyze the cooling temperature of an hot object as a function of time using a thermocouple and suitable data acquisition system
10. To calibrate Resistance Temperature Device (RTD) using Null Method/Off-Balance Bridge

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	*Advanced Practical Physics for students*	B.L. Flint & H.T. Worsnop	Asia Publishing House.
2	*Advanced level Physics Practicals*	Michael Nelson and Jon M. Ogborn	Heinemann Educational Publishers
3	*A Text Book of Practical Physics*	Indu Prakash and Ramakrishna	Kitab Mahal, New Delhi

Course Code	CHM 203
Course Title	**Solutions , Phase equilibrium, Conductance, Electrochemistry and Functional Organic Chemistry-II Practical**
Type of course	Practical (GE)
L T P	0:0:4
Credits	2
Course prerequisite	B.Sc. 1st with chemistry as core subject
Course Objective	To provide practical knowledge about conductometry , potentiometry and qualitative organic analysis.

Distribution: Study of the equilibrium of one of the following reactions by the distribution method:

$I_2(aq) + I^-(aq) I_3^-(aq)$ $Cu^{2+}(aq) + xNH_2(aq)$ $[Cu(NH_3)_x]^{2+}$

Phase equilibria

Construction of the phase diagram of a binary system (simple eutectic) using cooling curves.

Determination of the critical solution temperature and composition of the phenol water system and study of the effect of impurities on it.

Study of the variation of mutual solubility temperature with concentration for the phenol water system and determination of the critical solubility temperature.

Conductance

Determination of cell constant
Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.

Perform the following conductometric titrations:

i. Strong acid vs. strong base
ii. Weak acid vs. strong base

Potentiometry

Perform the following potentiometric titrations:

i. Strong acid vs. strong base
ii. Weak acid vs. strong base
iii. Potassium dichromate vs. Mohr's salt

Systematic Qualitative Organic Analysis of Organic Compounds possessingmonofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.

Determination of the concentration of glycine solution by formylation method.

1. Titration curve of glycine
2. Action of salivary amylase on starch
3. Effect of temperature on the action of salivary amylase on starch.

4. Differentiation between a reducing and a non reducing sugar.
5. Organic and inorganic synthesis

Text and Reference Books

S. No	Name	Author(S)	Publisher
01	Vogel's Qualitative Inorganic Analysis	Svehla	Orient Longman
02	Laboratory Experiments on Organic Chemistry	R. Edemas, J.R. Johnson and C.F. Wilcox	The Macmillan Limited, London,
	Laboratory Manual in Organic Chemistry	R.K. Bansal,	Wiley Eastern
03	Experimental Physical Chemistry	C. Das, B. Behera	Tata McGraw Hill Publishing Company Limited.

SEMESTER -IV

Course Code	MAT218
Course Title	**Numerical Methods (Theory)**
Type of course	Core
L T P	4 0 0
Credits	4
Course prerequisite	10+ 2 with Mathematics as core subject
Course Objective (CO)	The aim of the subjects that students will be familiar with the notation and terminology related to finding the errors, significant numbers and Able to interpolate the problems using numerical methods
Course outcomes	• Students will be able to obtain numerical solutions of algebraic and transcendental equations. • To find numerical solutions of system of linear equations and check the accuracy of the solutions. • Students will be able to solve initial and boundary value problems in differential equations using numerical methods.

Unit-I

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.

Unit-II

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

Unit-II

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

Unit-II

Numerical Integration: Trapezoidal rule, Simpson's rule, Simpsons 3/8th rule, Boole's Rule. Midpoint rule, Composite Trapezoidal rule, Composite Simpson's rule.

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

Text and reference books

S. No	Name	Author(S)	Publisher
1	*A Friendly Introduction to Numerical Analysis*	Brian Bradie	Pearson Education, India, 2007
2	*Numerical Methods for Scientific and Engineering Computation*,	M.K. Jain, S.R.K. Iyengar and R.K. Jain	6th Ed., New age International Publisher, India, 2007.
3	*Applied Numerical Analysis*	C.F. Gerald and P.O. Wheatley	Pearson Education, India, 2008

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Course Code	MAT220
Course Title	**Numerical Methods (Practical)**
Type of course	Core
L T P	0 0 2
Credits	2
Course prerequisite	10+ 2 with Mathematics as core subject
Course Objective (CO)	The aim of the subjects that students will be familiar with the practical concept of numerical methods by computer software.
Course outcomes	• Students will be able to use mathematical libraries for computational objectives and represent the outputs of programs visually in terms of well formatted text and plots. • Students will be able to obtain the numerical solutions of algebraic and transcendental equations. • This course will enable the students to find numerical solutions of system of linear equations and check the accuracy of the solutions.

List of Practical (using any software)

(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 and reference books

Sr. No.	Name	Author(s)	Publisher
1.	*A Friendly Introduction to Numerical Analysis*	Brian Bradie	Pearson Education, India
2.	*Numerical Methods for Scientific and Engineering Computation*	M.K. Jain, S.R.K. Iyengar and R.K. Jain	New age International Publisher, India
3.	*Applied Numerical Analysis*	C.F. Gerald and P.O. Wheatley	Pearson Education, India
4.	*A First Course in Numerical Methods*	Uri M. Ascher and Chen Greif	PHI Learning Private Limited
5.	*Numerical Methods using Matlab*	John H. Mathews and Kurtis D. Fink	PHI Learning Private Limited

Course Code	MAT222
Course Title	**Riemann Integration and Series of Functions**
Type of course	Core
L T P	5 1 0
Credits	6
Course prerequisite	10+ 2 with Mathematics as core subject
Course Objective (CO)	Students will become knowledgeable about definite integral is the infinite accumulation (i.e. sum) of some quantity and Become able to decode/encode Riemann sum notation. Acquire the skills to calculate definite integrals, determine convergence (or radii of convergence) for series and Power Series. They will solve problem related to improper integral, Beta and Gamma functions.
Course Outcomes	• The course will enable the students to learn about some of the families and properties of Riemann integrable functions, and the applications of the fundamental theorems of integration. • To understand the Beta and Gamma functions and their properties. • To learn the valid situations for the inter-changeability of differentiability and integrability with infinite sum, and approximation of transcendental functions in terms of power series.

Unit-I

Riemann integration; inequalities of upper and lower sums; Riemann conditions of integrability. Riemann sum and definition of Riemann integral through Riemann sums; equivalence of two definitions; Riemann integrability of monotone and continuous functions

Unit-II

Properties of the Riemann integral; definition and integrability of piecewise continuous and monotone functions.Intermediate Value theorem for Integrals; Fundamental theorems of Calculus. Improper integrals; Convergence of Beta and Gamma functions.

Unit-II

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; Cauchy criterion for uniform convergence and Weierstrass M-Test.

Unit-IV

Limit superior and Limit inferior. Power series, radius of convergence, Cauchy Hadamard Theorem, Differentiation and integration of power series; Abel's Theorem; Weierstrass Approximation Theorem.

Text and reference books

Sr. No.	Name	Author(s)	Publisher
1.	*Elementary Analysis, The Theory of Calculus,*	K.A. Ross	Springer
2.	*Introduction to Real Analysis*	R.G. Bartle D.R. Sherbert	John Wiley and Sons (Asia)
3.	*Elements of Real Analysis*	Charles G. Denlinger	Jones & Bartlett

Course Code	**MAT224**
Course Title	**Ring Theory and Linear Algebra-I**
Type of course	Core
L T P	5 1 0
Credits	6
Course prerequisite	10+ 2 with Mathematics as core subject
Course Objective (CO)	The aim of the subjects that students will be able to describe Concepts of Ring Theory and to understand the theory of Vector space and Linear Transformations.
Course outcomes	• The course will enable the students to learn about the fundamental concept of Rings, Fields, subrings, integral domains. • Students will able to understand the concept of linear independence of vectors over a field, the idea of a finite dimensional vector space, basis of a vector space and the dimension of a vector space. • To learn the basic concepts of linear transformations, the Rank-Nullity Theorem, matrix of a linear transformation, algebra of transformations and the change of basis.

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.

Unit-II

Ring homomorphisms, properties of ring homomorphisms, Isomorphism theorems I, II and III, field of quotients.

Unit-III

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

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.

Text and reference books

Sr. No.	Name	Author(s)	Publisher
1.	*A First Course in Abstract Algebra*	John B. Fraleigh	Pearson
2.	*Abstract Algebra*	M. Artin	Pearson
3.	*Linear Algebra*	Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence	Prentice-Hall of India Pvt. Ltd., New Delhi
4.	*Contemporary Abstract Algebra,*	Joseph A. Gallian	Narosa Publishing House, NewDelhi
5.	*Introduction to Linear Algebra*	S. Lang	Springer
6.	*Linear Algebra and its Applications*	Gilbert Strang	Thomson
7.	*Linear Algebra- A Geometric Approach*	S. Kumaresan	Prentice Hall of India
8.	*Linear Algebra*	Kenneth Hoffman, Ray Alden Kunze	Prentice-Hall of India Pvt. Ltd.
9.	*Groups, Rings and Fields*	D.A.R. Wallace	Springer Verlag London Ltd

Course Code	**PHY202**
Course Title	**Waves and optics**
Type of course	Theory(GE)
L T P	4:0:0
Credits	4
Course prerequisite	B.Sc 1st with Physics as core subject
Course Objective (CO)	The main objective of the course is to enhance the knowledge of students in wave and optics, the two key subjects of physics.

Unit-I: Superposition of Two Collinear Harmonic oscillations: Linearity and Superposition Principle. (1) Oscillations having equal frequencies and (2) Oscillations having differentfrequencies (Beats). Superposition of Two Perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures with equal an unequal frequency and their uses.Waves Motion- General: Transverse waves on a string. Travelling and standing waves on a string. Normal Modes of a string. Group velocity, Phase velocity. Plane waves.Spherical waves, Wave intensity.

Unit-II: Fluids: Surface Tension: Synclastic and anticlastic surface - Excess of pressure - Application to spherical and cylindrical drops and bubbles - variation of surface tension with temperature - Jaegar's method. Viscosity: Viscosity - Rate flow of liquid in a capillary tube - Poiseuille's formula - Determination of coefficient of viscosity of a liquid - Variations of viscosity of a liquid with temperature lubrication. Detection of leakageSound: Simple harmonic motion - forced vibrations and resonance - Fourier's Theorem - Application to saw tooth wave and square wave - Intensity and loudness of sound - Decibels - Intensity levels - musical notes - musical scale. Acoustics of buildings: Reverberation and time of reverberation - Absorption coefficient - Sabine's formula - measurement of reverberation time - Acoustic aspects of halls and auditoria.

Unit-III: Wave Optics: Electromagnetic nature of light. Definition and Properties of wave front.Huygens Principle. Interference: Interference: Division of amplitude and division of wavefront. Young's Double Slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: measurement of wavelength and refractive index.Michelson's Interferometer: Idea of form of fringes (no theory needed), Determinationof wavelength, Wavelength difference, Refractive index and Visibility of fringes.

Unit-IV: Diffraction: Fraunhofer diffraction: Single slit; Double Slit. Multiple slits & Diffractiongrating. Fresnel Diffraction: Half-period zones. Zone plate. Fresnel Diffraction patternof a straight edge, a slit and a wire using half-period zone analysis.Polarization: Transverse nature of light waves. Plane polarized light – production andanalysis. Circular and elliptical polarization.

S. No	**Name**	**Author(S)**	**Publisher**
1	*University Physics*	FW Sears, MW Zemansky and HD Young 13/e	Addison-Wesley
2	*Fundamentals of Optics*	H.R. Gulati and D.R. Khanna	R. Chand Publication

Course Code	CHM 202
Course Title	**Coordination Chemistry, States of Matter and Chemical Kinetics**
Type of course	Theory (GE)
L T P	4:0:0
Credits	4
Course prerequisite	BSc. 1st with chemistry as core subject
Course Objective	The aim of this course is to impart knowledge to the students about basic of transition elements, their bonding, states of matter and chemical kinetics.

Unit-I

Transition Elements (3d series):General group trends with special reference to electronic configuration, variable valency, colour, magnetic and catalytic properties, ability to form complexes and stability of various oxidation states (Latimer diagrams) for Mn, Fe and Cu.Lanthanoids and actinoids: Electronic configurations, oxidation states, colour, magnetic properties, lanthanide contraction, separation of lanthanides (ion exchange method only).

Coordination Chemistry: Valence Bond Theory (VBT): Inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu (coordination numbers 4 and 6). Structural and stereoisomerism in complexes with coordination numbers 4 and 6.Drawbacks of VBT. IUPAC system of nomenclature.

Unit-II

Crystal Field Theory: Crystal field effect, octahedral symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Tetrahedral symmetry. Factors affecting the magnitude of D. Spectrochemical series. Comparison of CFSE for *Oh* and *Td* complexes, Tetragonal distortion of octahedral geometry. Jahn-Teller distortion, Square planar coordination.

Unit-III

Kinetic Theory of Gases: Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation. Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. van der Waals equation of state for real gases. Boyle temperature (derivation not required).

Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance. Temperature dependence of these distributions. Most probable, average and root mean square velocities (no derivation). Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules. Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only).

Liquids: Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only).

Solids: Forms of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices. Miller indices. X–Ray diffraction by crystals, Bragg's law. Structures of NaCl, KCl and CsCl (qualitative treatment only). Defects in crystals.

Unit-IV

Chemical Kinetics: The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half–life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation.Theories of Reaction

Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only).

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Concise Inorganic Chemistry	1.D. Lee	ELBS
2	Inorganic Chemistry	A.G. Sharpe	ELBS
3	Introduction to Ligand Field	B.N. Figgis	Wiley Eastern.

Course Code	**MAT226**
Course Title	**Graph Theory**
Type of course	**SEC**
L T P	2 0 0
Credits	2
Course prerequisite	10+ 2 with Mathematics as core subject
Course Objective (CO)	The student will be able to understand with the most fundamental Graph Theory topics and results and Be exposed to the techniques of proofs and analysis.
Course outcomes	• This course will enable the students to appreciate the definition and basics of graphs along with types and their examples. • To understand the concept of Paths and circuits • To Solve problems related to Travelling salesman's problem and to learn Dijkstra's algorithm and Floyd-Warshall algorithm

Definition, examples and basic properties of graphs,
Pseudo graphs, complete graphs, bi-partite graphs, isomorphism of graphs,
Paths and circuits, Eulerian circuits,
Hamiltonian cycles, the adjacency matrix, weighted graph,
Travelling salesman's problem, shortest path,
Dijkstra's algorithm,
Floyd-Warshall algorithm.

Text and reference books

Sr. No.	Name	Author(s)	Publisher
1.	*Introduction to Lattices and Order*	B.A. Davey and H.A. Priestley	Cambridge University Press, Cambridge
2.	*Discrete Mathematics with Graph Theory*	Edgar G. Goodaire and Michael M. Parmenter	Pearson Education (Singapore) P. Ltd
3.	*Applied Abstract Algebra*	Rudolf Lidl and Gunter Pilz	

Course Code	**CSE 234**
Course Title	**Operating System: Linux**
Type of course	**SEC**
L T P	2 0 0
Credits	2
Course prerequisite	10+ 2 with Mathematics as core subject
Course Objective (CO)	The aim of this course is to impart knowledge to the students Linux – The Operating System. .
Course outcomes	• To understand and make effective use of linux utilities and shell scripting language to solve problems. • To implement in C some standard linux utilities like mv,cp,ls etc. • To learn the fundamentals of Operating Systems.

Operating System: Linux

Linux – The Operating System: Linux history, Linux features, Linux distributions, Linux's relationship to Unix, Overview of Linux architecture, Installation, Start up scripts, system processes (an overview),
Linux Security, The Ext2 and Ext3 File systems: General Characteristics of, The Ext3 File system, file permissions.
User Management: Types of users, the powers of Root, managing users (adding and deleting): using the command line and GUI tools.
Resource Management in Linux: file and directory management, system calls for files Process Management, Signals,
IPC: Pipes, FIFOs, System V IPC, Message Queues, system calls for processes, Memory Management, library and system calls for memory.

Books Recommended

Sr. No.	Name	Author(s)	Publisher
1.	*Linux Programming by Examples The Fundamentals*	Arnold Robbins	Pearson Education
2.	*Red Hat Linux Administrator's Guide*	Cox K	PHI
3.	*UNIX Network Programming*	R. Stevens	PHI
4.	*Unix Concepts and Applications*	Sumitabha Das	TMH
5.	*Linux in a Nutshell*	Ellen Siever, Stephen Figgins, Robert Love, Arnold Robbins	O'Reilly Media
6.	*Beginning Linux Programming*	Neil Matthew, Richard Stones, Alan Cox	

Course Code	**PHY204**
Course Title	**Waves and optics Practical**
Type of course	Practical (GE)
L T P	0:0:4
Credits	2
Course prerequisite	B.Sc 1st with Physics as one core subject
Course Objective (CO)	This course is designed for improving practical knowledge among the students and provides them with exposure on wave and optics related experiments.

1. To investigate the motion of coupled oscillators
2. To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's Experiment and to verify λ^2 – T Law.
3. To study Lissajous Figures
4. Familiarization with Schuster`s focussing; determination of angle of prism.
5. To determine the Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
6. To determine the Refractive Index of the Material of a given Prism using Sodium Light.
7. To determine Dispersive Power of the Material of a given Prism using Mercury Light
8. To determine the value of Cauchy Constants of a material of a prism.
9. To determine the Resolving Power of a Prism.
10. To determine wavelength of sodium light using Fresnel Biprism.
11. To determine wavelength of sodium light using Newton's Rings.
12. To determine the wavelength of Laser light using Diffraction of Single Slit.
13. To determine wavelength of (1) Sodium & (2) spectrum of Mercury light using plane diffraction Grating
14. To determine the Resolving Power of a Plane Diffraction Grating.
15. To measure the intensity using photosensor and laser in diffraction patterns of single and double slits.

Text and Reference Books

S. No	**Name**	**Author(S)**	**Publisher**
1	*Advanced Practical Physics for students*	B.L. Flint & H.T. Worsnop	Asia Publishing House.
2	*Advanced level Physics Practicals*	Michael Nelson and Jon M. Ogborn	Heinemann Educational Publishers

Course Code	CHM 204
Course Title	**Coordination Chemistry, States of Matter and Chemical Kinetics Practical**
Type of course	Practical (GE)
L T P	0:0:4
Credits	2
Course prerequisite	BSc. 1st with chemistry as core subject
Course Objective	The aim of this course is to impart practical knowledge to the students about semi micro qualitative analysis and physical properties of solutions.

Semi-micro qualitative analysis (using H_2S or other methods) of mixtures - not more than four ionic species (two anions and two cations, excluding insoluble salts) out of the following:Cations : NH_4^+, Pb^{2+}, Bi^{3+}, Cu^{2+}, Cd^{2+}, Fe^{3+}, Al^{3+}, Co^{2+}, Ni^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, K^+ Anions : CO_3^{2-}, S^{2-}, SO^{2-}, $S_2O_3^{2-}$, NO_3^-, CH_3COO^-, Cl^-, Br^-, I^-, NO_3^-, SO_4^{2-}, PO_4^{3-},BO_3^{3-}, $C_2O_4^{2-}$, F^- *(Spot tests should be carried out wherever feasible)*

1. Estimate the amount of nickel present in a given solution as bis(dimethylglyoximato) nickel(II) or aluminium as oximate in a given solution gravimetrically.
2. Estimation of (i) Mg^{2+} or (ii) Zn^{2+} by complexometric titrations using EDTA.
3. Estimation of total hardness of a given sample of water by complexometric titration.

(I) Surface tension measurement (use of organic solvents excluded).

a) Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.

b) Study of the variation of surface tension of a detergent solution with concentration.

(II) Viscosity measurement (use of organic solvents excluded).

a) Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer.

b) Study of the variation of viscosity of an aqueous solution with concentration of solute.

(III) Chemical Kinetics

Study the kinetics of the following reactions.

1. Integrated rate method:
   a. Acid hydrolysis of methyl acetate with hydrochloric acid.
   b. Saponification of ethyl acetate.
   c. Compare the strengths of HCl and H_2SO_4 by studying kinetics of hydrolysis of methyl acetate

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Vogel's Qualitative Inorganic Analysis	Svehla	Orient Longman
2	Vogel's Textbook of Quantitative Inorganic Analysis (revised),	J. Basseff, R.C. Dennery, G.H. Jeffery and J. Mendham	ELBS
3	Advanced Practical Physical Chemistry	J.B. Yadav	KRISHNA Prakashan Media (P) Ltd,

SEMESTER-V

Course Code	MAT311
Course Title	**Multivariate Calculus**
Type of course	Core
L T P	5 1 0
Credits	6
Course prerequisite	10+ 2 with Mathematics as core subject
Course Objective (CO)	To ensure the students to understand functions of several variables, directional dirivatives, concept of extrema of function of two variables and To get familiar with the double integration and triple integration.
Course outcomes	• This course will enable the students to learn conceptual variations while advancing from one variable to several variables in calculus. • Studnts will able to apply multivariable calculus in optimization problems and Inter-relationship amongst the line integral, double and triple integral formulations. • To Realize importance of Green, Gauss and Stokes' theorems in other branches of mathematics.

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

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.Change of variables in double integrals and triple integrals.

Unit-III

Line integrals, Applications of line integrals: Mass and Work. Fundamental theorem for line integrals, conservative vector fields, independence of path.

Unit-IV

Green's theorem, surface integrals, integrals over parametrically defined surfaces. Stoke's theorem, The Divergence theorem.

Text and reference books

Sr. No.	Name	Author(s)	Publisher
1.	*Calculus*	G.B. Thomas and R.L. Finney	Pearson Education, Delhi
2.	*Calculus*	M.J. Strauss, G.L. Bradley and K. J. Smith	Dorling Kindersley (India) Pvt. Ltd.
3.	*Basic Multivariable Calculus*	E. Marsden, A.J. Tromba and A. Weinstein	Springer (SIE),
4.	*Multivariable Calculus, Concepts and Contexts*	James Stewart	Thomson Learning, USA

Course Code	MAT313

Course Title	Group Theory-II
Type of course	Core
L T P	5 1 0
Credits	6
Course prerequisite	10+ 2 with Mathematics as core subject
Course Objective (CO)	Students will become knowledgeable about advance concept in Group theory.
Course outcomes	• This course will enable the students to understand the basic concepts of Automorphism, inner automorphism, automorphism groups. • To Learn the idea of external and internal direct productsof groups. • To Understand the basic concepts of group actions and their applications and Recognize the use the Sylow theorems to characterize certain finite groups

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.

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.

Unit-III

Group actions, stabilizers and kernels, permutation representation associated with a given group action, Applications of group actions: Generalized Cayley's theorem, Index theorem.

Unit-IV

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

Text and reference books

Sr. No.	Name	Author(s)	Publisher
1.	*A First Course in Abstract Algebra*	John B. Fraleigh	Pearson
2.	*Abstract Algebra*	M. Artin	Pearson
3.	*Contemporary Abstract Algebra*	Joseph A. Gallian	Narosa Publishing House
4.	*Abstract Algebra*	David S. Dummit and Richard M. Foote	John Wiley and Sons (Asia) Pvt. Ltd., Singapore
5.	*Modern Algebra*	.R. Durbin	John Wiley & Sons, New York
6.	*Groups, Rings and Fields*	D. A. R. Wallace	Springer Verlag London Ltd

Course Code	MAT315
Course Title	Portfolio Optimization
Type of course	DSE-I(a)
L T P	40 0
Credits	4
Course prerequisite	10+ 2 with Mathematics as core subject
Course Objective	Portfolio optimization refers to the allocation of limited resources across qualified securities in such a manner to meet or exceed certain target objectives, performance metrics and criteria. The objectives can include **minimizing risk, maximizing return, meeting liquidity benchmarks** and other limits.
Course outcomes	• To understand the basic concepts of Financial markets, Measures of return and risk and Mutual funds. • To learn the Portfolio of assets, the Markowitz model and the two-fund theorem. • To know about Capital market theory and Capital assets pricing model- the capital market line.

Unit-I

Financial markets. Investment objectives. Measures of return and risk. Types of risks. Risk free assets. Mutual funds.

Unit-II

Portfolio of assets. Expected risk and return of portfolio. Diversification, Mean-variance portfolio optimization- the Markowitz model and the two-fund theorem.

Unit-III

Risk-free assets and one fund theorem, efficient frontier. Portfolios with short sales. Capital market theory, Capital assets pricing model- the capital market line.

Unit-IV

Beta of an asset, beta of a portfolio, security market line. Index tracking optimization models. Portfolio performance evaluation measures.

Text and reference books

Sr. No.	Name	Author(s)	Publisher
1.	*Investment Analysis and Portfolio Management*	. F. K. Reilly, Keith C. Brown	South-Western Publishers
2.	*Mean-Variance Analysis in Portfolio Choice and Capital Markets*	. H.M. Markowitz	Blackwell, New York
3.	*Portfolio Optimization*	M.J. Best	Chapman and Hall, CRC Press
4.	*Investment Science*	D.G. Luenberger	Oxford University Press

Course Code	MAT317
Course Title	**Number Theory**
Type of course	DSE-I(b)
L T P	40 0
Credits	4
Course prerequisite	10+ 2 with Mathematics as core subject
Course Objective (CO)	Students will become knowledgeable about the concept of Number theory.
Course Outcomes	• To learn about some important results in the theory of numbers including the prime number theorem, Chinese remainder theorem, Wilson's theorem and their consequences. • To Learn about number theoretic functions, modular arithmetic and their applications. • To familiarise with modular arithmetic and find primitive roots of prime and composite numbers.

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.

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.

Unit-III

Euler's phi-function, Euler's theorem, reduced set of residues, some properties of Euler's phi function, Order of an integer modulo n, primitive roots for primes, composite numbers having primitive roots, Euler's criterion, the Legendre symbol and its properties.

Unit-IV

Quadratic reciprocity, quadratic congruences with composite moduli. Public key encryption, RSA encryption and decryption, the equation $x^2 + y^2 = z^2$, Fermat's Last theorem.

Text and reference books

Sr. No.	Name	Author(s)	Publisher
1.	*Elementary Number Theory*	.David M. Burton	6th Ed., Tata McGraw-Hill, Indian reprint, 2007
2.	*Beginning Number Theory*	Neville Robinns	2nd Ed., Narosa Publishing House Pvt. Ltd., Delhi, 2007

Course Code	**MAT319**
Course Title	**Analytical Geometry**
Type of course	DSE-I(c)
L T P	40 0
Credits	4
Course prerequisite	10+ 2 with Mathematics as core subject
Course Objective (CO)	The aim of this course is to impart knowledge to the students about sketching of different conics
Course outcomes	• This course will enable the students to sketch the conics like parabola, ellipse, hyperbola understand the properties of parabola, ellipse and hyperbola. • To learn Classification of quadratic equations representing lines, parabola, ellipse and hyperbola, Spheres, Cylindrical surfaces • To understand about graphing standard quadric surfaces like cone, ellipsoid

Unit-I
Techniques for sketching parabola, ellipse and hyperbola.

Unit-II
Reflection properties of parabola, ellipse and hyperbola.

Unit-III
Classification of quadratic equations representing lines, parabola, ellipse and hyperbola, Spheres, Cylindrical surfaces.

Unit-IV
Illustrations of graphing standard quadric surfaces like cone, ellipsoid.

Text and reference books

Sr. No.	Name	Author(s)	Publisher
1.	*Calculus*	G.B. Thomas and R.L. Finney	9th Ed., Pearson Education, Delhi, 2005
2.	*Calculus*	H. Anton, I. Bivens and S. Davis	John Wiley and Sons (Asia) Pvt. Ltd. 2002
3	*The Elements of Coordinate Geometry*	S.L. Loney	McMillan and Company, London
4	*Elementary Treatise on Coordinate Geometry of Three Dimensions*	. R.J.T. Bill	, McMillan India Ltd., 1994

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Course Code	**MAT321**
Course Title	**Industrial Mathematics**
Type of course	DSE-II(a)
L T P	40 0
Credits	0
Course prerequisite	10+ 2 with Mathematics as core subject
Course Objective	The **objective** of **Industrial Mathematics** is to enable students to acquire the fundamentals of applied **mathematics** in areas of classical and numerical analysis, differential equations and dynamical systems, and probability and statistics.
Course outcomes	• This course will enable the students to learn about Medical Imaging and Inverse Problems • To understand the concept of Inverse problems and its applications. • To know about X-ray and its properties and X-ray behavior and to understand the Algorithms of CT scan machine.Learn about Medical Imaging and Inverse Problems.

Unit-I

Medical Imaging and Inverse Problems. The content is based on Mathematics of X-ray and CT scan based on the knowledge of calculus, elementary differential equations, complex numbers and matrices.

Unit-II

Introduction to Inverse problems: Why should we teach Inverse Problems? Illustration of Inverse problems through problems taught in Pre-Calculus, Calculus, Matrices and differential equations. Geological anomalies in Earth's interior from measurements at its surface (Inverse problems for Natural disaster) and Tomography.

Unit-III

X-ray: Introduction, X-ray behavior and Beers Law (The fundament question of image construction) Lines in the place, Radon Transform: Definition and Examples, Linearity, Phantom (Shepp - Logan Phantom - Mathematical phantoms), Back Projection: Definition, properties and examples.

Unit-IV

CT Scan: Revision of properties of Fourier and inverse Fourier transforms and applications of their properties in image reconstruction. Algorithms of CT scan machine. Algebraic reconstruction techniques abbreviated as ART with application to CT scan.

Books Recommended

Sr. No.	Name	Author(s)	Publisher
1.	*The Mathematics of Medical Imaging, A Beginners Guide*	Timothy G. Feeman	Springer Under graduate Text in Mathematics and Technology, Springer, 2010
2.	*Inverse Problems*	C.W. Groetsch	Activities for Undergraduates, The Mathematical Association of America, 1999

3	*An Introduction to the Mathematical Theory of Inverse Problems*	Andreas Kirsch	2nd Ed., Springer, 2011

Course Code	**MAT323**
Course Title	**Boolean Algebra and Automata Theory**
Type of course	DSE-II(b)
L T P	40 0
Credits	4
Course prerequisite	10+ 2 with Mathematics as core subject
Course Objective (CO)	
Course outcomes	• To learn about partially ordered sets, lattices and their types. • To understand Boolean algebra and Boolean functions, logic gates, switching circuits and their applications. • To solve real-life problems using finite-state, Turing machines and assimilate various graph theoretic concepts and familiarize with their applications.

Unit-I

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

Unit-II

Quinn-McCluskey method, Karnaugh diagrams, switching circuits and applications of switching circuits. 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.

Unit-III

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.

Unit-IV

Turing Machines: Turing machine as a model of computation, programming with a Turing machine, variants of Turing machine and their equivalence, Undecidability: Recursively enumerable and recursive languages, undecidable problems about Turing machines: halting problem, Post Correspondence Problem, and undecidability problems about CFGs.

Text and reference books

Sr. No.	Name	Author(s)	Publisher
1.	Introduction to Lattices and Order	B A. Davey and H. A. Priestley	Cambridge University Press,
2.	*Discrete Mathematics with Graph Theory*	. Edgar G. Goodaire and Michael M. Parmenter	Pearson Education (Singapore) P.Ltd

3	Applied Abstract Algebra	. Rudolf Lidl and Günter Pilz	Springer (SIE), Indian reprint, 2004

Course Code	**MAT325**
Course Title	**Probability and Statistics**
Type of course	DSE-II(c)
L T P	40 0
Credits	4
Course prerequisite	10+ 2 with Mathematics as core subject
Course objective	The main objectives of this course is to provide students with the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and sciences.
Course outcomes	• This course will enable the students to learn about random variables (discrete and continuous) and discrete and continuous distributions • To understand Joint cumulative distribution function , its properties and the concept of bivariate normal distribution and correlation coefficient • To learn Chebyshev's inequality, Markov Chains and Chapman-Kolmogorov equations

Unit-I

Sample space, probability axioms, real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments, moment generating function, characteristic function, discrete distributions: uniform, binomial, Poisson, geometric, negative binomial, continuous distributions: uniform, normal, exponential.

Unit-II

Joint cumulative distribution function and its properties, joint probability density functions, marginal and conditional distributions, expectation of function of two random variables, conditional expectations.

Unit-III

Independent random variables, bivariate normal distribution, correlation coefficient, joint moment generating function (jmgf) and calculation of covariance (from jmgf), linear regression for two variables.

Unit-IV

Chebyshev's inequality, statement and interpretation of (weak) law of large numbers and strong law of large numbers, Central Limit theorem for independent and identically distributed random variables with finite variance, Markov Chains, Chapman-Kolmogorov equations, classification of states.

Text and reference books

Sr. No.	Name	Author(s)	Publisher
1.	*Introduction to Mathematical Statistics*	Robert V. Hogg, Joseph W. McKean and Allen T. Craig	Pearson Education, Asia, 2007
2.	*Mathematical Statistics with Applications*	Irwin Miller and Marylees Miller, John E. Freund	7th Ed., Pearson Education, Asia, 2006
3	*Introduction to Probability Models*	Sheldon Ross,	9th Ed., Academic Press, Indian

			Reprint, 2007
4	*Introduction to the Theory of Statistics*	Alexander M. Mood, Franklin A. Graybill and Duane C. Boes	3rd Ed., Tata McGraw-Hill, Reprint 2007

Course Code	**MAT327**
Course Title	**Introduction to R Programming**
Type of Course	SEC
L T P	2 0 1
Credits	3
Course Prerequisites	Statistical analysis
Course Objective(s)	This subject gives an overview of Statistical analysis, graphics representation and reporting.
Course Outcomes (CO)	The students will be able to: 1. List motivation for learning a programming language. 2. Access online resources for R and import new function packages into the R workspace. 3. Import, review, manipulate and summarize data-sets in R. 4. Explore data-sets to create testable hypotheses and identify appropriate statistical tests.

Unit-I:

Introducing to R, Help functions in R, Vectors, Common Vector Operations, Using all and any function, subletting of vector. Creating matrices,

Unit-II:

Creating matrices, Matrix operations, Applying Functions to Matrix Rows and Columns, Adding and deleting rows and columns , lists, Creating lists, general list operations, Accessing list components and values, applying functions to lists, recursive lists

Unit-III

:Input/ Ouput: scan() , readline() Function, Printing to the Screen Reading and writing CSV and text file. Control statements: Loops, Looping Over Nonvector, Sets, if-else , writing user defined function, scope of the variable, R script file

Unit-IV:

Graphics in R: Graph Syntax ((title, xlabel, ylabel, pch, lty, col.), Simple graphics (Bar, Multiple Bar, Histogram, Pie, Box-Plot, Scatter plot, qqplot), Low-level and High-Level plot functions, par() command to generate multiple plots.

Practical: Based on simple mathematical problems and based on syllabus of Statistical Methods for descriptive Statistics

RECOMMENDED BOOKS

Sr. no.	Name	AUTHOR(S)	PUBLISHER
1.	The R Student Companion	Dennis, B. (2013)	Taylor & Francis Group
2.	R for Everyone: Advanced Analytics and Graphics	William. Lander, J. P.	Addison- Wesley Data

3.	The Art of R Programming	Matloff, N.	Statistical Software Design

SEMESTER-VI

Course Code	MAT314
Course Title	**Metric Spaces and Complex Analysis**
Type of course	Core
L T P	5 1 0
Credits	6
Course prerequisite	10+ 2 with Mathematics as core subject
Course Objective (CO)	Students will become knowledgeable about basic concept of metric space and complex analysis.
Course outcomes	• The course will enable the students to understand the basic concepts of metric spaces and Appreciate the abstractness of the concepts such as open balls, closed balls,compactness, connectedness etc. beyond their geometrical imaginations. • To Understand Functions of complex variable, mappings, Differentiate among Contours, upper bounds for moduli of contour integrals. and Contour integrals • To Understand Cauchy-Goursat theorem, Cauchy integral formula and to be able to explain Liouville's theorem and the fundamental theorem of algebra.

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.

Unit-II

Continuous mappings, sequential criterion and other characterizations of continuity. Uniform continuity. Homeomorphism, Contraction mappings, Banach Fixed point Theorem. Connectedness, connected subsets of R.

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.Analytic functions, examples of analytic functions, exponential function, Logarithmic function, trigonometric function, derivatives of functions, definite integrals of functions

Unit-IV

Contours,Contour integrals and its examples, upper bounds for moduli of contour integrals. Cauchy-Goursat theorem, Cauchy integral formula. Liouville's theorem and the fundamental theorem of algebra. Convergence of sequences and series, Taylor series and its examples. Laurent series and its examples, absolute and uniform convergence of power series.

Text and reference books

Sr. No.	Name	Author(s)	Publisher
1.	*Metric Spaces*	Satish Shirali and Harikishan L. Vasudeva	Springer Verlag, London, 2006

2.	*Topology of Metric Spaces*	S. Kumaresan	2nd Ed., Narosa Publishing House, 2011
3	*Introduction to Topology and Modern Analysis*	G.F. Simmons	McGraw-Hill, 2004

Course Code	**MAT316**
Course Title	**Ring Theory and Linear Algebra-II**
Type of course	Core
L T P	5 1 0
Credits	6
Course prerequisite	10+ 2 with Mathematics as core subject
Course Objective (CO)	Students will become knowledgeable about ring theory and Inner product spaces.
Course outcomes	• On successful completion of this course, students will be able to understand Polynomial rings, principal ideal domains, Euclidean domains, factorization of polynomials, unique factorization in Z[x]and Divisibility in integral domains. • To be able to understandthe concept of Dual spaces, dual basisand transpose of a linear transformation and its matrix in the dual basis • To understand Eigen spaces of a linear operator, diagonalizability and Differentiate between invariant subspaces and Cayley-Hamilton theorem

Unit-I

Polynomial rings over commutative rings, division algorithm and consequences, principal ideal domains, factorization of polynomials, reducibility tests, irreducibility tests.

Unit-II

Eisenstein criterion,unique factorization in Z[x]**.** Divisibility in integral domains, irreducibles, primes, unique factorization domains, Euclidean domains.

Unit-III

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.

Unit-IV

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.

Text and reference books

S. No	**Title**	**Author(S)**	**Publisher**
1	*A First Course in Abstract Algebra*	John B. Fraleigh	7th Ed., Pearson, 2002
2	*Abstract Algebra*	M. Artin	2nd Ed., Pearson, 2011
3	*Contemporary Abstract Algebra*	Joseph A. Gallian	4th Ed., Narosa Publishing House, 1999

4	*Linear Algebra*	Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence	4th Ed., Prentice-Hall of India Pvt. Ltd., New Delhi, 2004
5	*Linear Algebra and its Applications*	Gilbert Strang	Thomson, 2007

Course Code	**MAT318**
Course Title	**Theory of Equations**
Type of course	DSE-III(a)
L T P	40 0
Credits	4
Course prerequisite	10+ 2 with Mathematics as core subject
Course Objective (CO)	The aim of this course is to impart knowledge to the students about theory of equations. .
Course outcomes	• To understand the basic concept of polynomials and its significance properties. • To lean about the Descarte's rule of signs positive and negative rule and Relation between the roots and the coefficients of equations. • To understand the Symmetric functions and the Strums theorem and its applications.

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.

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..

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, Separation of the roots of equations, Strums theorem.

Unit-IV

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

Text and reference books

S. No	**Name**	**Author(S)**	**Publisher**
1	*The Theory of Equations*	W.S. Burnside and A.W. Panton	Dublin University Press, 1954
2	*Theory of Equations*	C. C. MacDuffee	, John Wiley & Sons Inc., 1954

Course Code	**MAT320**
Course Title	**Bio-Mathematics**
Type of course	DSE-III(b)
L T P	40 0
Credits	4
Course prerequisite	10+ 2with Mathematics as core subject
Course Objective (CO)	Students will become knowledgeable about basic concept of bio-Mathematics.
Course outcomes	• This course will enable the students to explain the Mathematical Biology and the modeling process. • To understand the Activator-Inhibitor system, Insect Outbreak Model. • To learn various Spatial , Discrete Models and different models with their application

Unit-I

Mathematical Biology and the modeling process: an overview. Continuous models: Malthus model, logistic growth, Allee effect, Gompertz growth, Michaelis-Menten Kinetics, Holling type growth, Bacterial growth in a Chemostat, Harvesting a single natural population, Prey predator systems and Lotka Volterra equations, Populations in competitions, Epidemic Models (SI, SIR, SIRS, SIC).

Unit-II

Activator-Inhibitor system, Insect Outbreak Model: Spruce Budworm, Numerical solution of the models and its graphical representation. Qualitative analysis of continuous models: Steady state solutions, stability and linearization, multiple species communities and Routh-Hurwitz Criteria, Phase plane methods and qualitative solutions, bifurcations and limit cycles with examples in the context of biological scenario.

Unit-III

Spatial Models: One species model with diffusion, Two species model with diffusion, Conditions for diffusive instability, Spreading colonies of microorganisms, Blood flow in circulatory system, Travelling wave solutions, Spread of genes in a population. Discrete Models: Overview of difference equations, steady state solution and linear stability analysis.

Unit-IV

Introduction to Discrete Models, Linear Models, Growth models, Decay models, Drug Delivery Problem, Discrete Prey-Predator models, Density dependent growth models with harvesting, Host-Parasitoid systems (Nicholson-Bailey model), Numerical solution of the models and its graphical representation. Case Studies: Optimal Exploitation models, Models in Genetics, Stage Structure Models, Age Structure Models.

Text and reference books

S. No	Name	Author(S)	Publisher
1	*Mathematical Models in Biology*	L.E. Keshet	SIAM, 1988

2	*Mathematical Biology*	J. D. Murray	Springer, 1993
3	*Biomechanics*	Y.C. Fung	Springer-Verlag, 1990
4	*Mathematical Epidemiology*	F. Brauer, P.V.D. Driessche and J. Wu	Springer, 2008
5	*Elements of Mathematical Ecology*	M. Kot	Cambridge University Press, 2001

Course Code	**MAT322**
Course Title	**Linear Programming**
Type of course	DSE-III(c)
L T P	40 0
Credits	4
Course prerequisite	10+ 2 with Mathematics as core subject
Course Objective (CO)	Linear programming is a mathematical concept used to determine the solution to a linear problem,
Course outcomes	• On successful completion of this course, students will be able to solve problems related to formulation of linear programming problems (LPP), Simplex method , two-phase method, Big-M method • To undersatnd the Transportation problemm, Feasibile and optimal solution of transportation Problems and Assignment problems • To understand the basic concepts of game theory including strategic games and graphical solution procedure and linear programming solution of games.

Unit-I

Introduction to linear programming problem, Theory of simplex method, optimality and unboundedness, the simplex algorithm, simplex method in tableau format, introduction to artificial variables, two-phase method, Big-M method and their comparison.

Unit-II

Duality, formulation of the dual problem, primal-dual relationships, economic interpretation of the dual.

Unit-III

Transportation problem and its mathematical formulation, northwest-corner method least cost method and Vogel approximation method for determination of starting basic solution, algorithm for solving transportation problem, assignment problem and its mathematical formulation, Hungarian method for solving assignment problem.

Unit-IV

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.

Text and reference books

S. No	**Name**	**Author(S)**	**Publisher**
1	*Linear Programming and Network Flows*	Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali	2nd Ed., John Wiley and Sons, India, 2004

2	*Introduction to Operations Research*	F.S. Hillier and G.J. Lieberman	9th Ed., Tata McGraw Hill, Singapore, 2009
3	*Operations Research, An Introduction*	Hamdy A. Taha	8th Ed., Prentice-Hall India, 2006
4	*Linear Programming*	G. Hadley	Narosa Publishing House, New Delhi, 2002

Course Code	**MAT324**
Course Title	**Mathematical Modeling**
Type of course	DSE-IV(a)
L T P	4 0 0
Credits	4
Course prerequisite	10+ 2with Mathematics as core subject
Course Objective (CO)	The objective of course is to introduce mathematical modelling,that is,the construction and analysis of mathematical model inspired by real life problem.
Course outcomes	• This course will enable the students to understand the concepts of Power series , Bessel's equation and Legendre's equation. • To understand the Laplace transform and its application to initial value problem up to second order. • To learn Monte Carlo Simulation Modeling and know the optimization modeling and its applications

Unit-I
Power series solution of a differential equation about an ordinary point, solution about a regular singular point, Bessel's equation and Legendre's equation.

Unit-II
Laplace transform and inverse transform, application to initial value problem up to second order.

Unit-III
Monte Carlo Simulation Modeling: simulating deterministic behavior (area under a curve, volume under a surface), Generating Random Numbers: middle square method, linear congruence, Queuing Models: harbor system, morning rush hour.

Unit-IV
Overview of optimization modeling, Linear Programming Model: geometric solution algebraic solution, simplex method, sensitivity analysis.

List of Practicals (using any software)
(i) Plotting of Legendre polynomial for n = 1 to 5 in the interval [0,1]. Verifying graphically that all the roots of Pn (x) lie in the interval [0,1].
(ii) Automatic computation of coefficients in the series solution near ordinary points.
(iii) Plotting of the Bessel's function of first kind of order 0 to 3.
(iv) Automating the Frobenius Series Method.
(v) Random number generation and then use it for one of the following (a) Simulate area under a curve (b) Simulate volume under a surface.
(vi) Programming of either one of the queuing model (a) Single server queue (e.g. Harbor system) (b) Multiple server queue (e.g. Rush hour).
(vii) Programming of the Simplex method for 2/3 variables.

Text and reference books

S. No	Name	Author(S)	Publisher
1	*Linear Partial Differential Equation for Scientists and Engineers*	Tyn Myint-U and Lokenath Debnath	Springer, Indian reprint, 2006
2	*A First Course in Mathematical Modeling*	Frank R. Giordano, Maurice D. Weir and William P. Fox	Thomson Learning, London and New York, 2003

Course Code	**MAT326**
Course Title	**Static & Dynamic Mechanics**
Type of course	DSE-IV(b)
L T P	4 0 0
Credits	4
Course prerequisite	10+ 2 with Mathematics as core subject
Course Objective (CO)	The aim of this course is to provide knowledge about the basic concept of Mechanics.
Course Outcomes	• To understand the concept of Moment and couple moment of a force about a point and an axis. • To learn Laws of Coulomb friction , its applications and understand the concept of Conservative force field and translation and rotation of rigid bodies. • To understand the general relationship between time derivatives of a vector for different references

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, 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.

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.

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.

Unit-IV

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.

Text and reference books

S. No	Name	Author(S)	Publisher
1	*Engineering Mechanics: Statics and Dynamics,*	I.H. Shames and G. Krishna Mohan Rao	(4th Ed.), Dorling Kindersley (India) Pvt.

			Ltd. (Pearson Education), Delhi, 2009
2	*Engineering Mechanics: Statics and Dynamics*	R.C. Hibbeler and Ashok Gupta	11th Ed., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi.

Course Code	**MAT328**
Course Title	**Differential Geometry**
Type of course	DSE-IV(c)
L T P	4 0 0
Credits	4
Course prerequisite	10+ 2with Mathematics as core subject
Course Objective (CO)	The aim of this course is to provide knowledge about the Space Curves and Geodesics, Tensor.
Course outcomes	• This course will enable the students to explain the basic concepts of tensors and role of tensors in differential geometry • To learn various properties of curves and to know the Interpretation of the curvature tensor, Geodesic curvature, Gauss and Weingarten formulae. • To Understand the role of Gauss-Bonnet theorem and its consequences and to apply problem-solving with differential geometry to diverse situations in physics, engineering and in other mathematical contexts.

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, Theory of Surfaces: Parametric curves on surfaces, Direction coefficients.

Unit-II

First and second Fundamental forms. Principal and Gaussian curvatures. Lines of curvature, Euler's theorem, Rodrigue's formula, Conjugate and Asymptotic lines, Developables: Developable associated with space curves and curves on surfaces, Minimal surfaces.

Unit-III

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.

Unit-IV

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.

Text and reference books

S. No	Name	Author(S)	Publisher

1	*An Introduction to Differential Geometry*	T.J. Willmore	Dover Publications, 2012.
2	*Elementary Differential Geometry*	B. O'Neill	2nd Ed., Academic Press, 2006
3	*Differential Geometry of Three Dimensions*	C.E. Weatherburn	Cambridge University Press 2003

Course Code	**MAT330**
Course Title	**Fundamental of Python**
Type of Course	SEC
L T P	2 0 1
Credits	3
Course Prerequisites	Basic knowledge of Programming
Course Objective(s)	The objective of this course is to develop a basic understanding about the Python Concept.
Course Outcome (CO)	The students will be able to: 1. Interpret the fundamental Python syntax and semantics and be fluent in the use of Python control flow statements. 2. Express proficiency in the handling of strings and functions. 3. Determine the methods to create and manipulate Python programs by utilizing the data structures like lists, dictionaries, tuples and sets.

Unit-I:
Introduction to python and Setting up the Python development Environment, Basic syntax, interactive shell, editing, saving, and running a script,

Unit-II:
Concept of data types, Declaring and using Numeric data types: int, float, complex Lists and Tuples and their basic operations, Python console Input / Output. Arithmetic operators and expressions, Conditions, Comparison operators, Logical Operators, Is and In operators.

Unit-III
String Handling, Unicode strings, Strings Manipulation:- compare strings, concatenation of strings, Slicing strings in python, converting strings to numbers and vice versa. Dictionaries Control statements: if-else, Nested If-Else, Loops (for, while) Loop manipulation using pass, continue, break and else

Unit-IV
Files: Understanding read functions, read(), readline() and readlines() Understanding write functions, write() and writelines() Manipulating file pointer using seek. Introduction to graphics.Simple graphics (Bar, Multiple Bar, Histogram, Pie, Box-Plot, Scatter plot, qqplot).

RECOMMENDED BOOKS			
Sr. no.	**Name**	**AUTHOR(S)**	**PUBLISHER**

1.	Fundamentals of Python:	Kenneth Lambert	Course Technology,
2.	Learning Python	O' Reilly	Mark Lutz
3.	Python Programming: An Introduction to Computer Science 2nd Edition	John Zelly	Mark Lutz