CHOICE BASED CREDIT SYSTEM

SCHEME & SYLLABUS

B.Sc Non Medical

Department of Physical Sciences

University Institute of Sciences (UIS)

Sant Baba Bhag Singh University

2021

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 and 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.

Student centric, ICT enabled and interactive teaching, outcome based teaching model comprising of theoretical work, regular academic activities such as research projects, seminars, resource learning and hands-on laboratory work.

The Department wishes to focus on providing a comprehensive curriculum at undergraduate and postgraduate levels with teaching- learning adjunct to cater the need of industry, relevant research and career opportunities, meritorious careers in academia and proficient industries. Our research oriented teaching paves the way for entry into different careers since it equips students with advanced transferable skills in information gathering, analysis and presentation, which are vital tools in the field of science.

SALIENT FEATURES OF THE DEPARTMENT

- The department is blessed to have specialized faculty in various fields of Physical Sciences *viz.* Chemistry, Physics, Mathematics.
- The Department keeps its students abreast of latest advancements in technology through ultra-modern computer facilities, e-learning, virtual labs, SWAYAM Courses as per UGC guidelines.
- The department updates curricula on a regular basis to ensure that 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, TIFR etc.
- 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, Ultrasonic interferometer, Ballistic Galvanometer **,** Deflection and vibration Magnetometer **,** Electron spin resonance, Turbiditimeter, Abbs Refractrometer, Digital weighing balance/ Spring balance, Magnetic plate with stirrer, pH meter, Conductometer, Flame Photometer, colorimeter and a double distillation plant etc.
- Students and teachers participation in International, National, State and Regional seminars and conferences. Along with Industry aligned academia, expert interaction, is the key features of the department.
- Curricular and the co-curricular activities are well balanced in the Teaching Learning environment to provide holistic education to the students.
- 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(Non Medical)

B.Sc (Non medical) is a three year undergraduate programme. This course is fundamentally based on the basic principles of scientific studies namely Mathematics, Physics, Chemistry for the synthesis, analysis and instrumentation. Knowledge of these basic subjects is essential for thorough understanding of the concepts and applications of Physics, Chemistry and Mathematics which will help students to understand the fundamentals laws of nature which are essential in understanding the principles of the technology.

Vision

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

Mission:

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

Eligibility Criteria

10+2 with Physics, Chemistry & Mathematics with 50% marks (45% marks in case of **SC**/ST candidates) in aggregate or equivalent grade.

Duration: 3 years

Career pathways

Areas that offer jobs for B.Sc. degree holder are: -Education, College, Universities, Healthcare providers, Hospitals, Research firms, Environmental management and conservation, forest services, chemical Industry, Biotechnology, Pharmaceutical companies, Geological Survey Department, Wastewater plants, Testing laboratories, Engineering firms, Oil Companies, Medical Laboratories, Food Institutes, Petroleum Companies, Power generating companies, Agricultural Research, Forensic Crime Research, Indian Civil Services etc.

- **Government Jobs**

  In the government sector, the top job posts for B.Sc. Non-medical students include Food inspectors, Government lab technicians, Clinical research, etc.

- **Corporate jobs**

  Multiple pathways designed according to the level of the students to prepare them for different job profiles as per needs of industrial sector.

- **Higher studies**

  After B.Sc(non medical) student can do B.Ed ,M.Sc, M.phill and PHD

- **Entrepreneurship**

  To set up new ventures

Programme Educational Objective (PEO)

PEO1. To impart quality education in basic physical sciences to achieve excellence in teaching-learning and Graduates will pursue higher studies in related fields.

PEO2. To provide hand on training which enable graduates to get employed in private/government institutions.

PEO3 . To construct a bridge between the theoretical and practical aspects of Physical Sciences & inculcate entrepreneur skills.

PEO4. To equip the learners to apply knowledge of Physical Sciences and to analyze the local and global impact of chemistry on individuals, organizations, and society.

PEO5. To develop employable skills and life time leaning .

Programme Outcomes (PO)

PO1. Disciplinary Knowledge: Students will be able to understand specialised areas and explain major concepts in the Physical sciences and its applications.

PO2: Critical Thinking: Critical thinking as an attribute enables a student to identify, formulate and analyze a complex variety of problems in Physical Sciences (Physics, Chemistry & Mathematics).

PO3: Problem Solving: The student will be well-equipped to solve complex problems of numericals related to Physics/ Chemistry & Mathematics that are best approached with critical thinking.

PO4: Practical skills: Student will be able to demonstrate the ability to read, understand, and critically review scientific information.

PO5: Modern Tool Usage: Increasing the usage of appropriate techniques, resources having interface with computers and use of computers in laboratory work creates this attribute.

PO6: Multicultural Competence: Development of a set of competencies in order to enhance and promote the growth of multicultural sensitivity with in universities to assess societal, health, safety, legal and cultural issues. Integrating multicultural awareness such as race, gender, physical ability, age, income and other social variables and by creating an environment that is, " welcoming for all students"

PO7: Environment & Sustainability: Understand the impact of the scientific solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Research related skills & Ethics: Students will be able to motivate and communicate scientific knowledge in oral and written form accurately using a range of formats.

PO9: Self-directed Learning: Students are encouraged to accept challenges in Physical Sciences by information available to them. Various activities/advanced ideas equip the students to find relevant information and educate themselves.

PO10: Individual and Team Work: Leadership is essential in making teamwork into a reality. Working in teams promotes both teamwork and leadership qualities in the student. Teams may comprise of peers in classroom, laboratory or any other team of members from diverse fields. The student is capable of contributing meaningfully to team ethos and goals.

PO11: Communication Skills: Effective communication is a much desirable attribute across courses. However, a Chemistry student is expected to assimilate technical information about chemistry from various sources and convey it to intended audience, both orally and in writing in an intelligible manner.

PO12: Life long Learning: Having a strong conceptual framework in the subject along with the skills of teamwork, analytical reasoning, problem solving, critical thinking etc. make the students lifelong learners.

Programme Specific Outcomes (PSO)

PSO1. •Acquire knowledge and understanding of essential facts, concepts, principles and theories of physics, chemistry and Mathematics
PSO2. •Develop Skills to evaluate, analyse and interpret information and data.
PSO3 • Solve problems competently by identifying the essential parts of a problem and formulating a strategy for solving the problem.
PSO4 • Use standard laboratory equipments, modern instrumentation and classical techniques to carry out experiments and develop skills to interpret and explain the limits of accuracy of experimental data in terms of significance and underlying theory.
PSO5 • Think creatively (divergently and convergent) to propose novel ideas in explaining facts and figures or providing new solution to the problems.

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(non medical) degree programme will have a curriculum with Syllabi consisting of following type of courses:

I. Ability Enhancement Courses (AEC): The Ability Enhancement Courses (AEC) may be of two kinds: Ability Enhancement Compulsory Courses (AECC) and Skill Enhancement Courses (SEC). AECC courses are the courses based upon the content that leads to Knowledge enhancement; these are mandatory for all disciplines. SEC courses are value-based and/or skill-based and are aimed at providing hands-on-training, competencies, skills, etc. A. Ability Enhancement Compulsory Courses (AECC): Environmental Science, English Communication/MIL Communication. B. Skill Enhancement Courses (SEC): These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based knowledge.

II. Core Courses (CR): A course, which should compulsorily 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/ analysing/exploring a real life situation/ difficult problem.

III. Elective Courses: Elective course is generally a course, which can be chosen from a pool of courses, and which may be very specific, specialized, 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. Accordingly, elective course may be categorizes as: A. Discipline Specific Elective (DSE) Course: Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective.

2. NOMENCLATURE USED:

A. Graduate Core Courses

i. core course (CR)
ii. Theory subject (T)
iii. Practical (P)

B. Ability Enhancement Courses (AEC):

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

C. Elective Courses (EL)

i. Discipline Specific Elective (DSE)

Scheme for B.Sc. –Non Medical (CBCS)

Semester 1

I. Theory Subjects

S No.	Course Type	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	CR	PHY 101	Mechanics	4:0:0	4:0:0	4	4
2	CR	CHM 101	Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons	4:0:0	4:0:0	4	4
3	CR	MAT 101	Calculus and Matrices	5:1:0	5:1:0	6	6
4	AEC	ENG 101	General English-I	3:0:0	3:0:0	3	3
5	AEC	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	CR	PHY103	Mechanics(Practical)	0:0:4	0:0:2	4	2
2	CR	CHM 103	Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons (Practical)	0:0:4	0:0:2	4	2
			Total			**30**	**24**

Total Contact Hours: 30

Total Credit Hours: 24

CR- Core Course

AEC-Ability Enhancement Compulsory Courses

Scheme for B.Sc. –Non Medical (CBCS)

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	PHY 102	Electricity and Magnetism	4:0:0	4:0:0	4	4
2	CR	CHM 102	Chemical Energetics, Equilibria & Functional Groups Organic Chemistry-I	4:0:0	4:0:0	4	4
3	CR	MAT 102	Differential Equations	5:1:0	5:1:0	6	6
4	AEC	ENG 102	General English-II	3:0:0	3:0:0	3	3
5	AEC	PBI 102/ HCP 102	General Punjabi-II/HCP	3:0:0	3:0:0	3	3
6			NCC/NSS/NSO	2:0:0	Non-credit	2	NC
1	CR	PHY 104	Electricity and Magnetism (Practical)	0:0:4	0:0:2	4	2
2	CR	CHM 104	Chemical Energetics, Equilibrium & Functional Group Organic Chemistry-I (Practical)	0:0:4	0:0:2	4	2
		Total				**30**	**24**

Total Contact Hours: 30

Total Credit Hours: 24

CR- Core Course

AECC-Ability Enhancement Compulsory Courses

Scheme for B.Sc. –Non Medical (CBCS)
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	PHY 201	Thermal Physics and Statistical Mechanics	4:0:0	4:0:0	4	4
2	CR	CHM 201	Solutions, Phase equilibrium, Conductance, Electrochemistry& Functional Group Organic Chemistry-II	4:0:0	4:0:0	4	4
3	CR	MAT 201	Real Analysis	5:1:0	5:1:0	6	6
4	CR	EVS 201	EVS	3:0:0	3:0:0	3	3
5	SEC-1		Elective subject(Skill Enhancement Course)-I	2:0:0	2:0:0	2	2
1	CR	PHY 203	Thermal Physics and Statistical Mechanics(Practical)	0:0:4	0:0:2	4	2
2	CR	CHM 203	Solutions, Phase equilibrium, Conductance, Electrochemistry & Functional Group Organic Chemistry-II (Practical)	0:0:4	0:0:2	4	2
						27	**23**

Total Contact Hours: 27

Total Credit Hours: 23

CR- Core Course

AEC-Ability Enhancement Compulsory Course
SEC-Skill Enhancement course

Scheme for B.Sc. –Non Medical (CBCS)

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	PHY 202	Waves and Optics	4:0:0	4:0:0	4	4
2	CR	CHM 202	Transition Metal & Coordination Chemistry, States of Matter & Chemical Kinetics	4:0:0	4:0:0	4	4
3	CR	MAT 202	Algebra	5:1:0	5:1:0	6	6
4	AEC	SSC001	Gender Equity	**3:0:0**	3:0:0	3	3
5	SEC-II		Elective subject(Skill Enhancement Course)-II	2:0:0	2:0:0	2	2
1	CR	PHY 204	Waves and Optics (Practical)	0:0:4	0:0:2	4	2
2	CR	CHM 204	Transition Metal & Coordination Chemistry, States of Matter & Chemical Kinetics (Practical)	0:0:4	0:0:2	4	2
Total						**27**	**23**

Total Contact Hours: 27

Total Credit Hours: 23

CR- Core Course

AEC-Ability Enhancement Compulsory Course

SEC-Skill Enhancement Course

Scheme for B.Sc. –Non Medical (CBCS)
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	PHY	Elective Subject(Discipline)-I	4:0:0	4:0:0	4	4
2	CR	CHM	Elective Subject(Discipline)-I	4:0:0	4:0:0	4	4
3	CR	MAT	Elective Subject(Discipline))-I	5:1:0	5:1:0	6	6
4	AEC	SSC006	Human values and professional ethics	3:0:0	3:0:0	3	3
5	SEC-II		Elective subject(Skill Enhancement Course)-III	2:0:0	2:0:0	2	2
1	CR	PHY	Elective Subject(Discipline) Lab-I	0:0:4	0:0:2	4	2
2	CR	CHM	Elective Subject(Discipline)Lab-I	0:0:4	0:0:2	4	2
			Total			**27**	**23**

Total Contact Hours: 27

Total Credit Hours: 23

DSE-Discipline Specific Elective

SEC-Skill Enhancement Course

Scheme for B.Sc. –Non Medical (CBCS)
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	DSE-IB	PHY	Elective Subject(Discipline)-II	4:0:0	4:0:0	4	4
2	DSE-IIB	CHM	Elective Subject(Discipline)-II	4:0:0	4:0:0	4	4
3	DSE-IIIB	MAT	Elective Subject(Discipline)-II	5:1:0	5:1:0	6	6
4	AEC	ENG004	Communication Skills and Personality Development	3:0:0	3:0:0	3	3
5	SEC-IV		Elective subject(Skill Enhancement Course)-IV	2:0:0	2:0:0	2	2
1	DSE-IA Lab	PHY	Elective Subject(Discipline) lab-II	0:0:4	0:0:2	4	2
2	DSE-IIB Lab	CHM	Elective Subject(Discipline) lab-II	0:0:4	0:0:2	4	2
						27	**23**

Total Contact Hours: 27

Total Credit Hours: 23

DSE-Discipline Specific Elective

SEC-Skill Enhancement Course

- **Practical training of 72 hours (Non credit based) have been included in course curriculum of B.Sc Non Medical: : Students have to complete their practical training in 3 year degree tenure and have to be evaluated on the basis of final submission of report and presentation before the Departmental Committee .**

Summarized report of Course Scheme for B.Sc Non Medical									
Sem	**L**	**T**	**P**	**Contact hrs/wk**	**Credits hrs/wk**	**CR**	**AEC**	**SEC**	**DSE**
1	**22**	**0**	**4**	**30**	**24**	**18**	**6**		
2	**22**	**0**	**4**	**30**	**24**	**18**	**6**		
3	**19**	**0**	**4**	**27**	**23**	**18**	**3**	**2**	
4	**19**	**0**	**4**	**27**	**23**	**18**	**3**	**2**	
5	**19**	**0**	**4**	**27**	**23**		**3**	**2**	**18**
6	**19**	**0**	**4**	**27**	**23**		**3**	**2**	**18**
Total	**120**	**0**	**24**	**168**	**140**	**72**	**24**	**8**	**36**

- **Practical training of 72 hours (Non credit based) have been included in course curriculum of B.Sc Non Medical: : Students have to complete their practical training in 3 year degree tenure and have to be evaluated on the basis of final submission of report and presentation before the Departmental Committee .**

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Skill enhancement courses (semester-III to VI)				
31.	Basic Analytical chemistry	**CHM 209**	**III**	**67-68**
32.	Green Methods in Chemistry	**CHM 210**	**IV**	**69-70**
33.	Fuel Chemistry	**CHM 313**	**V**	**71-72**
34.	Pharmaceutical Chemistry	**CHM 318**	**VI**	**73-74**
Discipline Subject Elective courses (semester-V,VI) Any two of each subject in both semesters				
35.	Molecules of Life	**CHM301**	**V**	**76-77**
36.	Molecules of Life (Practical)	**CHM303**	**V**	**78**
37.	Organometallic, Bioinorganic Chemistry, Polynuclear Hydrocarbons and UV, IR Spectroscopy	**CHM 305**	**V**	**79-80**
38.	Organometallic, Bioinorganic Chemistry, Polynuclear Hydrocarbons and UV, IR Spectroscopy (Practical)	**CHM 307**	**V**	**81-82**
39.	Industrial chemicals and Environment	**CHM 309**	**V**	**83-84**
40.	Industrial chemicals and Environment (Practical)	**CHM 311**	**V**	**85**
41.	Chemistry of main group elements, theories of acids and bases	**CHM 306**	**VI**	**86-87**
42.	Chemistry of main group elements, theories of acids and bases (Practical)	**CHM 308**	**VI**	**88**
43.	Green Chemistry	**CHM 310**	**VI**	**89-90**
44.	Green chemistry (Practical)	**CHM 312**	**VI**	**91-92**
45.	Analytical method in chemistry	**CHM 314**	**VI**	**93-94**
46.	Analytical method in chemistry (Practical)	**CHM 316**	**VI**	**95-96**
	Mathematics Courses			
	Core Courses (semester-I to IV)			
47.	Calculus and Matrices	MAT101	I	**98**
48.	Differential Equations	MAT102	II	**99**
49.	Real Analysis	MAT201	III	**100**
50.	Algebra	MAT202	IV	**101**
Skill enhancement courses (semester-III to VI)				
51.	Logic and Graph theory	MAT207	**III**	**103**
52.	Number theory	MAT208	**IV**	**104**
53.	Vector Calculus	MAT305	**V**	**105**
54.	Probability and Statistics	MAT310	**VI**	**106**
Discipline Subject Elective courses (semester-V,VI) Any one of each subject in both semesters				
55.	Numerical Method	MAT301	**V**	**108**
56.	Linear Algebra	MAT303	**V**	**109**

57.	Theory of Equations	MAT307	**V**	**110**
58.	Integral Calculus/	MAT302	**VI**	**111**
59.	Complex Analysis	MAT306	**VI**	**112**
60.	Introduction to Operation Research	MAT308	**VI**	**113**
AEC-Ability Enhancement Compulsory Courses				
61.	General English-I	ENG 101	**I**	**115**
62.	General Punjabi-I/HCP-I	PBI 101/ HCP 101	**I**	**116/117**
63.	General English-II	ENG 102	**II**	**118-119**
64.	General Punjabi-II/HCP	PBI 102/ HCP 102	**II**	**120-121/122**
65.	Environmental science	EVS201	**III**	**123-124**
66.	Gender Equity	SSC001	**IV**	**125**
67.	Human values and professional ethics	SSC006	**V**	**126-127**
68.	Communication Skills and Personality Development	ENG004	**VI**	**128**
69.	Practical Training		**III-VI**	**129**

SCHEME & SYLLABUS of
PHYSICS
for
B.Sc. Non Medical

SEMESTER I

Course Code	**PHY101**
Course Title	**Mechanics**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	10+2 with Physics as core subject
Course Objective(CO)	The aim of the subject is to enhance the knowledge of students in mechanics.
Course outcome	**Student will able to:** CO1 Explain the concept of Co–ordinate systems and frame of reference. CO2 Understand the concept of central force & Central Force Motion. CO3 Illustrate the concept of rotational dynamics, elasticity & relativity.

Syllabus

Unit -I

Co–ordinate systems and Frame of references : Cartesian and spherical polar co–ordinate systems, area, volume, velocity and Acceleration in these systems; frame of reference, Galilean transformation, Galilean Invariance of space & time intervals; Newton's laws of motion; law of conservation of linear momentum & energy; Inertial and non-inertial frames and fictitious forces; Uniformly rotating frame; Laws of physics in rotating coordinate systems; Centrifugal force; Coriolis force and its applications.

UNIT-2

Central forces and Central Force Motion: Conservative and non-conservative forces; Potential Energy; Force as gradient of potential energy; Newton's Law of Gravitation, two body problem and concept of reduced mass; Motion of a body under central force; Differential equation of orbit; Kepler's laws and their derivation; Satellite in circular orbit and applications; Geosynchronous orbits; Weightlessness; Basic idea of global positioning system, Motion of rockets.

UNIT-3

Rotational dynamics and Elasticity: Angular momentum of a particle and system of particles, Principle of conservation of angular momentum, Rotation about a fixed axis, Torque, Moment of Inertia, Calculation of moment of inertia for rectangular, cylindrical and spherical bodies. **Elasticity:** Hooke's law, Stress-strain diagram, 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, Torsional pendulum, Determination of Rigidity modulus and moment of inertia, q, η and σ by Searles method.

Unit-IV

Special Theory of Relativity: Michelson-Morley experiment and its outcome, Postulates of special theory of relativity, Lorentz transformations, Simultaneity and order of events, Length contraction, Time dilation and its experimental verification, Relativistic transformation of velocity, Relativistic addition of velocities, Variation of mass with velocity, Mass-energy

equivalence, Relativistic Doppler Effect, Relativistic kinematics, Transformation of energy and momentum.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Mechanics Berkeley Physics course	Charles Kittel, et. Al.	2007, Tata McGrawHill
2	Engineering Mechanics	Basudeb Bhattacharya	2nd edn., 2015, Oxford University Press
3	An introduction to mechanics	D. Kleppner, R.J. Kolenkow	New Delhi: McGrawHill, 1973.
4	Analytical Mechanics	G.R. Fowles and G.L. Cassiday	New Delhi: Cengage Learning, 2005.
5	Introduction to Special Relativity	R. Resnick	John Wiley and Sons, 2005

Course Code	**PHY103**
Course Title	**Mechanics**
Type of course	Practical
L T P	0 0 4
Credits	2
Course prerequisite	10+2 physics with a 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 in mechanics.
Course outcome	**Student will able to:** CO1.Determine length, height, moment of inertia, young's modulus, modulus of rigidity, elastic constants of various system by using different apparatus. CO2.Verify the Newton's 2nd law . CO3.Demonstrate the experimental techniques for different pendulums.

*** Note:** Students has to perform any of the 12-14 experiments from the given list**.**

1. To determine the Moment of Inertia of a Flywheel.
2. To find torque of a flywheel.
3. To determine the angular acceleration of flywheel.
4. To find the acceleration and distance of the cart in the given interval of time (Newton's 2nd law).
5. To find the Time of flight, Horizontal range and maximum height of a projectile for different velocity, angle of projection, cannon height and environment.
6. To determine g by Kater's Pendulum.
7. To determine g and velocity for a freely falling body using Digital Timing Technique.
8. To find the radius of gyration of objects of different geometrical shapes but of same mass by noting the time period of oscillation.
9. To determine g by Bar Pendulum.
10. To understand the torsional oscillation of pendulum in different liquid and determine the rigidity modulus of the suspension wire using torsion pendulum.
11. To study the Motion of a spring and calculate (a) Spring Constant (b) Value of g.
12. To determine the Elastic Constants of a Wire by Searle's method.
13. To determine the Young's Modulus of a Wire by Optical Lever Method.
14. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
15. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.
16. To determine the Height of a Building using a Sextant.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Practical Physics	C. L. Arora	S. Chand
2	Advanced Practical Physics for students	B.L.Flint and H.T.Worsnop	1971, Asia Publishing House

3	Engineering Practical Physics	S.Panigrahi & B.Mallick	Cengage Learning India Pvt. Ltd. 2015
4.	A Text Book of Practical Physics	Indu Prakash and Ramakrishna	11th Edition, 2011, Kitab Mahal, New Delhi.
5.	Advanced level Physics Practicals	Michael Nelson and Jon M. Ogborn,	4th Edition, reprinted 1985, Heinemann Educational Publishers.

SEMESTER

II

Course Code	**PHY102**
Course Title	**Electricity and Magnetism**
Type of course	Core
L T P	4 0 0
Credits	4
Course prerequisite	10+2 with physics as core subject.
Course Objective (CO)	The aim of the subject is to enhance the knowledge of students in Electricity and Magnetism.
Course outcome	**Student will able to:** CO1 understand the vector calculus and vector algebra and its applications in electricity and magnetism. CO2 Learn how to analyze various problems in electrostatics & magnetostatics with mathematical methods. CO2 analyze various problems in electromagnetism with mathematical methods and able to solve Maxwell equations.

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.

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

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

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.

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	Electricity and Magnetism	Edward M. Purcell	1986, McGraw-Hill Education
6	Electricity and Magnetism	J.H. Fewkes & J. Yarwood	Vol. I, 1991, Oxford Univ. Press.
7	Electricity and Magnetism	D C Tayal	1988, Himalaya Publishing House.

Course Code	**PHY104**
Course Title	**Electricity and Magnetism**
Type of course	Practical
L T P	0 0 4
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 outcome	**Student will able to:** CO1: Determine resistance, voltages, current, fuses, capacitances, field strength by using multimeter, galvanometer, de-sauty bridge, carey foster bridge &solenoid. CO2: To determine characteristic, resonant frequency& quality factor of RC, LCR (series, parallel) circuits. CO3: To determine magnetism by using different apparatus.

*** Note:** Students has to perform any of the 12-14 experiments from the given list.

1. To use a Multimeter for measuring (a) Resistances,(b) AC and DC Voltages (c) DC Current (d) Checking electrical fuses.
2. Measurement of charge and current sensitivity.
3. Measurement of CDR.
4. Determine a high resistance by Leakage Method.
5. To determine the reduction factor of the given tangent galvanometer (*K*).
6. To find out the horizontal component of earth's magnetic field (B_h).
7. To compare capacitances using De'Sauty's bridge.
8. To determine a Low Resistance by Carey Foster's Bridge.
9. To find the temperature coefficient of resistance of a given coil.
10. To determine Self Inductance of a Coil by Rayleigh's Method.
11. To determine the self inductance of the coil (L) using Anderson's bridge.
12. To calculate the value of inductive reactance (X_L) of the coil at a particular frequency.
13. To study the Characteristics of a Series RC Circuit.
14. To study the series LCR circuit and determine its: (a) Resonant frequency, (b) Impedance at resonance (c) Quality factor Q (d) Band width
15. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q
16. To study the variation of magnetic field with distance along the axis of a circular coil carrying current.
17. To determine the volume magnetic susceptibility of Manganese sulphate solution at different concentrations.
18. To determine the magnetic dipole moment (*m*) of a bar magnet and horizontal intensity (B_H) of earth's magnetic field using a deflection magnetometer.

19. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx)

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S. No	Name	Author(S)	Publisher
1	Practical Physics	C. L. Arora	S. Chand
2	Advanced Practical Physics for students	B.L.Flint & H.T.Worsnop	1971, Asia Publishing House.
3	A Text Book of Practical Physics	Indu Prakash and Ramakrishna	11th Edition, 2011, Kitab Mahal, New Delhi.
4	Engineering Practical Physics	S.Panigrahi & B.Mallick	2015, Cengage Learning India Pvt. Ltd.
5	Advanced level Physics Practicals	Michael Nelson and Jon M. Ogborn	4th Edition, reprinted 1985, Heinemann Educational Publishers

SEMESTER III

Course Code	**PHY201**
Course Title	**Thermal physics and statistical mechanics**
Type of course	Theory
L T P	4:0:0
Credits	4
Course prerequisite	BSc. Ist 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.
Course outcome	**Student will able to:** CO1: Have a basic knowledge of the thermodynamically system and potentials. CO2: understand the physics of kinetic theory of gases. CO3: Solve statistical mechanics problems for simple non-interacting systems.

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 equations, Clausius- Clapeyron equation, Expression for (CP – CV), CP/CV, TdS equations, Joule Thomson effect, Use of Joule Thomson effect in liquefaction of gasses, Low temperatures: Production and measurement of very low temperatures, adiabatic demagnetization, Phase transitions of first and second orders, phase diagrams of Helium, Gibbs phase rule and its applications.

Unit-III

Kinetic Theory of Gases: Derivation of Maxwell's law of distribution of velocities and its experimental verification, Mean free path (Zeroth Order), 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, Microstate and Microstate, Entropy and thermodynamic probability distribution of n particles in two compartments, distribution of distinguishable particles in compartments and cells, phase space and its division into cells

,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
5	Thermal Physics	A. Kumar and S.P. Taneja	2014, R. chand Publications.

Course Code	**PHY203**
Course Title	**Thermal physics and statistical mechanics**
Type of course	Practical
L T P	0 0 4
Credits	2
Course prerequisite	BSc. Ist 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 & and statistical mechanics.
Course outcome	**Student will able to:** CO1: To interpret various experiments using Mechanical Equivalent of heat. CO2: To devise various experiments using the concept of Thermal conductivity. CO3: To illustrate various experiments using the theory of probability & expansion of gases.

*** Note:** Students has to perform any of the 12-14 experiments from given list.

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 compare heat transfer between different material surface and the black body surface by radiation.
4. To find the emissivity of different material surface.
5. To determine Stefan's Constant.
6. To determine the coefficient of thermal conductivity of copper by Searle's Apparatus.
7. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
8. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method.
9. To find the co-efficient of thermal conductivity of bad conductor by using Lee's method.
10. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).
11. To study the variation of thermo emf across two junctions of a thermocouple with temperature.
12. To record and analyze the cooling temperature of a hot object as a function of time using a thermocouple and suitable data acquisition system.
13. To verify certain laws of probability.
14. To verify laws of probability by throwing one, two or 10 coins.
15. To determine the co-efficient of increase of volume of air at constant pressure.
16. To determine the co-efficient of increase of pressure of air at constant volume.

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

SEMESTER

IV

Course Code	**PHY202**
Course Title	**Waves and optics**
Type of course	Theory
L T P	4:0:0
Credits	4
Course prerequisite	BSc. Ist 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.
Course outcome	**Student will able to:** CO1: To explain various concepts regarding waves motion & simple harmonic motion. CO2: Understand the concepts of wave optics, different optical instruments. CO3: Analyze the basic difference between interference, diffraction &polarization.

Unit-I

Wave: Types of Waves, Characteristics of Wave Motion, Differential Equation of Wave Motion, Equation of a Progressive Simple Harmonic Waves, Energy in Progressive waves, Velocities of Wave motion – Particle, Wave and Group Velocities, Relation between Particle Velocity and Wave Velocity, Transverse waves on a string, Travelling and standing waves on a string, Normal Modes of a string, Reflection and Transmission of Waves on a string at a Boundary, Reflection and Transmission Coefficients – Amplitude and Energy, Stationary Waves and Waves on a string of fixed length, Nodes and Anti-nodes, Energy of a Vibrating String.

Unit-II

Simple harmonic motion: Hooke's law, Simple harmonic motion, Equation of Simple harmonic motion, Frequency, Amplitude, Displacement, Velocity, Acceleration, and phase difference of SHM, Energy of a simple harmonic oscillator, Compound pendulum, Torsional pendulum, Simple harmonic oscillations in electrical system, Principle of Superposition Harmonic Oscillations, Superposition of Two Harmonic Motions of Same Frequency, Beats, Lissajous Figures and its applications, Anharmonic Oscillations.

Sound**:** 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

Optics: Electromagnetic nature of light, Definition and Properties of wave front, Huygens Principle, Interference: Interference: Division of amplitude and division of wave front, 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), Determination of wavelength, Wavelength difference, Refractive index and Visibility of fringes.

Unit-IV

Diffraction and Polarisation: Fraunhofer diffraction: Single slit; double slit. Multiple slits & Diffraction grating. Fresnel Diffraction: Half-period zones. Zone plate, Fresnel Diffraction pattern of a straight edge, a slit and a wire using half-period zone analysis. Polarization: Transverse nature of light waves. Plane polarized light – production and analysis. Circular and elliptical polarization. Polarization by transmission and reflection, Malus Law, Brewster's Law, Polarization by refraction, Theory of double refraction, Quarter wave and half wave plates, Production and detection of polarized light.

Text and Reference Books

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
3	Fundamentals of Optics	F A Jenkins and H E White	McGraw-Hill
4	Principles of Optics	B.K. Mathur	Gopal Printing

Course Code	**PHY204**
Course Title	**Waves and optics**
Type of course	Practical
L T P	0:0:4
Credits	2
Course prerequisite	BSc. Ist with physics as 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.
Course outcome	**Student will able to:** CO1: infer refractive index, Cauchy constant of prism using Sodium Light, Mercury Light. CO2: Determine the wavelength, grating element, of sodium light, laser light using Fresnel biprism, Resolving Power Plane diffraction grating, Newton's Rings, Michelson interferometer, Diffraction of Single Slit. CO3: Draw the inferences of Brewster's law, specific rotation of cane sugar and motion of coupled oscillators.

*** Note:** Students has to perform any of the 12-14 experiments from given list.

1. To determine the Refractive Index of the Material of a given Prism using Sodium Light.
2. To determine Dispersive Power of the Material of a given Prism using Mercury Light.
3. To determine the value of Cauchy Constants of a material of a prism.
4. To determine the Resolving Power of a Prism.
5. To determine wavelength of sodium light using Fresnel Biprism.
6. To determine wavelength of sodium light using Newton's Rings.
7. To determine the refractive index of a thin glass plate.
8. To determine the wavelength of a laser using the Michelson interferometer.
9. To determine the wavelength of Laser light using Diffraction of Single Slit.
10. To determine the grating element of Laser light using Diffraction of Single Slit.
11. To determine the Resolving Power of a Plane Diffraction Grating.
12. To verify the Brewster's law and to find the Brewster's angle.
13. To measure the specific rotation of cane sugar using Polarimeter.
14. To investigate the motion of coupled oscillators.
15. To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's Experiment and to verify $\lambda 2$ – T Law.
16. To study Lissajous Figur

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

SKILL ENHANCEMENT COURSES

(Physics)

Course Code	**PHY205**
Course Title	**Physics workshop skill**
Type of course	Skill enhancement
L T P	2:0:0
Credits	2
Course prerequisite	BSc. Ist , IInd year with Physics as core subject
Course Objective (CO)	The aim of this course is to enable the students to familiar and experience with various mechanical and electrical tools through hands-on mode.
Course outcome	**Student will able to:** CO1: Explain the working of vernier calliper, screw gauge, sextant in measuring length, height, thickness, diameter etc. CO2: Understand the physics of various workshops (casting, foundry, welding etc) & their use in electrical circuits. CO3: Infer the concepts of gear system, levers, pulleys.

UNIT I

Measuring units: Conversion to SI and CGS. Familiarization with meter scale, Vernier calliper, Screw gauge and their utility. Measure the dimension of a solid block, volume of cylindrical beaker/glass, diameter of a thin wire, thickness of metal sheet, etc. Use of Sextant to measure height of buildings, mountains, etc.

UNIT II

Concept of workshop practice: Overview of manufacturing methods: casting, foundry, machining, forming and welding. Types of welding joints and welding defects, Common materials used for manufacturing like steel, copper, iron, metal sheets, composites and alloy, wood. Concept of machine processing, introduction to common machine tools like lathe, shaper, drilling, milling and surface machines.

UNIT III

Electrical and Electronic Skill: Use of Multimeter. Soldering of electrical circuits having discrete components (R, L, C, and diode) and ICs on PCB. Operation of oscilloscope. Making regulated power supply. Timer circuit, Electronic switch using transistor and relay.

UNIT IV

Introduction to prime movers: Mechanism, gear system, wheel, Fixing of gears with motor axel. Lever mechanism, lifting of heavy weight using lever. Braking systems, pulleys.

Text and Reference Books

S. No	**Name**	**Author(S)**	**Publisher**
1	A text book in electrical technology	B l theraja	S. Chand and company
2	Performance and design of ac machines	M.g. say	Elbs edn
3	Mechanical workshop practice	K.c. john, 2010	Phi learning pvt. Ltd.
4.	Workshop processes, practices and materials	Bruce j black 2005,	3rd edn., editor newnes
5.	New Engineering Technology	Lawrence Smyth/Liam Hennessy,	The Educational Company of Ireland

Course Code	**PHY206**
Course Title	Electrical circuits and network skills
Type of course	Skill enhancement
L T P	2:0:0
Credits	2
Course prerequisite	BSc. Ist , IInd year with Physics as core subject
Course Objective (CO)	The aim of this course is to enable the students to design and trouble shoots the electrical circuits, networks and appliances through hands-on mode.
Course outcome	**Student will able to:** CO1: Acquire the basic knowledge of role of electricity in electrical circuits. CO2: Understand the physics regarding electrical designs, symbols and electric motors. CO3: Interpret the different types of electrical wiring & electrical protection devices.

UNIT I

Basic Electricity Principles: Voltage, Current, Resistance, and Power, Ohm's law, Series, parallel, and series-parallel combinations. AC Electricity and DC Electricity Familiarization with multimeter, voltmeter and ammeter. Understanding electrical circuits: Main electric circuit and their combination Rules to analyze DC sourced electrical circuits. Current and voltage drop across the DC circuit elements. Single-phase and three-phase alternating current sources. Rules to analyze AC sourced electrical circuits. Real, imaginary and complex power components of AC source. Power factor. Saving energy and money.

UNIT II

Electrical Drawing and Symbols: Drawing symbols, Electrical Schematics. Power circuits. Control circuits. Reading of circuit schematics. Generators and Transformers: DC Power sources. AC/DC generators. Inductance, capacitance, and impedance. Operation of transformers.

UNIT III

Electric Motors: Single-phase, three-phase & DC motors, Basic design. DC or AC sources to control heaters & motors. Solid state devices: Inductors, capacitors, diode, resistor Components. In series or in shunt. Response of inductors and capacitors with DC or AC source.

UNIT-IV

Electrical Wiring: Different types of conductors and cables. Basics of wiring-Star and delta connection. Voltage drop and losses across cables and conductors. Instruments to measure current, voltage, power in DC and AC circuits. Insulation. Solid and stranded cable. Conduit. Cable trays. Splices: wirenuts, crimps, terminal blocks, split bolts, and solder.

Text and Reference Books

S. NO	**NAME**	**AUTHOR(S)**	**PUBLISHER**
1.	A text book in electrical technology	B l theraja	S chand & co.
2.	A text book of electrical technology	A k theraja	S chand & co.
3.	Performance and design of AC machines	M G Say	ELBS Edn.

Course Code	**PHY309**
Course Title	**Renewable and Energy Harvesting**
Type of course	Skill enhancement
L T P	2:0:0
Credits	2
Course prerequisite	BSc. Ist , IInd year with Physics as core subject
Course Objective (CO)	The aim of this course is to enhance knowledge of students about Renewable sources and Energy Harvesting.
Course outcome	**Student will able to:** CO1: Explain renewable sources and fundamentals of energy harvesting. CO2 Understand the physics of geothermal energy, thermal & hydro energy. CO3 Classify different tools for energy harvesting.

UNIT I

Fossil fuels and Alternate Sources of energy: Fossil fuels and Nuclear Energy, their limitation, need of renewable energy, non-conventional energy sources. Tidal Energy, Wave energy systems, Ocean, Solar energy, biomass, biochemical conversion, biogas generation, tidal energy, Hydroelectricity.

UNIT II

Wind Energy harvesting: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Ocean Energy: Ocean Energy Potential against Wind and Solar, Ocean Thermal Energy.

UNIT II

Geothermal Energy: Thermal Energy Conversion, Geothermal Resources, Geothermal Technologies. Hydro Energy: Hydropower resources, hydropower technologies, environmental impact of hydro power sources. Piezoelectric Energy harvesting: Introduction: piezoelectrics and Piezoelectricity.

UNIT IV

Electromagnetic Energy Harvesting: Linear generators, physics mathematical models, recent application carbon captured technologies, cell, batteries, power consumption Environmental issues and Renewable sources of energy, sustainability.

Text and Reference Books:

S. No	**Name**	**Author(S)**	**Publisher**
1	Non-conventional energy sources	G.D Rai	Khanna Publishers, New Delhi
2	Solar energy	M P Agarwal	S Chand and Co. Ltd.
3	Solar energy	Suhas P Sukhative	Tata McGraw - Hill Publishing Company Ltd
4	"Renewable Energy, Power for a sustainable future"	Godfrey Boyle,	Oxford University Press, in association with The Open University.
5	Photovoltaic	J.Balfour, M.Shaw and S. Jarosek	Lawrence J Goodrich (USA).

Course Code	**PHY314**
Course Title	**Radiology and Safety**
Type of course	Skill enhancement course
L T P	2:0:0
Credits	2
Course prerequisite	BSc. Ist , IInd year with Physics as core subject
Course Objective (CO)	The aim of this course is to enable the students to enhance their knowledge of radiation physics & their safety procedure.
Course outcome	**Student will able to:** CO1: Explain the basics of atomic & nuclear physics. CO2: Understand about different types of radiation, its detection and measuring instruments. CO3: Classify the radiation safety measures.

Unit-I

Basics of Atomic and Nuclear Physics: Basic concept of atomic structure; X rays characteristic and production; concept of bremsstrahlung and auger electron, The composition of nucleus and its properties, mass number, isotopes of element, spin, binding energy, stable and unstable isotopes, law of radioactive decay, basic concept of alpha, beta and gamma decay, concept of cross section and kinematics of nuclear reactions, types of nuclear reaction, Fusion, fission.

Unit-II

Interaction of Radiation with matter: Types of Radiation: Alpha, Beta, Gamma and Neutron and their sources, sealed and unsealed sources, Interaction of Photons - Photoelectric effect, Compton Scattering, Pair Production, Beta Particles- Collision and Radiation loss (Bremsstrahlung), Interaction of Neutrons- Collision, slowing down and Moderation.

Unit-III

Radiation safety management: Biological effects of ionizing radiation, Operational limits and basics of radiation hazards evaluation and control: radiation protection standards, International Commission on Radiological Protection (ICRP) principles, justification, optimization, and limitation, introduction of safety and risk management of radiation. Nuclear waste and disposal management.

Unit-V

Application of nuclear techniques: Application in medical science (e.g., MRI, PET, Mining and oil. Industrial Uses: Tracing, Gauging, Material Modification, Sterization, Food preservation.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Fundamental Physics of Radiology	W.J. Meredith and J.B. Massey	John Wright and Sons, UK, 1989.
2	"Fundamentals of Radiation Dosimetry"	J.R. Greening	Medical Physics Hand Book Series, No.6, Adam Hilger Ltd., Bristol 1981..
3	Practical Applications of Radioactivity and Nuclear Radiations,	G.C. Lowental and P.L. Airey	Cambridge University Press, U.K., 2001
4	"Medical Radiation Physics"	W.R. Hendee	Year Book – Medical Publishers Inc. London, 1981
5	An Introduction to Radiation Protection,	A. Martin and S.A. Harbisor	John Willey & Sons, Inc. New York, 1981.

Discipline Elective Courses
(SEM V, VI)
(Any two of each subject in both semesters)

SEMESTER-V

Course Code	**PHY301**
Course Title	**Digital and analog circuits and instrumentation**
Type of course	Discipline elective(theory)
L T P	4:0:0
Credits	4
Course prerequisite	BSc. Ist , IInd year with Physics as core subject
Course Objective (CO)	The aim of this course is to impart knowledge to the students about digital electronics and analog circuits and instrumentations.
Course outcome	**Student will able to:** CO1: gain knowledge about the concepts of digital circuits. CO2: understand the physics of semiconductor devices and amplifiers including OPAMPS. CO3 Infer the working of different electrical-electronic instruments.

UNIT-I

Digital Circuits: Difference between Analog and Digital Circuits, Binary Numbers, Decimal to Binary and Binary to Decimal Conversion, AND, OR and NOT Gates (Realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates, XOR and XNOR Gates, De Morgan's Theorems, Boolean Laws. Simplification of Logic Circuit using Boolean algebra, Conversion of a Truth Table into an Equivalent Logic Circuit by Karnaugh Map, Binary Addition, Binary Subtraction using 2's Complement Method. Half Adders and Full Adders and Subtractors, 4-bit binary Adder- Subtractor.

UNIT-II

Semiconductor Devices and Amplifiers: Semiconductor Diodes: p and n type semiconductors, Barrier Formation in PN Junction Diode. Qualitative Idea of Current Flow Mechanism in Forward and Reverse Biased Diode. PN junction and its characteristics, Static and Dynamic Resistance. Principle and structure of (1) LEDs (2) Photodiode (3) Solar Cell. Bipolar Junction transistors: n-p-n and p-n-p Transistors, Characteristics of CB, CE and CC Configurations. Active, Cutoff and Saturation Regions. Current gains α and β, Relations between α and β. Load Line analysis of Transistors. DC Load line and Q-point, Voltage Divider Bias Circuit for CE Amplifier. h-parameter Equivalent Circuit. Analysis of a single-stage CE amplifier using Hybrid Model. Input and Output Impedance. Current, Voltage and Power Gains. Class A, B, and C Amplifiers.

UNIT-III

Operational Amplifiers (Black Box approach) : Characteristics of an Ideal and Practical Op-Amp (IC 741), Open-loop& Closed-loop Gain. CMRR, concept of Virtual ground. Applications of Op-Amps: (1) Inverting and Non-inverting Amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator, (6) Zero Crossing Detector.

UNIT-IV

Instrumentations: Introduction to CRO: Block Diagram of CRO. Applications of CRO: (1) Study of Waveform, (2) Measurement of Voltage, Current, Frequency, and Phase Difference. Power Supply: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers Calculation of Ripple Factor and Rectification Efficiency, Basic idea about capacitor filter, Zener Diode, IC 555 Pin diagram and its application as Astable & Monostable Multivibrator.

Text and Reference Books

S. No	Name	Author(s)	Publisher
1	Integrated electronics	J. Millman and c.c. halkias, 1991	Tata mc-graw hill.
2	Electronic devices and circuits	S. Salivahanan and n. Suresh kumar, 2012,	Tata mc-graw hill.
3	Microelectronic circuits,	M.h. rashid, 2ndedn.,2011	Cengage learning.
4	Modern electronic instrumentation & measurement tech	Helfrick&cooper,1990	Phi learning
5	Digital principles & applications,,	A.p. malvino, d.p. leach & saha, 7th ed.,2011,	Tata mcgraw hill.

Course Code	**PHY303**
Course Title	**Digital and analog circuits and instrumentation**
Type of course	Practical
L T P	0:0:4
Credits	2
Course prerequisite	BSc. Ist , IInd year with Physics as core subject
Course Objective (CO)	The aim of this course is not just to impart practical knowledge to the students about digital electronics and analog circuits and instrumentations.
Course outcome	**Student will able to:** CO1: analyze, design and implement combinational logic circuits. CO2: knowledge of operational working of semiconductor devices. CO3:analyze, design and implement sequential logic circuits.

*** Note:** Students has to perform any of the 12-14 experiments from the given list.

1. To measure (a) Voltage, and (b) Frequency of a periodic waveform using a CRO
2. To test a Diode and Transistor using a Multimeter.
3. To verify and design AND, OR, NOT and XOR gates using NAND gates.
4. To design a combinational logic system for a specified Truth Table.
5. To minimize a given logic circuit.
6. To convert a Boolean expression into logic circuit and design it using logic gate ICs.
7. Half adder, Full adder and 4-bit Binary Adder.
8. Adder-Subtractor using Full Adder I.C.
9. To design an astable multivibrator of given specifications using 555 Timer.
10. To design a monostable multivibrator of given specifications using 555 Timer.
11. To study I-V characteristics of PN diode, Zener and Light emitting diode.
12. To study the V-I characteristics of a Zener diode and its use as voltage regulator.
13. To study (a) Half-wave Rectifier (b) Full-wave Bridge Rectifier and investigate the effect of C, L and π filters.
14. To study the characteristics of a Transistor in CE configuration.
15. To design a CE amplifier of a given gain (mid-gain) using voltage divider bias.
16. To study the characteristics of a Bipolar Junction Transistor in CE, CB and CC configurations.
17. To design a CE transistor amplifier of a given gain (mid-gain) using voltage divider bias.
18. To design an inverting amplifier of given gain using Op-amp 741 and study its frequency response.
19. To design a non-inverting amplifier of given gain using Op-amp 741 and study it's Frequency Response.
20. To study a precision Differential Amplifier of given I/O specification using Op-amp.
21. To investigate the use of an op-amp as a Differentiator
22. To design a Wien Bridge Oscillator using an op-amp.

Text and Reference Books

S. NO	NAME	AUTHOR(S)	PUBLISHER
1	Basic electronics: a text lab manual,	P.b. Zbar, a.p. Malvino, m.a. Miller, 1994,	Tata mc-graw hill.
2	Electronics: fundamentals and applications,	J.d. Ryder, 2004,	Prentice hall..
3	Microelectronic circuits,	M.h. Rashid, 2ndedn.,2011	Cengage learning.
4	Op-amps and linear integrated circuit,	R. A. Gayakwad, 4th edition, 2000,	Prentice hall.
5	Electronic principle	Albert malvino, 2008	Tata mcgraw hill.

Course Code	**PHY305**
Course Title	**Elements of modern physics**
Type of course	Discipline elective(theory)
L T P	4:0:0
Credits	4
Course prerequisite	BSc. Ist , IInd year with Physics as core subject
Course Objective (CO)	The aim of this course is to enhance the knowledge of students about the basic concept of quantum Mechanics and nuclear physics.
Course outcome	**Student will able to:** CO1: Explain the basic concepts of quantum mechanics. CO2: Understand about Schrodinger equations & its application including non-relativistic particles, operators, and energy eigen value and eigen function in 1 dimensional. CO3: Interpret various potential barriers using Schrodinger equations & fundamental concepts of nuclear physics.

UNIT I

Basic concept of Quantum mechanics: Planck's constant and light as a collection of photons; Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson-Germer experiment. Problems with Rutherford model- instability of atoms and observation of discrete atomic spectra; Bohr's quantization rule and atomic stability; calculation of energy levels for hydrogen like atoms and their spectra. Position measurement- gamma ray microscope thought experiment; Wave-particle duality, Heisenberg uncertainty principle- impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle.

Unit II

Matter waves and wave amplitude: Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of wave function, probabilities and normalization; Probability and probability current densities in one dimension, One dimensional infinitely rigid box-energy eigenvalues and eigenfunctions, normalization; Quantum mechanical scattering and tunnelling in one dimension - across a step potential and across a rectangular potential barrier.

Unit III

Atomic nucleus: Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. Nature of nuclear force, NZ graph, semi-empirical mass formula and binding energy. Radioactivity: stability of nucleus; Law of radioactive decay; Mean life & half-life; α decay; β decay - energy released, spectrum and Pauli's prediction of neutrino; γ-ray emission.

UNIT IV

Fission and fusion: mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons. Nuclear reactor: slow neutrons interacting with Uranium 235; Fusion and thermonuclear reactions.

Text and reference books

S. No	Name	Author(s)	Publisher
1	Concepts of modern physics,	Arthur beiser, 2009	Tata mc-graw hill.
2	Six ideas that shaped physics: particle behave like waves	Thomas a. Moore, 2003,,	Tata mc-graw hill.
3	Quantum physics	Berkeley physics course vol.4. E.h. wichman, 2008	Tata mc-graw hill.
4	Introduction to Quantum Mechanics	David J. Griffith	Pearson Education. 28, 2005
5	Quantum Mechanics: Theory & Applications,	A.K.Ghatak & S.Lokanathan	Macmillan, 2004.

Course Code	**PHY307**
Course Title	**Elements of modern physics**
Type of course	Discipline elective(practical)
L T P	0:0:4
Credits	2
Course prerequisite	BSc. Ist , IInd year with Physics as core subject
Course Objective (CO)	The aim of this course is to impart practical knowledge of quantum mechanics.
Course outcome	**Student will able to:** CO1: determine botzmann constant, planck constant, work function of material using electronic devices. CO2: determine ionization potential of mercury, wavelength of H- atom, absorption lines of iodine vapour. CO3: Infer the photo electric effect, charge of electron, e/m value experimentally.

*** Note:** Students has to perform any of the 12 out of 14 experiments from the given list.

1. To determine work function of material of filament of directly heated vacuum diode.
2. To determine the thermionic work function of tungsten
3. To determine value of Boltzmann constant using V-I characteristic of PN diode.
4. To determine value of Planck's constant using LEDs of at least 4 different colours.
5. Measurement of Planck's constant using black body radiation and photo-detector
6. To determine the ionization potential of mercury.
7. To determine the wavelength of H-alpha emission line of Hydrogen atom.
8. To determine the absorption lines in the rotational spectrum of Iodine vapour.
9. To study the diffraction patterns of single and double slits using laser source and measure its intensity variation using Photosensor and compare with incoherent source – Na light.
10. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light.
11. Study of excitations of a given atom by Franck Hertz set up.
12. To determine the value of e/m by magnetic focusing, bar magnet.
13. To setup the Millikan oil drop apparatus and determine the charge of an electron.
14. To determine charge to mass ratio of an electron by Thomson method.

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 , 1971.
2	Advanced level physics practicals	Michael nelson and jon m. Ogborn	Heinemann educational publishers 4th edition, reprinted 1985
3	A text book of practical physics	Indu prakash and ramakrishna,	11th edition, 2011,Kitab mahal, new delhi.

SEMESTER VI

Course Code	**PHY302**
Course Title	**Solid state physics**
Type of course	Discipline elective(theory)
L T P	4:0:0
Credits	4
Course prerequisite	BSc. Ist , IInd year with Physics as core subject
Course Objective	The aim of this subject is to enhance the knowledge of students in the field of solid state physics.
Course Outcome	**Student will able to:** CO1: Explain the detail concepts of crystal structure. CO2: Understand the physics of magnetic properties of matter & dielectric properties of materials. CO3: Illustrate the Kronig model, Hall effect & physics of superconductors.

UNIT I

Crystal Structure: Solids: Amorphous and Crystalline Materials, Lattice Translation Vectors, Lattice with a Basis – Central and Non-Central Elements, Unit Cell, Miller Indices, Reciprocal Lattice, Types of Lattices, Brillouin Zones, Diffraction of X-rays by Crystals, Bragg's Law, Atomic and Geometrical Factor, Elementary Lattice Dynamics: Lattice Vibrations and Phonons, Linear Monoatomic and Diatomic Chains, Acoustical and Optical Phonons, Dulong and Petit's Law, Einstein and Debye theories of specific heat of solids, T^3 law.

UNIT II

Magnetic Properties of Matter: Dia-, Para-, Ferri- and Ferromagnetic Materials, Classical Langevin Theory of dia – and Paramagnetic Domains, Quantum Mechanical Treatment of Paramagnetism, Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains. Discussion of B-H Curve, Hysteresis and Energy Loss.

UNIT III

Dielectric Properties of Materials: Polarization. Local Electric Field at an Atom. Depolarization Field, Electric Susceptibility, Polarizability, Clausius Mosotti Equation, Classical Theory of Electric Polarizability, Normal and Anomalous Dispersion, Cauchy and Sellmeir relations, Langevin-Debye equation, Complex Dielectric Constant, Optical Phenomena, Application: Plasma Oscillations, Plasma Frequency, Plasmons.

UNIT IV

Elementary band theory: Kronig Penny model, Band Gaps, Conductors, Semiconductors and insulators, P and N type Semiconductors, Conductivity of Semiconductors, mobility, Hall Effect, Hall coefficient. Superconductivity: Experimental Results, Critical Temperature, Critical magnetic field, Meissner effect, Type I and type II Superconductors, London's Equation and Penetration Depth, Isotope effect.

Text and reference books

S. No	Name	Author(s)	Publisher
1	Introduction to solid state physics	Charles kittel, 8th ed., 2004,	Wiley india pvt .ltd.
2	Elements of solid state physics	J.p. Srivastava, 2nd ed., 2006,	Prentice-hall of india .
3	Introduction to solids	Leonid v. Azaroff, 2004,	Tata mc-graw hill.
4.	Solid state physics	Neil w. Ashcroft and n. David mermin, 1976,	Cengage
5.	Learning solid state physics	Rita john, 2014	Mcgraw hill

Course Code	**PHY304**
Course Title	**Solid state physics**
Type of course	Discipline elective(Practical)
L T P	0:0:4
Credits	2
Course prerequisite	BSc. Ist , IInd year with Physics as core subject
Course Objective (CO)	The course is to impart practical knowledge to the students about solid state physics.
Course Outcome	**Student will able to:** CO1: Calculate the magnetic susceptibilty, coupling coefficient of crystal. CO2: measure dielectric constant of metals & refractive index of dielectric layer using SPR technique. CO3: Analyze PE, BH curve for magnetic materials, resistivity & Hall coefficient for semiconductor crystal.

*** Note:** Students has to perform any of the 12 out of 14 experiments from the given list.

1. Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method).
2. To measure the Magnetic susceptibility of Solids.
3. To determine the Coupling Coefficient of a piezoelectric crystal.
4. To measure the Dielectric Constant of a dielectric Materials with frequency.
5. To determine the complex dielectric constant and plasma frequency of metal using Surface Plasmon resonance (SPR).
6. To determine the refractive index of a dielectric layer using SPR.
7. To study the PE Hysteresis loop of a Ferroelectric Crystal.
8. To draw the BH curve of iron using a Solenoid and determine the energy loss from Hysteresis.
9. To measure the resistivity of a semiconductor (Ge) crystal with temperature by four-probe method (from room temperature to 150 ^{o}C) and to determine its band gap.
10. To determine the Hall coefficient of a semiconductor sample.
11. To study the reverse saturation current to a PN junction diode at various temperatures and to find out the approximate value of the energy gap.
12. To measure dielectric constant of a non-polar liquid and its applications.
13. To measure the thermal conductivity and thermal diffusivity of a conductor.
14. To study temperature coefficient of resistance of Cu.

Text and reference books:

S. NO	NAME	AUTHOR(S)	PUBLISHER
1	Advanced practical physics for students	B.l. Flint and H.T Worsnop,	Asia publishing house 1971
2	Advanced level physics practicals,	J michael nelson and jon m. Ogborn	4th edition, reprinted 1985, Heinemann educational publishers
3	A text book of practical physics,	Indu prakash and ramakrishna	11th ed., 2011, kitab mahal, new delhi
4.	Elements of solid state physics	J.p. Srivastava	2nd ed Prentice-Hall of India,2006

Course Code	**PHY306**
Course Title	**Quantum mechanics**
Type of course	Discipline elective (theory)
L T P	4:0:0
Credits	4
Course prerequisite	BSc. Ist , IInd year with Physics as core subject
Course Objective (CO)	The aim of this course is enhance knowledge of the students in the field of quantum mechanics.
Course Outcome	**Student will able to:** CO1: apply time dependent Schrodinger equation to understand the general concept of wave function, operators, energy eigen values, stationary states, wavepackets CO2: Solve the bound particle in terms of Schrodinger equation and explains the role of potentials, potential barrier, particle in a box, Hydrogen like atom. CO3: Understand the physics of atoms in electric, magnetic and external magnetic fields.

UNIT I

Time dependent Schrodinger equation: Time dependent Schrodinger equation , Properties of Wave Function, Interpretation of Wave Function Probability and probability current densities in three dimensions, Conditions for Physical Acceptability of Wave Functions, Normalization, Linearity and Superposition Principles, Eigen values and Eigen functions, Position, momentum & Energy operators, commutator of position and momentum operators, Expectation values of position and momentum, Wave Function of a Free Particle, Time independent Schrodinger equation-Hamiltonian, stationary states and energy eigenvalues, General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states, wave packets, Fourier transforms and momentum space wavefunction, Position-momentum uncertainty principle**.**

UNIT II

General discussion of bound states in an arbitrary potential: continuity of wave function, boundary condition and emergence of discrete energy levels, application to one-dimensional problem- square well potential, Quantum mechanics of simple harmonic oscillator-energy levels and energy eigen functions using Frobenius method.

Quantum theory of hydrogen-like atoms: time independent Schrodinger equation in spherical polar coordinates, separation of variables for the second order partial differential equation, angular momentum operator and quantum numbers, Orbital angular momentum quantum numbers l, m, s, p, d,.. Shells (idea only)

UNIT III

Atoms in Electric and Magnetic Fields: Electron Angular Momentum, Space Quantization, Electron Spin and Spin Angular Momentum, Larmor's Theorem, Spin Magnetic Moment, Stern-Gerlach Experiment, Zeeman Effect: Electron Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and Bohr Magneton.

UNIT IV

Atoms in External Magnetic Fields: Normal and Anomalous Zeeman Effect, Many electron atoms, Pauli's Exclusion Principle, Symmetric and Antisymmetric Wave Functions, Fine structure, Spin orbit coupling, Spectral Notations for Atomic States,Total Angular Momentum, Vector Model, Spin-orbit coupling in atoms-L-S and J-J couplings.

Text and reference books

S. No	Name	Author(s)	Publisher
1	A Text book of Quantum Mechanics	P.M. Mathews & K. Venkatesan	McGraw Hill, 2nd Ed. 2010
2	Quantum Mechanics	Robert Eisberg and Robert Resnick	Wiley 2ndEdn., 2002
3	Quantum Mechanics	Leonard I. Schiff	Tata McGraw Hill 3rdEdn. 2010
4.	Quantum Mechanics	G. Aruldhas	PHI Learning of India 2nd Edn. 2002,
5.	Quantum Mechanics	Bruce Cameron Reed,	Jones and Bartlett Learning.2008

Course Code	**PHY308**
Course Title	**Quantum mechanics**
Type of course	Discipline elective(practical)
L T P	0:0:4
Credits	2
Course prerequisite	BSc. Ist , IInd year with Physics as core subject
Course Objective (CO)	The aim of this course is to impart practical knowledge to the students of quantum mechanics using c++, Scilab.
Course Outcome	**Student will able to:** CO1: determine magnetic field of atom by using ESR technique. CO2: determine external magnetic field of atom & hyperfine splitting spectra. CO3: Infer quantum tunnelling effect by using semiconductor devices. CO4: Apply Scilab /C++ to solve ground state of atom by using schrodinger equation.

***Note:** Students has to perform 10 experiments from the given list.

Use C/C++/Scilab for solving the following problems based on Quantum Mechanics:

1. Solve the s-wave Schrodinger equation for the ground state and the first excited state of the hydrogen atom:

Here, m is the reduced mass of the electron. Obtain the energy eigenvalues and plot the corresponding wavefunctions. Remember that the ground state energy of the hydrogen atom is ≈ -13.6 eV. Take e = 3.795 $(eVÅ)^{1/2}$, ħc = 1973 (eVÅ) and m = $0.511x10^6 eV/c^2$.

2. Solve the s-wave radial Schrodinger equation for an atom

here m is the reduced mass of the system (which can be chosen to be the mass of an electron), for the screened coulomb potential

Find the energy (in eV) of the ground state of the atom to an accuracy of threesignificant digits. Also, plot the corresponding wavefunction. Take e = 3.795 $(eVÅ)^{1/2}$, m = $0.511x10^6 eV/c^2$, and a = 3 Å, 5 Å, 7 Å. In these units ħc = 1973(eVÅ). The ground state energy is expected to be above -12 eV in all three cases.

3. Solve the s-wave radial Schrodinger equation for a particle. "For the anharmonic oscillator potential for the ground state energy (in MeV) of the particle to an accuracy of three significant digits. Also, plot the corresponding wave function. Choose m = 940 MeV/c^2, k = 100 MeV fm^{-2}, b = 0, 10, 30 MeV fm^{-3} In these units, cℏ = 197.3 MeV fm. The ground state energy I expected to lie between 90 and 110 MeV for all three cases.

4 Solve the s-wave radial Schrodinger equation for the vibrations of hydrogen molecule:!!! – !!!! , – !

Find the lowest vibrational energy (in MeV) of the molecule to an accuracy of three significant digits. Also plot the corresponding wave function.

Take: m = 940x10^6eV/C^2, D = 0.755501 eV, α = 1.44, r_o = 0.131349 Å

Laboratory based experiments:

1. Study of Electron spin resonance- determine magnetic field as a function of the resonance frequency

2. Study of Zeeman Effect: with external magnetic field; Hyperfine splitting

3. To study the quantum tunnelling effect with solid state device, e.g. tunnelling current in backward diode or tunnel diode.

4. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light.

5. To determine the Planck's constant using LEDs of at least 4 different colours.

6. To determine the ionization potential of mercury.

7. To determine the absorption lines in the rotational spectrum of Iodine vapour.

8. To setup the Millikan oil drop apparatus and determine the charge of an electr

Text and reference books:

S. No	Name	Author(s)	Publisher
1	Schaum's outline of programming with c++	J.hubbard 2000	Mcgraw hill
2	Numerical recipes in c: the art of scientific computing ,	W.h.press et al.,	Cambridge university press 3rd edn., 2007
3	A guide to matlab	B.r. hunt, r.l. lipsman, j.m. rosenberg	Cambridge university press 2014, 3rd edn.

Course Code	**PHY310**
Course Title	**Nuclear & Particle Physics**
Type of course	Discipline Elective (Theory)
L T P	4:0:0
Credits	4
Course prerequisite	BSc. Ist , IInd year with Physics as core subject
Course Objective (CO)	The aim of this course is to impart theoretical knowledge to the students in the field of nuclear physics.
Course Outcome	**Student will able to:** CO1: Understand general properties of nuclei & concept of nuclear models. CO2: classify the different types of radioactive decay & interaction of nuclear radiation with matter. CO3: Interpret the working principle of various particle accelerators.

UNIT I

General Properties of Nuclei: Constituents of nucleus and their Intrinsic properties **,**quantitative facts about size, mass, charge density (matter energy), binding energy, average binding energy and its variation with mass number, main features of binding **,**energy versus mass number curve, angular momentum, parity, magnetic moment, electric moments, nuclear excites states. Nuclear Models: Liquid drop model approach, semi empirical mass formula and Significance of various terms, condition of nuclear stability, Fermi gas model (degenerate fermions gas, nuclear symmetry potential in Fermi gas, evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model, concept of mean field, residual interaction, concept of nuclear force.

UNIT II

Radioactivity decay: (a) Alpha decay: basics of α-decay processes, theory of α-emission, Gamow factor, Geiger Nuttall law, α-decay spectroscopy. (b) β-decay: energy kinematics for β-decay, positron emission, electron capture, neutrino hypothesis. (c) Gamma decay: Gamma rays emission & kinematics, internal conversion. Nuclear Reactions: Types of Reactions, Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Concept of compound and direct reaction, resonance reaction, Coulomb scattering (Rutherford scattering).

UNIT III

Interaction of Nuclear Radiation with matter: Energy loss due to ionization (Bethe- Block formula), energy loss of electrons, Cerenkov radiation, Gamma ray interaction through matter, photoelectric effect, Compton scattering, pair production, neutron interaction with matter. Detector for Nuclear Radiations**:** Gas detectors: estimation of electric field, mobility of particle, for ionization chamber and GM Counter.

UNIT IV

Particle Accelerators: Accelerator facility available in India: Van-de Graaff generator (Tandem accelerator), Cyclotron, Synchrotrons. Particle physics: Particle interactions; basic features, types of particles and its families. Symmetries and Conservation Laws: energy and momentum, angular momentum, parity, baryon number, Lepton number, Isospin, Strangeness and charm, concept of quark model, color quantum number and gluons.

Text and reference books

S. NO	NAME	AUTHOR(S)	PUBLISHER
1	Introductory nuclear Physics	Kenneth S. Krane .	Wiley (1978)
2	Concepts of nuclear physics	Bernard L. Cohen.	Tata Mcgraw Hill, 1998
3	Radiation detection and measurement	G.F. Knoll	John Wiley & Sons, 2000
4.	Quarks and Leptons	F. Halzen and A.D. Martin,	Wiley India, New Delhi

Course code	**PHY312**
Course Title	**Nuclear & Particle Physics**
Type of course	Practical
L T P	0:0:4
Credits	2
Course prerequisite	BSc. Ist , IInd year with Physics as core subject
Course Objective	The aim of this course is to impart practical Aspects of nuclear Physics to the students.
Course Outcome	**Student will able to:** CO1: draw plateau region, calculate dead time, study gaussian distribution, poisson distribution using GM Counter. CO2: determine absorption coefficient, source strength of beta source using GM Counter. CO3: detect the presence of gamma radiation using scintillation counter.

***Note:** Students has to do any of 12 experiments from the given list.

1. To draw the plateau of a GM counter and find its dead time.
2. To study the statistical fluctuations and end point energy of beta particles using GM counter.
3. To study the absorption of beta particles in aluminum using GM counter and determine the absorption coefficient of beta particles from it.
4. To study Gaussian distribution using G.M. counter.
5. To determine the Source strength of a beta source using G.M. counter.
6. Study of Poisson distribution using GM counter.
7. To calibrate the scintillation counter using a known Gamma Source.
8. To study absorption of gamma radiation by scintillation counter.
9. Study of characteristics of GM tube and determination of operating voltage and plateau length using background radiation as source (without commercial source).
10. Study of counting statistics using background radiation using GM counter.
11. Study of radiation in various materials (e.g. KSO4 etc.). Investigation of possible radiation in different routine materials by operating GM at operating voltage.
12. Study of absorption of beta particles in Aluminum using GM counter.
13. Detection of α particles using reference source & determining its half-life using spark counter
14. Gamma spectrum of Gas Light mantle (Source of Thorium)
15. Study the background radiation levels using Radiation meter

Text and reference books:

S. NO	NAME	AUTHOR(S)	PUBLISHER
1	Introductory nuclear Physics	Kenneth S. Krane .	Wiley (1978)
2	Concepts of nuclear physics	Bernard L. Cohen.	Tata Mcgraw Hill, 1998
3	Radiation detection and measurement	G.F. Knoll	John Wiley & Sons, 2000

SCHEME & SYLLABUS of *CHEMISTRY for*

B.Sc. Non Medical
&
B.Sc. Medical

SEMESTER I

Course Code	**CHM 101**
Course Title	**Atomic Structures , Bonding , General Organic Chemistry and Aliphatic Hydrocarbons**
Type of course	CORE (Theory)
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, visualizing the organic molecules in a three-dimensional space.
Course outcome	**By the end of the course, the students will be able to:** CO1 Solve the conceptual questions using the knowledge gained from quantum mechanical model of the atom, quantum numbers, electronic configuration, radial and angular distribution curves, shapes of s, p, and d orbitals, and periodicity in atomic radii, ionic radii, ionization energy. and electron affinity of elements. CO2 Draw the plausible structures and geometries of molecules using Radius Ratio Rules, VSEPR theory and MO diagrams. CO3 Able to explains significance of quantum numbers , de-Broglie's dual behaviour of matter and Heisenberg's uncertainty principle and solve numerical problems. CO4 Understand and explain the different nature and behavior of organic compounds and able to analyse and evaluate fundamental concepts of stereochemistry

Unit-I

Atomic Structure: Review of: Bohr's theory and its limitations, dual behavior of matter 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	**CHM 103**
Course Title	**Atomic Structures , Bonding , General Organic and Chemistry and Aliphatic Hydrocarbons**
Type of course	CORE (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 outcome	**By the end of the course, students will be able to:** CO1 Estimate and identify the various ions in stock solutions. CO2 Detection of elements (N, S and halogens) in organic compounds, Detection of functional groups CO3 Identify amino acid & sugars through chromatographic methods

Volumetric Analysis

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

Organic Chemistry

Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements)

Separation of mixtures by Chromatography: Measure the Rf value in each case (combination of two compounds to be given)

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
Identify and separate the sugars present in the given mixture by paper chromatography.
Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer chromatography (TLC).

*<u>*Perform any four experiments from each section*</u>

Text and References Books

S. No	Name	Author(S)	Publisher
1	Vogel's Qualitative Inorganic Analysis (7^{th} 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.
4	Vogel's Qualitative Inorganic Analysis	Svehla	Orient Longman
5	Vogel's Textbook of Quantitative Inorganic Analysis (revised),	J. Basseff, R.C. Dennery, G.H. Jeffery and J. Mendham	ELBS

SEMESTER

II

Course Code	**CHM 102**
Course Title	**Chemical Energetic, Equilibrium and Functional Group Organic chemistry – I**
Type of course	CORE (Theory)
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 outcome	**By the end of the course, students will be able to:** CO1 Acquire the knowledge of thermodynamic property of any system , Chemical & Ionic equilibria of various systems. CO2 Apply the concepts of concept of ionization of electrolytes with emphasis on weak acid and base and hydrolysis of salt, pH and electrolytes. CO3 Understand preparation, properties and reactions of haloalkanes, haloarenes and oxygen containing functional groups. CO4 Use the synthetic chemistry for functional group transformations & to propose plausible mechanisms for any relevant reaction.

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

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^o, 2^o and 3^o 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.$KMnO_4$, acidic dichromate, conc. HNO_3). 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	**CHM 104**
Course Title	**Chemical energetic, Chemical Equilibrium and Functional Group organic chemistry-I**
Type of course	Core (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 provide practical knowledge about the preparation of organic compounds, Thermo-chemistry and Ionic equilibrium.
Course outcome	**By the end of the course, students will be able to:** CO1 Acquire basic concepts of thermochemistry, Analyse thermodynamic parameters of solutions and salt mixtures. CO2 Find out the acidity, Basicity and pKa Value on pH meter. CO3 Accurately evaluate separation, purifications techniques, of organic compounds.

Section A: Physical 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.
6. Study of the solubility of benzoic acid in water and determination of ΔH.

Ionic equilibria

1. Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps using pH-meter.
2. Preparation of buffer solutions: Sodium acetate-acetic acid; Ammonium chloride-ammonium hydroxide
3. Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

Section B: Organic Chemistry

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.
   Bromination of Phenol/Aniline ; Benzoylation of amines/phenols
   Oxime and 2,4-dinitrophenylhydrazone of aldehyde/ketone; Acetylation of amines/phenols

**Perform any four experiments from each section*

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

SEMESTER

III

Course Code	**CHM 201**
Course Title	**Solutions , Phase Equilibrium, conductance, electrochemistry and functional group organic chemistry-II**
Type of course	Core (Theory)
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.
Course outcome	**By the end of the course, students will be able to:** CO1 Acquire coherent knowledge of solutions, phase equilibrium and conductance CO2 Learn the working of electrochemical cells, EMF & pH determination. CO3 Understand structure and bonding in carboxylic acids and amine derivatives & Use the synthetic chemistry for functional group transformations. CO4 Identify & Analyse structural components, configuration of amino acids, proteins and Carbohydrates

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

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.

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. pH determination using hydrogen electrode and quinhydrone electrode.

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 (open chain and cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in mono-saccharides.

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	**CHM 203**
Course Title	**Solutions , Phase equilibrium, Conductance, Electrochemistry and Functional Organic Chemistry-II (Practical)**
Type of course	Core (Practical)
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.
Course outcome	**By the end of the course, students will be able to:** CO1 demonstrate and calculate various parameters of distribution & phase equilibria CO2Calculate molar and normal solution of various concentrations. CO3 perform and evaluate outcomes of conductometric & potentiometric titrations. CO4 Study Qualitative Organic Analysis & biochemical analysis of amino acids & carbohydrates.

Section A: Physical Chemistry

Distribution:

1. Study of the equilibrium of one of the following reactions by the distribution method:
2. $I_2(aq) + I^-(aq)\ I_3^-(aq)$ $Cu^{2+}(aq) + xNH_2(aq)\ \ [Cu(NH_3)_x]^{2+}$
3. Distribution of acetic/ benzoic acid between water and chloroform or cyclohexane.
4. To find EMF of the cell. To calculate the Gibbs free energy change of the cell reaction.
5. To calculate the equilibrium constant.

Phase equilibria

1. Construction of the phase diagram of a binary system (simple eutectic) using cooling curves.
2. Determination of the critical solution temperature and composition of the phenol water system and study of the effect of impurities on it.
3. 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

1. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.
2. Perform the following conductometric titrations: Strong acid vs. strong base ; Weak acid vs. strong base

Potentiometry

1. Perform the following potentiometric titrations:
   Strong acid vs. strong base;
   Weak acid vs. strong base;
   Potassium dichromate vs. Mohr's salt

Section B: Organic Chemistry

1. Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.
2. Determination of the concentration of glycine solution by formylation method.
3. Titration curve of glycine
4. Action of salivary amylase on starch
5. Effect of temperature on the action of salivary amylase on starch.

6. Differentiation between a reducing and a non reducing sugar.
7. Organic and inorganic synthesis

*<u>*Perform any four experiments from each section*</u>

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	**CHM 202**
Course Title	**Transition Metal & Coordination Chemistry, States of Matter and Chemical Kinetics**
Type of course	CORE (Theory)
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.
Course Outcome	**By the end of the course, the students will be able to:** CO1 Understand the terms, ligand, denticity of ligands, chelate, coordination number and use standard rules to name coordination compounds. CO2 Explain the meaning of the terms Δo., Δt, pairing energy, CFSE, high spin and low spin and magnetic properties and colour of complexes on basis of Crystal Field Theory CO3 Derive mathematical expressions for different properties of gas, liquid and solids and understand their physical significance. CO4 Have understanding of rate law and rate of reaction, theories of reaction rates and catalysts

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.

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. Critical phenomena, critical constants and their calculation from van der Waals equation.

Unit-III

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.
4	Introduction to Liquid State	P.A. Eglestaff	Academic Press.
5	The Elements of Physical Chemistry	P.w. Aikins	Oxford
6	Physical Chemistry, A Molecular Approach	MacQuarrie and Simon	University Science Books,
7	Principles of Inorganic Chemistry	Puri, Sharma and Kalia	Vishal publishers

Course Code	**CHM 204**
Course Title	**Transition Metal & Coordination Chemistry, States of Matter and Chemical Kinetics (Practical)**
Type of course	Core (Practical)
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.
Course Outcome	**By the end of the course, students will be able to:** CO1Analyse and estimate Qualitative analysis of inorganic cations & anions. CO2Calculate viscosity and surface tension of different liquids and solutions. CO3 Understand and apply gravimetric analysis and complexometric titrations. CO4 Derive mathematical expressions of chemical kinetics methods.

Section A: Inorganic Chemistry

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

Section B: Physical Chemistry

Surface tension measurement (use of organic solvents excluded).

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

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

Viscosity measurement (use of organic solvents excluded).

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

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

Chemical Kinetics

Study the kinetics of the following reactions.

Initial rate method: Iodide-persulphate reaction

Integrated rate method:

Acid hydrolysis of methyl acetate with hydrochloric acid.

Saponification of ethyl acetate.

Compare the strengths of HCl and H_2SO_4 by studying kinetics of hydrolysis of methyl acetate

*<u>*Perform any four experiments from each section*</u>

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,

SKILL ENHANCEMENT COURSES

Course Code	**CHM 209**
Course Title	**Basic Analytical Chemistry**

Type of course	Skill Enhancement Course
L T P	2:0:0
Credits	2
Course prerequisite	B.sc. Ist, IInd year with Chemistry as core subject
Course Objective (CO)	The objective of this course is to make student aware about concepts of analytical Chemistry various spectrophotometric, electroanalytical methods of analysis Students are exposed to important separation methods like solvent extraction and chromatography.
Course outcome	**By the end of this course, students will be able to:** CO1 Handle analytical data & Expresses the role of analytical chemistry in science. CO2Determine composition and pH of soil, which can be useful in agriculture CO3Do qualitative and quantitative analysis of water, food adultrants & cosmetics CO4 Estimate macro nutrients using Flame photometry & Separate mixtures using separation techniques

UNIT I:

Introduction: Introduction to Analytical Chemistry and its interdisciplinary nature. Concept of sampling. Importance of accuracy, precision and sources of error in analytical measurements. Presentation of experimental data and results, from the point of view of significant figures.

Analysis of soil: Composition of soil, Concept of pH and pH measurement, Complexometric titrations, Chelation, Chelating agents, use of indicators a. Determination of pH of soil samples. b. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration.

Analysis of water: Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods. a. Determination of pH, acidity and alkalinity of a water sample. b. Determination of dissolved oxygen (DO) of a water sample.

UNIT II:

Chromatography: Definition, general introduction on principles of chromatography, paper chromatography, TLC etc.

a. Paper chromatographic separation of mixture of metal ion (Fe^{3+} and Al^{3+})

b. To compare paint samples by TLC method.

Ion-exchange: Column, ion-exchange chromatography etc. Determination of ion exchange capacity of anion / cation exchange resin (using batch procedure if use of column is not feasible).

UNIT III:

Analysis of food products: Nutritional value of foods, idea about food processing and food preservations and adulteration.

a. Identification of adulterants in some common food items like coffee powder, asafoetida, chilli powder, turmeric powder, coriander powder and pulses, etc.

b. Analysis of preservatives and colouring matter.

Analysis of cosmetics: Major and minor constituents and their function

a. Analysis of deodorants and antiperspirants, Al, Zn, boric acid, chloride, sulphate.

b. Determination of constituents of talcum powder: Magnesium oxide, Calcium oxide, Zinc oxide and Calcium carbonate by complexometric titration.

Unit IV:

Suggested Applications (Any one):

a. To study the use of phenolphthalein in trace cases.

b. To analyze arson accelerants.
c. To carry out analysis of gasoline.
Suggested Instrumental demonstrations**:**
a. Estimation of macro nutrients: Potassium, Calcium, Magnesium in soil samples by flame photometry.
b. Spectrophotometric determination of Iron in Vitamin / Dietary Tablets.
c. Spectrophotometric Identification and Determination of Caffeine and Benzoic Acid in Soft drink

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Analytical Chemistry,	Christian, G.D. (2004),	John Wiley & Sons.
2	Principles of Instrumental Analysis,	Skoog, D.A.; Holler F.J.; Nieman, T.A. (2005),	Thomson Asia Pvt. Ltd.
3	Vogel's Qualitative Inorganic Analysis (7^{th} Edition).	G Svehla	Prentice Hall
4	Instrumental Analysis	G.D. Christian and J.E.G. Reily	Allegn Becon, Latest edition
5	Instrumental Methods of Chemical Analysis	G.W.Ewing,	McGraw Hill Pub, 1975.
6			

Course Code	**CHM 210**
Course Title	**Green Methods in Chemistry**
Type of course	**Skill Enhancement Course**
L T P	2:0:0
Credits	2
Course prerequisite	Bsc. Ist, IInd year with Chemistry as core subject
Course Objective (CO)	The aim of this course is to impart Coherent knowledge principles and scope of Green chemistry and applications of green chemistry in current scenario.
Course outcome	**By the end of this course, students will be able to:** CO1 Understand the twelve principles of green chemistry and will build the basic understanding of toxicity, hazard and risk of chemical substances. CO2 Analyze a process and identify parameters that make environmentally friendly/sustainable/green. CO3 Learn to design safer chemical ,products and processes that are less toxic, than current alternatives. CO4 Appreciate the use of green chemistry in problem solving skills, critical thinking and valuable skills to innovate and find out solution to environmental problems.

UNIT – I

Introduction: Definitions of Green Chemistry. Brief introduction of twelve principles of Green Chemistry, with examples, special emphasis on atom economy, reducing toxicity, green solvents, Green Chemistry and catalysis and alternative sources of energy, Green energy and sustainability.

UNIT – II

The Real world Cases in Green Chemistry:

Surfactants for carbon dioxide – Replacing smog producing and ozone depleting solvents with CO for precision cleaning and dry cleaning of garments.

Designing of environmentally safe marine antifoulant.

UNIT –III

Right fit pigment: Synthetic azo pigments to replace toxic organic and inorganic pigments.

An efficient, green synthesis of a compostable and widely applicable plastic (poly lactic acid) made from corn.

UNIT - IV

Practical Aspects: Preparation and characterization of biodiesel from vegetable oil.

Extraction of D-limonene from orange peel using liquid CO prepared from dry ice.

Mechano- chemical solvent free synthesis of azomethine.

Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper (II).

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Green Chemistry- Theory and Practical, 1998	Anastas, P.T. & Warner, J.K.	Oxford University Press

2	Introduction to Green Chemistry, 2001	Matlack, A.S.	Marcel Dekker
3	Real-World cases in Green Chemistry, 2000	Cann, M.C. & Connely, M.E.	American Chemical Society, Washington
4	Introduction to Green Chemistry, 2002	Ryan, M.A. & Tinnesand, M.	American Chemical Society, Washington

Course Code	**CHM 313**

Course Title	**Fuel chemistry**
Type of course	**Skill enhancement Course**
L T P	2:0:0
Credits	2
Course prerequisite	Bsc. Ist, IInd year with CHEMISTRY as core subject
Course Objective (CO)	The course aims to provide students with a basic scientific and technical understanding of the production, behaviour and handling of hydrocarbon fuels and lubricants, including emerging alternative & renewable fuels. This will enable them to be industry ready to contribute effectively in the field of petroleum chemistry and technology.
Course outcome	**By the end of this course, students will be able to:** CO1 Understanding of both conventional petroleum-based fuels, and alternative & renewable fuels, including gaseous fuels. CO2understand the refining processes used to produce fuels and lubricants and their usage in different applications. CO3 Analyze origin of petroleum, crude oil, composition, different refining processes employed industrially to obtain different fractions of petroleum. CO4Catagorize alternative and renewable fuels like Biofuels (Different generations), Gaseous Fuels (e.g. CNG, LNG, CBG, Hydrogen etc.). CO5 Apply various test methods used to qualify different types of fuels as well characterization methods.

UNIT I:

Review of energy sources (renewable and non-renewable). Classification of fuels and their calorific value. Determination of calorific value by Bomb calorimeter and Junker's calorimeter.

Coal: Uses of coal (fuel and nonfuel) in various industries, its composition, carbonization of coal. Coal gas, producer gas and water gas—composition and uses.

Fractionation of coal tar, uses of coal tar bases chemicals, requisites of a good metallurgical coke, Coal gasification (Hydro gasification and Catalytic gasification), Coal liquefaction and Solvent Refining.

UNIT II:

Petroleum and Petrochemical Industry: Composition of crude petroleum, Refining and different types of petroleum products and their applications. Fractional Distillation (Principle and process), Cracking (Thermal and catalyticcracking)

UNIT III:

Reforming Petroleum and non-petroleum fuels (LPG, CNG, LNG, bio-gas, fuels derived from biomass), fuel from waste, synthetic fuels (gaseous and liquids), clean fuels. **Petrochemicals:** Vinyl acetate, Propylene oxide, Isoprene, Butadiene, Toluene and its derivatives Xylene.

UNIT IV:

Lubricants: Classification of lubricants, lubricating oils (conducting and nonconducting) Solid and semisolid lubricants, synthetic lubricants. Properties of lubricant (viscosity index, cloud point, pore point) and determination.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Principles of Instrumental	D. A. Skoog and	Saunder's College Publ.

	Methods of analysis	D.M.West	Latest edition.
2	Engineering Chemistry	Jain, P.C. & Jain, M.	Dhanpat Rai & Sons, Delhi
3	Instrumental methods of chemical analysis	B.K.sharma	Krishna prakashan media LTD
4	Industrial Chemistry	Sharma, B.K. & Gaur, H.	Goel Publishing House, Meerut
5	Industrial Chemistry Vol-I,	Stocchi, E.	Ellis Horwood Ltd. UK (1990).

Course Code	**CHM 318**
Course Title	**Pharmaceutical Chemistry**
Type of course	Skill enhancement course
L T P	2:0:0
Credits	2
Course prerequisite	Bsc. Ist, IInd year with CHEMISTRY as core subject
Course Objective (CO)	The objective of this paper is to develop basic understanding of drugs discovery, design, development and their side effects, an overview of fermentation process and production of certain dietary supplements and certain common antibiotics.
Course outcome	**By the end of this course, students will be able to:** CO1Gain insight into retro-synthesis approach in relation to drug design and drug discovery. CO2Learn synthetic pathways of major drug classes. CO3Understand the fermentation process and production of ethanol, citric acids, antibiotics and some classes of vitamins.

UNIT I

Drugs & Pharmaceuticals : Drug discovery, design and development; Classification of drugs, Basic Retrosynthetic approach. Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti- inflammatory agents (Aspirin, paracetamol, lbuprofen);

UNIT-II

Antibiotics (Chloramphenicol); antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim); Antiviral agents (Acyclovir),

UNIT –III

Central Nervous System agents (Phenobarbital, Diazepam),Cardiovascular (Glyceryl trinitrate), antilaprosy (Dapsone), HIV-AIDS related drugs (AZT- Zidovudine).

UNIT –IV

Aerobic and anaerobic fermentation. Production of (i) Ethyl alcohol and citric acid, (ii) Antibiotics; Penicillin, Cephalosporin, Chloromycetin and Streptomycin, Production of Lysine, Glutamic acid, Vitamin B2, Vitamin B12 and Vitamin C.

Practicals

1. Preparation of Aspirin and its analysis.
2. Preparation of magnesium bisilicate (Antacid).

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Introduction to Medicinal Chemistry	G.L. Patrick	Oxford University Press, UK.
2	Medicinal and Pharmaceutical Chemistry,	Hakishan, V.K. Kapoor	Vallabh Prakashan, Pitampura, New Delhi
3	Principles of Medicinal Chemistry	William O. Foye, Thomas L., Lemke , David A. William	B.I. Waverly Pvt. Ltd. New Delhi

4	Medicinal Chemistry-the role of organic chemistry in drug, 1993	C. R. Ganellin, and S. M. Roberts	Academic Press
5	Medicinal Chemistry-principles and practice,1994	F. D. King	Royal Society of Chemistry

Discipline Elective Courses
(SEM V, VI)
(Any two of each subjects in both semesters)

Course Code	**CHM 301**
Course Title	**Molecules of Life**
Type of course	Discipline Elective course (Theory)
L T P	4:0:0
Credits	4
Course prerequisite	Bsc. Ist, IInd year with CHEMISTRY as one core subject
Course Objective (CO)	The aim of this course is to impart coherent knowledge to the students about organometallic chemistry, polynuclear hydrocarbons and organic spectroscopy.
Course outcome	**On completion of this course, the students will be able to:** CO1 Understand and demonstrate how structure of biomolecules determines their reactivity and biological functions. CO2 Gain insight into concepts of heredity through the study of genetic code, replication, transcription and translation. CO3 Demonstrate understanding of metabolic pathways, their inter-relationship, regulation and energy production from biochemical processes.

UNIT I

Carbohydrates Classification of carbohydrates, reducing and non-reducing sugars, General properties of glucose and fructose, their open chain structure. Epimers, mutarotation and anomers. Determination of configuration of Glucose (Fischer proof). Cyclic structure of glucose. Haworth projections. Cyclic structure of fructose. Linkage between monosachharides, structure of disacharrides (sucrose, maltose, lactose) and polysacharrides (starch and cellulose) excluding their structure elucidation.

Amino Acids, Peptides and Proteins Classification *of Amino Acids,* Zwitterion structure and Isoelectric point. Overview of Primary, Secondary, Tertiary and Quaternary structure of proteins. Determination of primary structure of peptides, determination of N-terminal amino acid (by DNFB and Edman method) and C–terminal amino acid (by thiohydantoin and with carboxypeptidase enzyme). Synthesis of simple peptides (upto dipeptides) by N-protection (t-butyloxycarbonyl and phthaloyl) & C-activating groups and Merrifield solid phase synthesis.

UNIT -II

Enzymes and correlation with drug action

Mechanism of enzyme action, factors affecting enzyme action, Coenzymes and cofactors and their role in biological reactions, Specificity of enzyme action (including stereospecificity), Enzyme inhibitors and their importance, phenomenon of inhibition(Competitive and Non-competitive inhibition including allosteric inhibition). Drug action-receptor theory. Structure – activity relationships of drug molecules, binding role of –OH group,-NH2 group, double bond and aromatic ring,

UNIT – III

Nucleic Acids Components of nucleic acids: Adenine, guanine, thymine and Cytosine (Structure only), other components of nucleic acids, Nucleosides and nucleotides **(nomenclature**), Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA (**types of RNA**), Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation.

Lipids Introduction to lipids, classification. Oils and fats: Common fatty acids present in oils and fats, Omega fatty acids, Trans fats, Hydrogenation, Saponification value, Iodine number. Biological importance of triglycerides, phospholipids, glycolipids, and steroids (cholesterol).

UNIT IV

Concept of Energy in Biosystems Calorific value of food. Standard caloric content of carbohydrates, proteins and fats. Oxidation of foodstuff (organic molecules) as a source of energy for cells. Introduction to Metabolism (catabolism, anabolism), ATP: the universal currency of cellular energy, ATP hydrolysis and free energy change. Conversion of food into energy. Outline of catabolic pathways of Carbohydrate- Glycolysis, Fermentation, Krebs Cycle. Overview of catabolic pathways of Fats and Proteins. Interrelationships in the metabolic pathways of Proteins, Fats and Carbohydrates.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1.	Lehninger's Principles of Biochemistry 7th Ed.,	Nelson, D. L. & Cox, M. M.	W. H. Freeman.
2.	Biochemistry, 2002	Berg, J.M., Tymoczko, J.L. & Stryer, L.	W.H. Freeman,
3.	Bioinorganic Chemistry	Bertini, H. B. Grey, S. J. Lippard and J. S. Valentine	Viva Books Pvt. Ltd., New Delhi (1998
4.	Biological Inorganic Chemistry: An Introduction	Robert Crichton	.Elsevier Science (2008)
5.	Organic Chemistry (Vol. I & II),	I.L. Finar	E.L.B.S.
6.	Inorganic Chemistry	G.L. Miessler & Donald A. Tarr	Pearson Publication.
7.	Organic Chemistry,	R.T. Morrison & R.N. Boyd	Prentice Hall.
8.	A Guide Book to Mechanism in Organic Chemistry	Peter Sykes:	Orient Longman.

Course Code	**CHM 303**
Course Title	**Molecule of life (Practical)**
Type of course	Discipline elective(Practical)
L T P	0:0:4
Credits	2
Course prerequisite	Bsc. Ist, IInd year with CHEMISTRY as one core subject
Course Objective	The aim of this course is to impart practical knowledge to the biochemical analysis.
Course outcome	**On completion of this course, the students will be able to:** CO1 Idetify and carry out qualitative &quantitative analysis of biomolecules in stock solutions. CO2Analyze biochemical analysis of proteins, amino acids and carbohydrates.

1. Separation of amino acids by paper chromatography
2. To determine the concentration of glycine solution by formylation method.
3. Estimation of glucose by Fehling's solution.
4. Estimation of proteins by Lowry's method.
5. Determination of the isoelectric pH of a protein.
6. Study of titration curve of glycine
7. Action of salivary amylase on starch
8. Effect of temperature on the action of salivary amylase on starch.
9. To determine the saponification value of an oil/fat.
10. To determine the iodine value of an oil/fat
11. Differentiate between a reducing/ non reducing sugar.
12. Extraction of DNA from onion/cauliflower
13. To synthesise aspirin by acetylation of salicylic acid and compare it with theingredient of an aspirin tablet by TLC.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Vogel's Textbook of Practical Organic Chemistry,	Furniss, B.S.; Hannaford, A.J.; Rogers, V.; Smith, P.W.G.; Tatchell, A.R.	ELBS.
2	Comprehensive Practical OrganicChemistry,	Ahluwalia, V.K. & Aggarwal, R.	Universities Press.
3	Textbook of Practical Organic Chemistry, 5th edition, 1996.	Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G	Prentice-Hall
4	(2012), Biochemical Tests: Principles and Protocols.	Kumar, A.; Garg, S.; Garg, N.	Viva Books.

Course Code	**CHM 305**
Course Title	**Organometallics, Bioinorganic Chemistry, Polynuclear Hydrocarbons and UV, IR spectroscopy**
Type of course	Discipline Elective course (theory)
L T P	4:0:0
Credits	4
Course prerequisite	Bsc. Ist, IInd year with CHEMISTRY as one core subject
Course Objective (CO)	The aim of this course is to impart coherent knowledge to the students about organometallic chemistry, polynuclear hydrocarbons and organic spectroscopy.
Course outcome	**On completion of this course, the students will be able to:** CO1Apply 18-electron rule to rationalize the stability of organomettalic compounds CO2 Identify important structural features of the of Zeise's salt, metal alkyls tetrameric methyl lithium and dimeric trialkyl aluminium and explain the concept of multicenter bonding in these compounds CO3 Diagrammatically explain the working of the sodium-potassium pump in organisms and sources and consequences of excess and deficiency of trace elements CO4Analyse and elaborate structure & properties of polynuclear hydrocarbons CO5 Gain insight into the basic principles of UV, IR spectroscopic techniques & Use spectroscopic techniques to determine structure and stereochemistry of known and unknown compounds.

UNIT I

Chemistry of 3d metals: Oxidation states displayed by Cr, Fe, Co, Ni and Co.

A study of the following compounds (including preparation and important properties); Peroxo compounds of Cr, $K_2Cr_2O_7$, $KMnO_4$, $[Fe(CN)_6]$, Sodium nitroprusside, $[Co(NH_3)_6]Cl_3$, $Na_3[Co(NO_2)_6]$.

UNIT -II

Organometallic Compounds: Definition and Classification with appropriate examples based on nature of metal-carbon bond (ionic, s, p and multicentre bonds). Structures of methyl lithium, Zeiss salt and ferrocene. EAN rule as applied to carbonyls. Preparation, structure, bonding and properties of mononuclear and polynuclear carbonyls of 3d metals. p-acceptor behaviour of carbon monoxide. Synergic effects (VB approach)- (MO diagram of CO can be referred to for synergic effect to IR frequencies).

UNIT – III

Bio-Inorganic Chemistry: A brief introduction to bio-inorganic chemistry. Role of metal ions present in biological systems with special reference to Na +,K+,Mg2+ ions, Na/K pump; Role of Mg2+ions in energy production and chlorophyll. Role of Ca2+in blood clotting, stabilization of protein structures and structural role (bones).

Polynuclear and heteronuclear aromatic compounds: Properties of the following compounds with reference to electrophilic and Nucleophilic substitution: Naphthalene, Anthracene , Furan, Pyrrole, Thiophene, and Pyridine.

Active methylene compounds: Preparation: Claisen ester condensation. Keto-enol tautomerism. Reactions: Synthetic uses of ethylacetoacetate (preparation of non-hetero molecules)

UNIT IV

Application of Spectroscopy to Simple Organic Molecules: Application of visible, ultraviolet and Infrared spectroscopy in organic molecules. Electromagnetic radiations, electronic transitions, λmax& εmax , chromophore, auxochrome, bathochromic and hypsochromic shifts, Solvent Effect in UV and IR Spectroscopy. Application of electronic spectroscopy and Woodward rules for calculating l max of conjugated dienes and α,β– unsaturated compounds.
Infrared radiation and types of molecular vibrations, functional group and fingerprint region.
IR spectra of alkanes, alkenes and simple alcohols (inter and intramolecular hydrogen bonding), aldehydes, ketones, carboxylic acids and their derivatives (effect of substitution on >C=O stretching absorptions.

Text and Reference Books

S. No	Name	Author(S)	Publisher
9.	Concise Inorganic Chemistry	1.D. Lee	ELBS
10.	Inorganic Chemistry: Principles of Structure and Reactivity	James E. Huheey, Ellen Keiter & Richard Keiter	Pearson Publication.
11.	Bioinorganic Chemistry	Bertini, H. B. Grey, S. J. Lippard and J. S. Valentine	Viva Books Pvt. Ltd., New Delhi (1998
12.	Biological Inorganic Chemistry: An Introduction	Robert Crichton	.Elsevier Science (2008)
13.	Biological Inorganic Chemistry: Structure and Reactivity	Harry B. Gray, Edward I. Stiefel et al.,	University Science Books.
14.	Inorganic Chemistry	G.L. Miessler & Donald A. Tarr	Pearson Publication.
15.	Basic Inorganic Chemistry	F.A. Cotton & G. Wilkinson:	John Wiley & Sons
16.	Shriver & Atkin's Inorganic Chemistry (5th Edition),	P Atkins, T. Overton, J. Rourke, M. Weller, F. Armstrong, M. Hagerman	Oxford University Press,
17.	Organic Chemistry (Vol. I & II),	I.L. Finar	E.L.B.S.
18.	Applications of Absorption Spectroscopy of Organic Compounds,	John R. Dyer:	Prentice Hall.
19.	Spectroscopic Identification of Organic Compounds	R.M. Silverstein, G.C. Bassler & T.C. Morrill	John Wiley & Sons
20.	Organic Chemistry,	R.T. Morrison & R.N. Boyd	Prentice Hall.
21.	A Guide Book to Mechanism in Organic Chemistry	Peter Sykes:	Orient Longman.

Course Code	**CHM 307**
Course Title	**Organometallics, Bioinorganic Chemistry, Polynuclear Hydrocarbons and UV, IR Spectroscopy (Practical)**
Type of course	Discipline elective(Practical)
L T P	0:0:4
Credits	2
Course prerequisite	Bsc. Ist, IInd year with CHEMISTRY as one core subject
Course Objective	The aim of this course is to impart practical knowledge to the students about organometallic chemistry and organic qualitative analysis.
Course outcome	**On completion of this course, the students will be able to:** CO1 Interpret the structures of various complexes and understand their properties. CO2 Impart knowledge about handling the spectrophotometer and carry out qualitative &quantitative analysis CO3 Employ spectroscopy for characterization of metal complexes and organic compounds

Section A: Inorganic Chemistry

1. Separation of mixtures by chromatography: Measure the Rf value in each case. (Combination of two ions to be given)

Paper chromatographic separation of Fe^{3+}, $A1^{3+}$ and Cr^{3+}

Paper chromatographic separation of Ni^{2+}, Co^{2+}, Mn^{2+} and Zn^{2+}.

2. Preparation of any two of the following complexes and measurement of their conductivity:

(i) tetraamminecarbonatocobalt (III) nitrate

(ii) tetraamminecopper (II) sulphate

(i) potassium trioxala toferrate (III) trihydrate

Compare the conductance of the complexes with that of M/1000 solution of NaCl, $MgCl_2$ and $LiCl_3$

Section B: Organic Chemistry

Verification of Lambert-Beer's law and determination of concentration of a coloured species (CuSO4, KMnO4, CoCl2, CoSO4)

Identification of simple organic compounds by IR spectroscopy(Spectra to be provided).

Determination of a mixture of cobalt and nickel (UV-visible spectroscopy).

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Vogel's Qualitative Inorganic Analysis (7^{th} Edition).	A.I. Vogel , G Svehla	Prentice Hall
2	Vogel's Quantitative Chemical Analysis (6^{th} Edition),	A.I. Vogel , J. Mendham, R.C. Denney, J.D. Barnes, M.J.K. Thomas	Prentice Hall
3	Advanced Practical Inorganic Chemistry	Ayodha Singh	Campus Books 2002
4	Textbook of Practical Organic Chemistry, 5th edition, 1996.	Vogel, A.I., Tatchell, A.R., Furnis, B.S.,	Prentice-Hall

		Hannaford, A.J. & Smith, P.W.G	
5	Practical Organic Chemistry	Mann, F.G. & Saunders, B.C.	Orient-Longman,

Course Code	CHM 309
Course Title	**Industrial Chemical and Environment**
Type of course	Discipline elective(Theory)
L T P	4:0:0
Credits	4
Course prerequisite	Bsc. Ist, IInd year with Chemistry as core subject
Course Objective	The objective of this course is to make students aware about the concepts of different gases and their industrial production, uses, storage and hazards. Manufacturing, applications, analysis and hazards of the Inorganic Chemicals, Air and Water pollution, control measures for Air and Water Pollutants, Catalyst and Biocatalyst, Energy and Environment.
Course outcome	**By the end of this course students will be able to understand:** CO1 Understand the vital role played by chemistry in industry. CO2 Give solution based on chemical knowledge in the field of various industries such as manufacturing processes, handling and storage of inorganic chemicals & hazardous effects of the inorganic chemicals. CO3 Composition of air, various air pollutants, effects and control measures of air pollutants. CO4 Different sources of water, water quality parameters, impacts of water pollution, water treatment. CO5 Different industrial effluents and their treatment methods. CO6 Different sources of energy & generation of nuclear waste and its disposal.

UNIT I

Industrial Gases and Inorganic Chemicals

Industrial Gases: Large scale production, uses, storage and hazards in handling of the following gases: oxygen, nitrogen, argon, neon, helium, hydrogen, acetylene, carbon monoxide, chlorine, fluorine, sulphur dioxide and phosgene.

Inorganic Chemicals: Manufacture, application, analysis and hazards in handling the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt, borax, bleaching powder, sodium thiosulphate, hydrogen peroxide, potash alum, chrome alum, potassium dichromate and potassium permanganate.

UNIT II

Industrial Metallurgy Preparation of metals (ferrous and nonferrous) and ultrapure metals for semiconductor technology. Environment and its segments Ecosystems. Biogeochemical cycles of carbon, nitrogen and sulphur.

Air Pollution: Major regions of atmosphere. Chemical and photochemical reactions in atmosphere. Air pollutants: types, sources, particle size and chemical nature; Photochemical smog: its constituents and photochemistry. Environmental effects of ozone, Major sources of air pollution. Pollution by SO_2, CO_2 , CO, NOx, H_2S and other foul smelling gases. Methods of estimation of CO, NOx, SOx and control procedures. Effects of air pollution on living organisms and vegetation. Greenhouse effect and Global warming, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and Halogens, removal of sulphur from coal. Control of particulates.

UNIT III

Water Pollution: Hydrological cycle, water resources, aquatic ecosystems, Sources and nature of water pollutants, Techniques for measuring water pollution, Impacts of water pollution on

hydrological and ecosystems. Water purification methods. Effluent treatment plants (primary, secondary and tertiary treatment).

Industrial effluents from the following industries and their treatment: electroplating, textile, tannery, dairy, petroleum and petrochemicals, agro, fertilizer, etc. Sludge disposal. Industrial waste management, incineration of waste. Water treatment and purification (reverse osmosis, electro dialysis, ion exchange). Water quality parameters for waste water, industrial water and domestic water.

UNIT IV

Energy & Environment: Sources of energy: Coal, petrol and natural gas. Nuclear Fusion / Fission, Solar energy, Hydrogen, geothermal, Tidal and Hydel, etc. Nuclear Pollution: Disposal of nuclear waste, nuclear disaster and its management.

Biocatalysis Introduction to biocatalysis: Importance in "Green Chemistry" and Chemical Industry.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Standard methods for the examination of water and waste water- 19th Edn. 1995.	Andrew D. Eaton, Lenore, S. Clesceri and A. E. Greenberg,	EPS group, INC Roman,
2	Environmental Chemistry, , 2nd edition, 1990.	A. K. DE	Wiley Eastern Ltd
3	(2010), Environmental Pollution Analysis,	Khopkar, S.M.,	New Age International Publisher.
4	2003),Industrial Inorganic Chemistry,	Buchel, K.H.; Moretto, H.H.; Woditsch, P.	Wiley-VCH.
5	Waste water treatment disposal and release-, INC second Edn., 1990.	Metcalf and eddy	Tata Mc Graw Hill
6	Environmental pollution control and engineering, 1995.	C. S. Rao	Wiley Eastern Ltd.
7	Chemical and Biological methods for water pollution studies, 1986.	R. K. Trivedy, and P. K. Goel,	Environmental publications
8	Environmental Chemistry, 1994.	B. K. Sharma & H. Kaur	Goel publishing House,
9	Principles of Instrumental Methods of analysis	D. A. Skoog and D.M.West	Saunder's College Publ. Latest edition.

Course Code	**CHM 311**
Course Title	**Industrial chemical and environment (Practical)**
Type of course	Discipline elective (practical)
L T P	0:0:4
Credits	2
Course prerequisite	Bsc. Ist, IInd year with Chemistry as one core subject
Course Objective	The aim of this course is to impart practical knowledge to the students in Industrial processes and environmental chemistry.
Course outcome	**By the end of this course students will be able to:** CO1 Identify and analyse various water quality parameters CO2Analyse quantitively air, water pollutants. CO3 Estimate bioindicators of pollution through titrimetrically and spectrophotometrically.

1. Determination of dissolved oxygen in water.
2. Determination of Chemical Oxygen Demand (COD)
3. Determination of Biological Oxygen Demand (BOD)
4. Percentage of available chlorine in bleaching powder.
5. Measurement of chloride, sulphate and salinity of water samples by simple titration method (AgNO3 and potassium chromate).
6. Estimation of total alkalinity of water samples ($CO3^{2-}$, $HCO3^{-}$) using double titration method.
7. Measurement of dissolved CO_2.
8. Study of some of the common bio-indicators of pollution.
9. Estimation of SPM in air samples.
10. Preparation of borax/ boric acid.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	(2008),A Laboratory Manual for Environmental Chemistry,	Gopalan, R.; Anand, A.; Sugumar R.W.	I. K. International.
2	(2010), Environmental Pollution Analysis,	Khopkar, S.M.,	New Age International Publisher.
3	(1980),Experiments in Environmental Chemistry: A Laboratory Manual, Vol.4,	Vowles, P.D.; Connell, D.W.	Pergamon Series in Environmental Science.
4	Waste water treatment disposal and release-, INC second Edn., 1990.	Metcalf and eddy	Tata Mc Graw Hill
5	Environmental pollution control and engineering, 1995.	C. S. Rao	Wiley Eastern Ltd.
6	Principles of Instrumental Methods of analysis	D. A. Skoog and D.M.West	Saunder's College Publ. Latest edition.

Course Code	**CHM 306**
Course Title	**Chemistry of Main Group Element, Theories of Acids and Bases**
Type of course	Discipline Elective Course(Theory)
L T P	4:0:0
Credits	4
Course prerequisite	Bsc. Ist, IInd year with Chemistry as core subject
Course Objective (CO)	The aim of this course is to impart detailed knowledge of Main group elements and industrial important processes based upon main group chemistry.
Course Outcome	**By the end of the course, the students will be able to:** CO1 Learn the fundamental principles of metallurgy and understand the importance of recovery of byproducts during extraction. CO2 Understand the periodicity in atomic and ionic radii, electronegativity, ionization energy, electron affinity of elements of the periodic table. CO3 Understand structure & properties, role of inorganic polymers. CO4 Elaborate different acid and base reactions & covalent and ionic bonding using Lewis dot structure.

UNIT I

Acids and Bases Brönsted–Lowry concept, conjugate acids and bases, relative strengths of acids and bases, effects of substituent and solvent, differentiating and levelling solvents. Lewis acid-base concept, classification of Lewis acids and bases, Lux-Flood concept and solvent system concept. Hard and soft acids and bases (HSAB concept), applications of HSAB process

General Principles of Metallurgy: Chief modes of occurrence of metals based on standard electrode potentials, Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agents. Hydrometallurgy with reference to cyanide process for gold and silver. Methods of purification of metals (Al, Pb, Ti, Fe, Cu, Ni, Zn, Au): electrolytic refining, zone refining, van Arkel-de Boer process, Parting Process, Mond's process and Kroll Process.

UNIT II

***s*- and *p*-Block Elements** Periodicity in *s*- and *p*-block elements with respect to electronic configuration, atomic and ionic size, ionization enthalpy, electron gain enthalpy, electronegativity (Pauling scale).General characteristics of *s*-block metals like density, melting and boiling points, flame colour and reducing nature.Oxidation states of *s*- and *p*-block elements, inert-pair effect, diagonal relationships and anomalous behaviour of first member of each group. Allotropy in C, P and S. Complex forming tendency of *s* block elements and a preliminary idea of crown ethers and cryptates, structures of basic beryllium acetate, salicylaldehyde/ acetylacetonato complexes of Group 1 metals. Solutions of alkali metals in liquid ammonia and their properties. Common features, such as ease of formation, solubility and stability of oxides, peroxides, superoxides, sulphates and carbonates of *s*-block metals.

UNIT III

Structure, bonding and properties (acidic/ basic nature, oxidizing/ reducing nature and hydrolysis of the following compounds and their applications in industrial and environmental chemistry wherever applicable: Diborane and concept of multicentre bonding, hydrides of Groups 13 (EH3), 14, 15, 16 and 17.Oxides

Noble gases: Rationalization of inertness of noble gases, catharses, preparation and properties of XeF2, XeF4 and XeF6 ,bonding in these compounds using VBT and shapes of noble gas compounds using VSEPR Theory.

UNIT IV

Inorganic Polymers Types of inorganic polymers and comparison with organic polymers, structural features, classification and important applications of silicates. Synthesis, structural features and applications of silicones. Borazines and cyclophosphazenes – preparation, properties and reactions. Bonding in $(NPCl_2)_3$. of N and P, Ox acids of P, S and Cl. Halides and ox halides of P and S (PCl3, PCl5, SOCl2 and SO2Cl2). Interhalogen compounds. A brief idea of pseudo halides.

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	Inorganic Chemistry Principles of Structure and Reactivity	J.E. Huheey	Harper Inter science
4	Principles of Inorganic Chemistry	Puri, Sharma and Kalia	Vishal publishers
5	Synthesis and Technique in Inorganic chemistry	G. S.Girlomi; R.J. Angleci	Latest edition, University Science Books.
6	Physical Chemistry	R.A. Alberty	Wiley Eastern Ltd
7	Shriver & Atkin's Inorganic Chemistry (5^{th} Edition),	P Atkins, T. Overton, J. Rourke, M. Weller, F. Armstrong, M. Hagerman	Oxford University Press,
8	(2014),Inorganic Chemistry, 5th Edition,	Miessler, G.L.; Fischer P.J.; Tarr, D. A.	Pearson.

Course Code	**CHM 308**
Course Title	**Chemistry of Main Group Element, Theories of Acids and Bases (Practical)**
Type of course	Discipline Elective Course (Practical)
L T P	0:0:4
Credits	2
Course prerequisite	Bsc. Ist, IInd year with CHEMISTRY as core subject
Course Objective (CO)	The aim of this course is to impart practical knowledge of iodometric, complexometric and gravimetric titration used for analysis of Main group elements,.
Course Outcome	**By the end of the course, the students will be able to:** CO1 Carry out iodometric/iodimetric analysis. CO2 Perform and estimate constituent ions through complexometric titrations & gravimetrically CO3 Handle and prepare some industrially significant complex salts

(A) Iodo / Iodimetric Titrations

1. Iodometric estimation of potassium dichromate and copper sulphate
2. Iodimetric estimation of antimony in tartaremetic
3. Estimation of amount of available chlorine in bleaching powder and household bleaches.
4. Iodimetric estimation of ascorbic acid in fruit juices.
5. Estimation of iodine in iodized salts.

(B) Complexometric titrations using disodium salt of EDTA

(i) Estimation of Mg2+,Zn2+

(ii) Estimation of Ca2+ by substitution method

(C) Gravimetric Analysis

1. Gravimetric estimation of sulphate as barium sulphate.
2. Gravimetric estimation of aluminium as oximato complex

(D) Inorganic preparations

1. Preparation of the following :

(i) Cuprous Chloride, Cu2Cl2

(ii) Aluminium potassium sulphate KAl(SO4)2 .12H2O (potash alum) or Chromium potassium sulphate

KCr(SO4)2.12H2O (chrome alum).

(iii)tetraamminecopper(II) sulphate monohydrate, potassium trioxalatoferrate(III)

(any two, including one double salt and one complex).

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Advanced Practical Inorganic Chemistry	Ayodha Singh	Campus Books 2002
2	Vogel's Quantitative Chemical Analysis (6^{th} Edition, 7^{th} Edition),	J. Mendham, R.C. Denney, J.D. Barnes, M.J.K. Thomas	Prentice Hall

Course Code	**CHM 310**
Course Title	**Green Chemistry**
Type of course	Discipline Elective Course (Theory)
L T P	4:0:0
Credits	4
Course prerequisite	Bsc. Ist, IInd year with CHEMISTRY as core subject
Course Objective (CO)	The aim of this course is to impart Coherent knowledge principles and scope of Green chemistry and applications of green chemistry in current scenario
Course Outcome	**By the end of this course, students will be able to:** CO1 Understand the twelve principles of green chemistry and will build the basic understanding of toxicity, hazard and risk of chemical substances. CO2 Learn to design safer chemical ,products and processes that are less toxic, than current alternatives as well as safer design for accident prevention. CO3 Appreciate the use of green chemistry in problem solving skills, critical thinking and valuable skills to innovate and find out solution to environmental problems. CO4 Observe the current environmental issues and their appropriate solutions by chemical approach.

UNIT I

Introduction to Green Chemistry: What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry.

Principles of Green Chemistry and Designing a Chemical synthesis: Twelve principles of Green Chemistry with their explanations and examples and special emphasis on the following: Designing a Green Synthesis using these principles; Prevention of Waste/ byproducts; maximum incorporation of the materials used in the process into the final products , Atom Economy, calculation of atom economy of the rearrangement, addition, substitution and elimination reactions. Prevention/ minimization of hazardous/ toxic products reducing toxicity. risk = (function) hazard × exposure; waste or pollution prevention hierarchy.

UNIT II

Green solvents– supercritical fluids, water as a solvent for organic reactions, ionic liquids, fluorous biphasic solvent, PEG, solvent less processes, immobilized solvents and how to compare greenness of solvents. Energy requirements for reactions – alternative sources of energy: use of microwaves and ultrasonic energy.

Selection of starting materials; avoidance of unnecessary derivatization – careful use of blocking/protecting groups. Catalysis and green chemistry, comparison of heterogeneous and homogeneous catalysis, biocatalysis, asymmetric catalysis and photocatalysis.

Strengthening/ development of analytical techniques to prevent and minimize the generation of hazardous substances in chemical process

UNIT III

Examples of Green Synthesis/ Reactions and some real world cases

Green Synthesis of the following compounds: adipic acid, catechol, disodium iminodiacetate (alternative to Strecker synthesis)
Microwave assisted reactions in water: Hofmann Elimination, methyl benzoate to benzoic acid, oxidation of toluene and alcohols; microwave assisted reactions in organic solvents Diels-Alder reaction and Decarboxylation reaction
Ultrasound assisted reactions: Sono chemical Simmons-Smith Reaction (Ultrasonic alternative to Iodine)
Surfactants for carbon dioxide – replacing smog producing and ozone depleting solvents with CO2 for precision cleaning and dry cleaning of garments.
Designing of Environmentally safe marine antifoulant.

UNIT IV

Future Trends in Green Chemistry Oxidation reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green chemistry; Proliferation of solvent less reactions; co crystal controlled solid state synthesis (C^2S^3); Green chemistry in sustainable development.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Green Chemistry	V. K. Ahluwalia	New Age International
2	Green Chemistry- Theory and Practical, 1998	Anastas, P.T. & Warner, J.K.	Oxford University Press
3	Introduction to Green Chemistry,2001	Matlack, A.S.	Marcel Dekker
4	Real-World cases in Green Chemistry, 2000	Cann, M.C. & Connely, M.E.	American Chemical Society, Washington
5	Introduction to Green Chemistry,2002	Ryan, M.A. & Tinnesand, M.	American Chemical Society, Washington
6	Green Chemistry Experiments: A monograph	Sharma, R.K.; Sidhwani, I.T. & Chaudhari, M.K.	I.K. International Publishing House Pvt Ltd. New Delhi

Course Code	**CHM 312**
Course Title	**Green Chemistry (Practical)**
Type of course	Discipline Elective Course (Practical)
L T P	0:0:4
Credits	2
Course prerequisite	Bsc. Ist, IInd year with CHEMISTRY as core subject
Course Objective (CO)	The aim of this course is to equip students about practical aspects of green chemistry applications of green chemistry in current scenario
Course Outcome	**By the end of this course, students will be able to:** CO1 Apply twelve principles of green chemistry for synthesis and analysis. CO2 design safer chemical ,products and processes that are less toxic, than current alternatives CO3 Incorporate problem solving skills, critical thinking and valuable skills to innovate and find out solution to environmental problems.

1. Safer starting materials

Preparation and characterization of nanoparticles of gold using tea leaves/silver nanoparticles using plant extracts.

2. **Using renewable resources:** Preparation of biodiesel from vegetable/ waste cooking oil.

3. **Avoiding waste:** Principle of atom economy. Use of molecular model kit to stimulate the reaction to investigate how the atom economy can illustrate Green Chemistry.

Preparation of propene by two methods can be studied

Triethylamine ion + OH^- → propene + trimethylpropene + water

(II) 1-propanol $\xrightarrow{H_2SO_4/\square}$ propene + water

Other types of reactions, like addition, elimination, substitution and rearrangement should also be studied for the calculation of atom economy.

4. **Use of enzymes as catalysts** Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide.

5. **Alternative Green solvents** Extraction of D-limonene from orange peel using liquid CO2 prepared form dry ice. Mechanochemical solvent free synthesis of azomethines.

6. **Alternative sources of energy:** Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper (II).

Photoreduction of benzophenone to benzopinacol in the presence of sunlight.

Reducing waste

Designing and conducting an experiment by utilizing the products and by products obtained in above preparations which become waste otherwise if not used. This is done by critical thinking and literature survey.

Students should be taught to do spot tests for qualitative inorganic analysis for cations and anions, and qualitative organic analysis for preliminary test and functional group analysis.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Green Chemistry	V. K. Ahluwalia	New Age International
2	Green Chemistry- Theory and Practical, 1998	Anastas, P.T. & Warner, J.K.	Oxford University Press
3	Introduction to Green Chemistry,2001	Matlack, A.S.	Marcel Dekker
4	(2002), Greener approaches to undergraduate chemistry experiment.	Kirchoff, M.; Ryan, M.A.	American Chemical Society, Washington DC.
5	Green Chemistry Experiments: A monograph	Sharma, R.K.; Sidhwani, I.T. & Chaudhari, M.K.	I.K. International Publishing House Pvt Ltd. New Delhi
6	Green Chemistry: An introductory text	Lancaster, M.	RSC publishing, 2nd Edition.

Course Code	**CHM 314**
Course Title	**Analytical Method in Chemistry**
Type of course	Discipline Elective Course(theory)
L T P	4:0:0
Credits	4
Course prerequisite	Bsc. Ist, IInd year with Chemistry as core subject
Course Objective (CO)	The objective of this course is to make student aware about concepts of analytical Chemistry various spectrophotometric, electroanalytical and themal methods of analysis Students are exposed to important separation methods like solvent extraction and chromatography.
Course Outcome	**By the end of this course, students will be able to:** CO1 Understand basic principle of instrument of various spectrophotometric, electroanalytical and themal methods of analysis CO2Develop experience and knowledge to operate and use effectively the analytical tools and instruments available in laboratory. CO3 Understand the significance, quality and limitations of the results produced by various separation techniques. CO4 Develop methods of analysis for different samples independently.

UNIT I

Qualitative and quantitative aspects of analysis: Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals.

Optical methods of analysis: Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law. UV-Visible Spectrometry: Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument; Basic principles of quantitative analysis: estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers. Determination of composition of metal complexes using Job's method of continuous variation and mole ratio method.

UNIT II

Infrared Spectrometry: Basic principles of instrumentation (choice of source, NM monochromatic & detector) for single and double beam instrument; sampling techniques. Structural illustration through interpretation of data, Effect and importance of isotope substitution.

Flame Atomic Absorption and Emission Spectrometry: Basic principles of instrumentation (choice of source, monochromatic, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal. Techniques for the quantitative estimation of trace level of metal ions from water samples.

UNIT III

Thermal methods of analysis: Theory of thermogravimetry (TG), basic principle of instrument Techniques for quantitative estimation of Ca and Mg from their mixture .

Electro-analytical methods: Classification of electro analytical methods, basic principle of pH metric, potentiometric and conduct metric titrations. Techniques used for the determination of equivalence points. Techniques used for the determination of pKa values.

UNIT IV

Separation techniques: Solvent extraction: Classification, principle and efficiency of the technique. Mechanism of extraction: extraction by solvation and chelation. Technique of extraction: batch, continuous and counter current extractions. Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and non-aqueous media.

Chromatography: Classification, principle and efficiency of the technique. Mechanism of separation: adsorption, partition & ion exchange. Development of chromatograms: frontal, elution and displacement methods. Qualitative and quantitative aspects of chromatographic methods of analysis: IC, GLC, GPC, TLC and HPLC.

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	Inorganic Chemistry	A.G. Sharpe	ELBS
3	Principles of Instrumental Methods of analysis	D. A. Skoog and D.M.West	Saunder's College Publ. Latest edition.
4	Vogel's Qualitative Inorganic Analysis (7^{th} Edition).	G Svehla	Prentice Hall
5	Vogel's Quantitative Chemical Analysis (6^{th} Edition),	J. Mendham, R.C. Denney, J.D. Barnes, M.J.K. Thomas	Prentice Hall
6	Instrumental Analysis	G.D. Christian and J.E.G. Reily	Allegn Becon, Latest edition
7	Instrumental Methods of Chemical	G.W.Ewing,	McGraw Hill Pub, 1975.

Course Code	**CHM 316**
Course Title	**Analytical Method in Chemistry (Practical)**
Type of course	Discipline Elective (Practical)
L T P	0:0:4
Credits	2
Course prerequisite	Bsc. Ist, IInd year with CHEMISTRY as core subject
Course Objective (CO)	The aim of this course is to impart practical knowledge of analytical methods of chemical analysis . It expose students to latest instrumentation and they learn to detect analytes in a mixture.
Course Outcome	**By the end of this course, students will be able to:** CO1 Perform experiment with accuracy and precision. CO2 Perform various types of titrations i.e redox, colorimetric, complexometric and acid- base titration. CO3 Determine composition of soil, water analysis, Estimation of macronutrients using Flame Photometery CO4 Learn separation of analytes by chromatography.

I. Separation Techniques

Chromatography:

1. Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the Rf values.
2. Separate a mixture of Sudan yellow and Sudan Red by TLC technique and identify them on the basis of their Rf values.
3. Chromatographic separation of the active ingredients of plants, flowers and juices by TLC
4. Separation of compounds using column chromatography.

II. Solvent Extractions:

1. To separate a mixture of Ni^{2+} & Fe^{2+} by complexation with DMG and extracting the Ni^{2+}- DMG complex in chloroform, and determine its concentration by spectrophotometry.
2. Determine the pH of the given aerated drinks fruit juices, shampoos and soaps.
3. Determination of Na, Ca, Li in cola drinks and fruit juices using flame photometric techniques.

III Analysis of soil and water:

1. Determination of pH of soil.
2. Total soluble salt

3. Estimation of calcium, magnesium, phosphate, nitrate
4. Determination of physical and chemical parameters of water .
5. Determination of dissolved oxygen in water.
6. Determination of chemical oxygen demand (COD).
7. Determination of Biological oxygen demand (BOD).
8.

IV Ion exchange:

(i) Determination of exchange capacity of cation exchange resins and anion exchange resins.
(ii) Separation of metal ions from their binary mixture.
(iii) Separation of amino acids from organic acids by ion exchange chromatography.

V Spectro-photometry

1. Verification of Lambert-Beer's law and determination of concentration of a coloured species ($CuSO_4$, $KMnO_4$, $CoCl_2$, $CoSO_4$)
2. Determination of pKa values of indicator using spectrophotometry.
3. Structural characterization of compounds by infrared spectroscopy.

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	Inorganic Chemistry	A.G. Sharpe	ELBS
3	Principles of Instrumental Methods of analysis	D. A. Skoog and D.M.West	Saunder's College Publ. Latest edition.
4	Vogel's Qualitative Inorganic Analysis (7^{th} Edition).	G Svehla	Prentice Hall
5	Vogel's Quantitative Chemical Analysis (6^{th} Edition),	J. Mendham, R.C. Denney, J.D. Barnes, M.J.K. Thomas	Prentice Hall
6	Instrumental Analysis	G.D. Christian and J.E.G. Reily	Allegn Becon, Latest edition
7	Instrumental Methods of Chemical Analysis	G.W.Ewing,	McGraw Hill Pub, 1975.

SCHEME & SYLLABUS
of
MATHEMATICS
for
B.Sc. Non Medical

Course Code	**MAT101** ~~GENERALENGLISH–I~~
Course Title	**Calculus and Matrices**
Type of course	Theory
L T P	5 1 0
Credits	6
Course prerequisite	10+2 with Mathematics as core subject
Course Objective(CO)	The aim of the subject is to introduce calculus. Students will be familiarized to the concepts and applications of limits, derivatives, integrals and Matrices.
Course outcome	By the end of the course, students will be able to: CO1 Locate the x and y intercepts, any undefined points, and any asymptotes. CO2 Apply the concept of derivative to completely analyze graph of a function. CO3 Solve Taylor's series, Maclaurin's series CO4 Understand the concept of diagonal, normal for of matrices and applications of matrices in other fields

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, Indeterminate forms.

Unit-II

Reduction formulae, derivations and illustrations of reduction formulae of the type $\int \sin^n x\,dx$, $\int \cos^n x\,dx$, $\int \tan^n x\,dx$, $\int \sec^n x\,dx$, $\int (\log x)^n\,dx$, $\int \sin(nx)\sin(mx)\,dx$, 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, Maxima and Minima.

Unit-IV

Algebra of matrices, Inverse and rank of a matrix, rank-nullity theorem; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, Matrices in diagonal form. Reduction to diagonal form upto matrices of order 3, Reduction to normal form, Orthogonal transformation and quadratic to canonical forms. Solutions of a system of linear equations using matrices. Illustrative examples of above concepts from Geometry, Physics, Chemistry, and Statistics.

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
3.	Introduction to Algebra	A.I. Kostrikin	Springer Verlag
4.	Theory and Problems of Matrix Operations	Richard Bronson	Tata McGraw Hill

Course Code	**MAT102**
Course Title	**Differential Equations** GENERAL ENGLISH–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 subject is to develop the knowledge about Differential Equations and partial equations.
Course outcome	By the end of the course, students will be able to: CO1 Find out the General, particular, explicit, implicit, and singular solutions of a differential equation. CO2 Understand the concept of Wronskian: its properties, its applications, and Linear homogeneous and non-homogeneous equations of higher order with constant coefficients. CO3 Solve Partial differential equation with Lagrange's solution and Charpit's general method of solution. CO4 Use Laplace transformation to solve differential equation

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

Partial differential equation: Formation of first and second order equations, linear equation of first order, integral surfaces passing through a given curve, surfaces orthogonal to a given system of surfaces. Nonlinear first order partial differential equations: Charpit's method, Higher order linear partial differential equations with constant coefficients: complementary function, particular integral.

Unit-IV

Laplace transforms. Introduction to infinite integrals. Linearity of Laplace transforms. Existence theorem for Laplace transforms. Laplace transforms of derivative sand integrals. Shifting theorems. Differentiation and integration of transforms. Convolution theorem. Solution of integral equations and systems of differential equations using Laplace transforms.

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
3	Laplace Transforms	Murray Spiegel	McGraw-Hill Education

Course Code	**MAT201**
Course Title	**Real analysis**

GENERALENGLISH–I

Type of course	Theory
L T P	5 1 0
Credits	6
Course prerequisite	B.Sc. /B.A. 1st year with Mathematics as core subject
Course Objective (CO)	The aim of the subject is to have the knowledge of basic properties of field of real numbers, convergence of sequences and metric space.
Course outcome	By the end of the course, students will be able to: CO1 Understand and find the Bounded and unbounded sets, Infimum and supremum of a set. CO2 Learn Bolzano- Weierstrass theorem for sets, topology of real line and Rn. CO3 Understand the theorems on limits of sequences, Subsequences, Monotone sequences, Monotone convergence Theorem. CO4 Study the basic concept of metric space.

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. Real Sequence, Bounded sequence, Cauchy convergence criterion for sequences.

Unit-II

Cauchy's theorem on limits, order preservation and squeeze theorem, monotone sequences and their convergence (monotone convergence theorem without proof). 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).

Unit-III

Definition and examples of absolute and conditional convergence. Sequences and series of functions, Pointwise and uniform convergence. M_n-test, M-test, Statements of the results about uniform convergence and integrability and differentiability of functions, Power series and radius of convergence

Unit-IV

Metric spaces, Examples of metric spaces, Neighbourhood of a point, Limit point and isolated points of a set, Closed set, Interior point of a set, Open set, Perfect set, Bounded set, Dense set, Union and intersection of open sets, Closure of a set.

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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

GENERALENGLISH–I

Course Code	**MAT202**
Course Title	**Algebra**
Type of course	Theory
L T P	5 1 0
Credits	6
Course prerequisite	B.Sc. /B.A. 1st year with Mathematics as one core subject
Course Objective (CO)	The aim of this course is to make the students learn fundamental concepts of Groups, Ring, Field and trigonometry concepts.
Course outcome	By the end of the course, students will be able to: CO1 Have a working knowledge of important mathematical concepts in abstract algebra such as definition of a group, order of a finite group and order of an element. CO2 Be knowledgeable of different types of subgroups such as normal subgroups, cyclic subgroups and understand the structure and characteristics of these subgroups. CO3 Understand the concept of De-Moivre's theorem and expansion of trigonometric functions.

Unit-I

Definition and examples of groups, examples of abelian and non-abelian groups, the group Zn of integers under addition modulo n and the group U(n) of units under multiplication modulo n. Cyclic groups from number systems, complex roots of unity, circle group, the general linear group GLn (n,R), groups of symmetries of (i) an isosceles triangle, (ii) an equilateral triangle, (iii) a rectangle, and (iv) a square, the permutation group Sym (n), Group of quaternions.

Unit-II

Subgroups, cyclic subgroups, the concept of a subgroup generated by a subset and the commutator subgroup of group, examples of subgroups including the center of a group. Cosets, Index of subgroup, Lagrange's theorem, order of an element, Normal subgroups: their definition, examples, and characterizations, Quotient groups

Unit-III

Definition and examples of rings, examples of commutative and non- commutative rings: rings from number systems, Zn the ring of integers modulo n, ring of real quaternions, rings of matrices, polynomial rings, and rings of continuous functions. Subrings and ideals, Integral domains and fields, examples of fields: Zp, Q, R, and C. Field of rational functions.

.**Unit-IV**

De-Moivre's theorem and applications. Direct and inverse, circular and hyperbolic, functions. Logarithm of a complex quantity, Expansion of trigonometric functions.

Text and Reference Books

S. 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
4.	Metric Spaces	Satish Shirali and Harikishan L. Vasudeva	Springer Verlag, London

SEC- Skill Enhancement Courses (Mathematics)

GENERALENGLISH–I

Course Code	**MAT207**
Course Title	**Logic and Graph theory**
Type of Course	Skill Enhancement
L T P	2:0:0
Credits	2
Course Prerequisites	B.Sc. /B.A. 1st year with Mathematics as one core subject
Course Objectives (CO)	The aim of the subjects that students have basic knowledge of sets, relation and graph theory.
Course Outcome (CO)	By the end of the course, students will be able to: CO1 Demonstrate the ability to write and evaluate a proof in Logics. CO2 Write an argument using logical notation and determine if the argument is or is not valid. CO3 Use Graphs in Networking & other engineering problems.

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

Relations, types of relation, matrix of relation, product sets and partitions , Equivalence Relations with example of congruence modulo relation, hasse diagram and digraph, path in relation and digraphs, functions, types of functions

UNIT IV

Graphs(directed and undirected),types of graphs, Euler's paths and circuits, Hamiltonian paths and circuits, colorings of graphs , partially ordered sets, external elements of poset, lattices, lattices as algebraic system, finite Boolean

S. No	**Name**	**Author(S)**	**Publisher**
1	Discrete Mathematics and Combinatorial Mathematics	R.P. Grimaldi	Pearson Education
2	Naive Set Theory	P.R. Halmos	Springer
3.	Discrete Mathematics with Graph Theory	Edgar G. Goodaire and Michael M. Parmenter	Pearson Education (Singapore) P. Ltd

GENERALENGLISH–I

Course Code	**MAT208**
Course Title	**Number theory**
Type of course	Skill enhancement
L T P	2:0:0
Credits	2
Course prerequisite	B.Sc. /B.A. Ist, IInd year with Mathematics as core subject
Course Objective (CO)	The aim of the subjects to develops the knowledge about number theory and combinations of numbers.
Course outcome	By the end of the course, students will be able to: CO1 Gain the knowledge of divisibility and related algorithm CO2 Solve the Diophantine equations. CO3 Understand and gain the knowledge of Mobius inversion formula, Euler's phi functions, the greatest integer functions.

UNIT I: Divisibility, Division algorithm, GCD, Euclidean Lemma, Lame's theorem(Statement only), linear Diophantine equation, fundamental theorem of arithmetic, prime counting function, statement of prime number theorem.

UNIT II:

Euler's phi-function, Congruence, Basic Properties of congruence, linear congruences, complete set of residues.

UNIT III:

Number theoretic functions, sum and number of divisors, totally multiplicative functions,definition and properties of the Dirichlet product.

UNIT IV:

Goldbach's conjecture, binary and decimal representation of integers, Mobius inversion formula, the greatest integer function.

Text and Reference Books

S. No	**Name**	**Author(S)**	**Publisher**
1	Elementary Number Theory	David M. Burton	Tata McGraw-Hill
2	Beginning Number Theory	Neville Robinns	Narosa Publishing
3	Computational Number Theory (Discrete Mathematics and Its Applications)	Abhijit Das	Chapman and Hall/CRC

GENERALENGLISH–I

Course Code	**MAT305**
Course Title	**Vector Calculus**
Type of course	Skill enhancement course
L T P	2:0:0
Credits	2
Course prerequisite	B.Sc. /B.A. Ist, IInd year with Mathematics as core subject
Course Objective (CO)	The aim of the subjects to learn the students about vector function, field, and its properties and apply different operations on vector field.
Course outcome	By the end of the course, students will be able to: CO1 Learn the concept of differentiation and partial differentiation of vector functions. CO2 Solve the derivatives of sum, dot product, and cross product of two vector functions. CO3 Find the gradient, divergence and curl of vector functions.

UNIT I:

Scalar product and its geometric interpretation, norm, angle between two vectors, the triangle inequality, cross product, and its geometric interpretation.

UNIT II:

Scalar and Vector fields, gradient fields and potentials, flow line, gradient, divergence, curl and the del operator, Orthogonal curvilinear coordinates

UNIT III:

Scalar and vector line integrals, work, line integrals along curves, Green's theorem and divergence theorem in plane.

UNIT IV:

Scalar and vector surface integrals with interpretations, Stokes theorem, Volume integrals, Gauss Divergence Theorem.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Calculus	H. Anton	John Wiley and Sons
2	Vector Calculus	P.C. Matthew's	London Limited
3	A Textbook of Vector Calculus	Shanti Narayan , P.K. Mittal	S Chand; 4th edition

GENERALENGLISH–I

Course Code	**MAT310**
Course Title	**Probability and Statistics**
Type of course	Skill enhancement course
L T P	2:0:0
Credits	2
Course prerequisite	B.Sc. /B.A. Ist, IInd year with Mathematics as core subject
Course Objective (CO)	The main objectives of this course is to provide knowledge with the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and sciences.
Course outcome	By the end of the course, students will be able to: CO1 Learn about random variables (discrete and continuous) and discrete and continuous distributions CO2 Understand Joint cumulative distribution function , its properties and the concept of bivariate normal distribution and correlation coefficient CO3 Understand and solve the concept of Measures of Central tendency and dispersion.

UNIT I:

Measures of Central Tendency: mathematical and positional. Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation, Moments

UNIT II:

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.

UNIT III:

Discrete distributions: uniform, binomial, Poisson, cumulative distribution function and its properties

UNIT IV:

Normal, exponential. Joint probability density functions, marginal and conditional distributions, expectation of function of two random variables, conditional expectations.

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	Fundamentals of Statistics	Gupta M.K. and Dasgupta B.	8th Edn. The World Press, Kolkata., 2002
4	Fundamentals of Mathematical	S.C. Gupta, V.K.	Sultan Chand &

	Statistics	Kapoor	Sons,2014

Discipline Elective Courses (Mathematics) (SEM V, VI)

GENERALENGLISH–I

Course Code	**MAT301**
Course Title	**Numerical Methods**
Type of course	Discipline Elective Course
L T P	5 1 0
Credits	6
Course prerequisite	B.Sc. /B.A. Ist, IInd year 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	By the end of the course, students will be able to: CO1 Find numerical solutions of algebraic and transcendental equations. CO2 Obtain numerical solutions of system of linear equations and check the accuracy of the solutions. CO3 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

GENERALENGLISH–I

Course Code	**MAT303**
Course Title	**Linear Algebra**
Type of course	Discipline Elective Course
L T P	5 1 0
Credits	6
Course prerequisite	B.Sc. /B.A. Ist, IInd with Mathematics as one core subject
Course Objective	The main objectives of this course is to provide the knowledge of basic Quotient Space, linear transformation, invertibility and Isomorphism on vector space.
Course outcome	By the end of the course, students will be able to: CO1 Identify many of familiar systems as vector spaces and operate with them using vector space tools such as basis and dimension. CO2 Understand linear transformations and manipulate them using their matrix representations. CO3 Students completing this course will be able to find the matrix representation of a linear transformation given bases of the relevant vector spaces.

UNIT I:

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

UNIT II:

Linear transformations, null space, range, rank, and nullity of a linear transformation, matrix representation of a linear transformation, algebra of linear transformations.

UNIT III:

Dual Space, Dual Basis, Double Dual, Eigen values, and Eigen vectors, Characteristic Polynomial**.**

UNIT IV:

Isomorphism's, Isomorphism theorems, invariability and isomorphism's, change of coordinate matrix.

Text and Reference Books

S. No	**Name**	**Author(S)**	**Publisher**
1	Linear Algebra,	Stephen H. Friedberg	Prentice-Hall of India
2	Linear Algebra and its Applications	David C. Lay	Pearson
3	Introduction to Linear Algebra	S. Lang,	Springer
4	Linear Algebra and its Applications	Gilbert Strang	Cengage Learning

GENERALENGLISH–I

Course Code	**MAT307**
Course Title	**Theory of Equations**
Type of course	Discipline Elective Course
L T P	5 1 0
Credits	6
Course prerequisite	B.Sc. /B.A. Ist, IInd with Mathematics as one core subject
Course Objective (CO)	The aim of this course is to impart knowledge to the students about theory of equations.
Course outcomes	By the end of the course, students will be able to: CO1 Understand the basic concept of polynomials and its significance properties. CO2 Lean about the Descarte's rule of signs positive and negative rule and Relation between the roots and the coefficients of equations. CO3 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

Newton's theorem on the sums of powers of roots, homogeneous products, limits of the roots of equations, Separation of the roots of equations.

Unit-IV

Strums theorem, 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

3	Higher Algebra	Hall and Knight	Arihant

Course Code	**MAT302**
Course Title	**Integral Calculus**
Type of course	Discipline Elective
L T P	5 1 0
Credits	6
Course prerequisite	B.Sc. /B.A. Ist, IInd with Mathematics as one core subject
Course Objective (CO)	The aim of this course is to impart practical knowledge to the students about integrals of functions of two, three variables, Riemann Integral and improper Integral.
Course Outcome	By the end of the course, students will be able to: CO1 Find the areas and lengths of curves in the plane, volumes and surfaces of solids of revolution. CO2 Solve the double and triple integration CO3 Understand the concept of Riemann Integral and to solve the improper integrals.

UNIT I:

Integrals of functions of two variables, double integrals, Applications to evaluation of area, volumes and surfaces of solids of revolution, Change of order of Integration. Change of variables.

UNIT II:

Integrals of functions of three variables, Triple integral, Evaluation of volume, density etc., Change of order of Integration. Change of variables. Implicit and Explicit functions, Integration of hyperbolic and inverse hyperbolic functions

UNIT III:

Riemann Integral. Integrability of continuous and monotonic functions. The fundamental theorem of integral calculus. Mean value theorems of integral calculus.

UNIT IV:

Convergence of improper integrals. Comparison tests, Abel's and Dirichlet's tests. Beta and Gamma functions. Frullani's integral. Integral as a function of a parameter, and its continuity, differentiability, and integrability.

Text and Reference Books

S. No	**Name**	**Author(S)**	**Publisher**
1	Calculus,	G.B. Thomas and R.L. Finney	Pearson Education
2	Calculus	H. Anton, I. Bivens	John Wiley and Sons

		and S. Davis	
3	Elementary Analysis, The Theory of Calculus	K.A. Ross	Springer

Course Code	**MAT306**
Course Title	**Complex Analysis**
Type of course	Discipline Elective
L T P	5 1 0
Credits	6
Course prerequisite	B.Sc. /B.A. Ist, IInd with Mathematics as one core subject
Course Objective (CO)	The aim of this course is to develops the knowledge of analytic function ,derivative function and Cauchy-Riemann equation
Course Outcome	By the end of the course, students will be able to: CO1 Demonstrate accurate and efficient use of complex analysis techniques. CO2 Express analytic functions in terms of power series and Laurent series. CO3 calculate complex line integrals and some infinite real integrals using Cauchy's integral theorem

UNIT I:

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.

UNIT II:

Analytic functions, examples of analytic functions, exponential function, Logarithmic function, trigonometric function, derivatives of functions, definite integrals of functions. Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals.

UNIT III:

Cauchy-Goursat theorem, Cauchy integral formula. Liouville's theorem and the fundamental theorem of algebra.

UNIT IV:

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

S. No	**Name**	**Author(S)**	**Publisher**
1	Complex Variables and Applications	James Ward Brown and Ruel V. Churchill	Hill International Edition
2	Complex analysis	Joseph Bak and Donald J. Newman	Springer-Verlag New York

3	Complex Analysis	J.V Deshpande	Tata McGraw-Hill Publishing Company

Course Code	**MAT308**
Course Title	Introduction to Operation Research
Type of course	Discipline Elective
L T P	5 1 0
Credits	6
Course prerequisite	B.Sc. /B.A. Ist, IInd with Mathematics as one core subject
Course Objective	The aim of this course is to help to understand Simplex Method, Big M Method, and Primal – dual Relationship.
Course Outcome	By the end of the course, students will be able to: CO1 prepare model a problem as a linear programming problem and to apply the appropriate method in order to find an optimal solution. CO2 Find primal – dual Relationship. CO3 Use transportation and game theory in real life problem.

UNIT I

Introduction to operational research: features, models, limitation. Introduction to linear programming problem their problem formulations .Graphical solution of linear programming problems , simplex method, Big- M method.

UNIT II

Primal dual relationship, formulation of dual problems. Duality in linear programming, economic interpretation of duality.

UNIT III

Transportation problem and its mathematical formulation, northwest-corner method, least cost method and Vogel approximation method. 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

Text and Reference Books

S. No	Name	Author(S)	Publisher
1.	Linear programming and Network flows	Mokhtar S. Bazaraa	John Wiley and Sons
2.	Linear programming	Mokhtar S. Bazaraa	Tata McGraw Hill
3.	Operations Research, An Introduction	Hamdy A. Taha	Prentice- Hall India

AEC-Ability Enhancement Compulsory Courses

(SEMESTER I to VI)

GENERALENGLISH–I

Course Code	**ENG101**
Course Title	**General English-I**
Type Course	Theory
LTP	3:0:0
Credits	**3**
Course Pre-requisite	+2
Course Objective(CO)	1. The students will critically read and analyze the prescribed texts. 2. The students will learn effective word choice, vocabulary, idioms, grammarandsentencestructureallowingaccuratecommunicationofmeaningi nwrittenwork. 3. The students will recognize the correct usage often seism context.
Course Outcomes	1. The learners will be able to use the English language to make and communicate meaning in spoken and written contexts. 2. The student will begin to know the difference between spoken and literary language. 3. The exhaustive exercises in Murphy's Grammar will remove their doubts in tenses, if they had any.

UNITI

Tales of Life: The Umbrella (Guy de Maupassant), The Story Teller (H. H. Munro Saki)
Prose for Young Learners: On Spendthrifts, The Power of Women (Richard Gordon)

UNITII

Tales of Life: The Lament (Anton Pavlovich Chekhov), the Luncheon (William Somerset Maugham)
Prose for Young Learners: A Dialogue On Democracy (Albert Sydney Hornby), Universal Declaration of Human Rights

UNITIII

Tales of Life: The Shroud (Prem Chand)
Prose for Young Learners: Symptoms (Jerome K. Jerome)

UNITIV

English Grammar in Use: Units 1 to 25
Paragraph Writing

Text and Reference books:

S.No.	Author(S)	Year	Title	Publisher
1	Singh,S	2008	Tales of Life	Press and Publication Department , GNDU, Amritsar.
2	Tewari,A. K, Midha,V.K, Sharma,R.K	2011	Prose For Young Learners	Publication Bureau, GNDU ,Amritsar
3	Murphy,R	2015	English Grammar in Use, 4^{th}edn.	CUP

GENERALENGLISH-II

Course Code	**PBI101**
Course Title	**General Punjabi-I**
Type of Course	Theory
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 outcome	CO1 ividAwrQI AwDuink pMjwbI kvIAW dI jIvnI qoN jwxU hoxgy[CO2 ividAwrQIAW nUM AwDuink pMjwbI kivqw dI ivSYgq jwxkwrI ho jwvygI[CO3 ividAwrQIAW iv`c ryKw ic`qrW dw AiDAYn krn dw hunr auqpMn hovygw[

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

GENERALENGLISH-II

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	Theory
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 outcome	CO1 The Student will acquire the knowledge about Punjab and its Historical Resources. CO2 The Student will understand the Harppan Culture and different Vedic Periods. CO3 The Students will analyze the Alexander's invasions.

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.	Author's	Title	Publisher
1	Sukhdev Sharma	History And Culture Of Punjab	New Academic Publisher
2	Romila Thapar	A History of India, Vol. I	Penguin Books

GENERALENGLISH-II

Course Code	ENG102
Course Title	General English-II
Type of course	Theory
LTP	3:0:0
Credits	3
Course prerequisite	NA
Course Objectives(CO)	1. Students will demonstrate familiarity with major poets, works and genres. 2. Students will acquire the ability to read, write and think critically. 3. The student will get to understand better the usage of modals, Voice, Narration and interrogatives.
Course Outcomes	1. The learners will be able to use the English language to make and communicate meaning in spoken and written contexts. 2. The students will learn effective word choice, vocabulary, idioms, grammar and sentence structure allowing accurate communication of meaning in written work. 3. With better knowledge of modals, voice and narration, the learners will confidently handle all modules of the English language.

UNITI

Tales of Life: The Doll's House (Katherine Mansfield), Eveline (James Joyce)

Prose for Young Learners**:** The School for Sympathy (E.V. Lucas) AIDS (U.N. Report)

UNITII

Tales of Life: The Taboo (Victor Astafyev), A Strand of Cotton (Suneet Chopra)

Prose for Young Learners**:** Beauty And The Beast (R.K. Narayan)**,**

With A Song on Their Lips (Hugh & Colleen Gantzer)

UNIT-III

Tales of Life: Toba Tek Singh (Saadat Hassan Manto)

Prose for Young Learners: My Financial Career (Stephen Leacock)

UNIT-IV

English Grammar in Use: Units 26 to 52 &

Personal Letter Writing

Text and Reference books**:**

S.No.	Author(S)	Title	Publishers
1	Singh,S	Tales of Life	Press and Publication Department, GNDU, Amritsar.
2	Tewari, A.K. Midha, V.K,Sharma,	Prose For Young Learners	Press and Publication Department, GNDU, Amritsar.
3	Murphy,R	English Grammar in Use	CUP

Course Code	**PBI102**
Course Title	**General Punjabi-II**
Type of Course	Theory
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 outcome	CO1 ividAwrQIAW iv`c ryKw ic`qrW dw Alocnwqmk AiDAYn krn dw hunr auqpMn hovygw[CO2 ividAwrQIAW nUM AwDuink pMjwbI khwxI dI ivSYgq jwxkwrI ho jwvygI[CO3 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

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	Theory
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 outcome	CO1 The Student will acquire the knowledge about Punjab and its Historical Resources. CO2 The Student will understand the Harppan Culture and different Vedic Periods. CO3 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.	Author's	Title	Publisher
1	Sukhdev Sharma	History And Culture Of Punjab	New Academic Publisher
2	Romila Thapar	A History of India, Vol. I	Penguin Books

3	L.M.Joshi	History and Culture of the Punjab, Vol. I	Punjabi University, Patiala

Course Code	**EVS201**
Course Title	**Environmental Science**
Type of course	Theory
L T P	3 0 0
Credits	3
Course prerequisite	NA
Course Objective (CO)	To make students aware about environment and need of maintaining it with best possible knowledge.
Course outcome	CO1 To gain understanding of enviornment and ecosystem. CO2 To study environmental pollutions and natural resources. CO3 To study social issues related to envionment.

UNIT-I

Introduction to Environment and Ecosystem: Definition and scope and importance of multidisciplinary nature of environment. Need for public awareness, Concept of Ecosystem, Structure, interrelationship, producers, Consumers and decomposers, ecological pyramids-biodiversity and importance. Hot spots of biodiversity.

UNIT-II

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

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

UNIT-IV

Human Population and the Environment & Field Work: 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. Case studies

Visit to a local area to document environemntal assetsriver/forest/grassland/hill/mountain;Visit to a local polluted site-Urban/Rural/Industrial/Agricultural;Study of common plants, insects, birds;Study of simple ecosystems-pond, river, hill slopes, etc.

Text and reference books:

S. No	Title	Author(S)	Publisher
1	A Textbook for Environmental Studies	Erach Bharucha	
2	Environmental Biology,	Agarwal, K.C. 2001	Nidi Publ. Ltd. Bikaner.
3	Environmental Science,	Miller T.G. Jr.	Wadsworth

Course Code	**SSC001**
Course Title	**Gender Equity**
Type of course	ID
L T P	3:0:0
Credits	3
Course prerequisite	NA
Course Objectives (CO)	1. The students will be able to acquire knowledge and understanding of theory and concepts related to gender and gender relations 2. The students will be able to critically reflect how gender is a development issue.
Course Outcome	CO1 Students will have a working knowledge of important mathematical concepts in abstract algebrasuch as definition of a group, order of a finite group and order of an element. CO2 Students will be knowledgeable of different types of subgroups such asnormal subgroups, cyclic subgroups and understand the structure and characteristics of these subgroups. CO3 Students will see and understand the connection and transition between previously studied mathematics and more advanced mathematics.

UNIT I

Concept of sex and gender

Gender attributes and questions of identity.

UNIT II

Empowerment- concept and meaning.

Definition of feminism, feminist and women movements in U.S.A, U.K., France and India

UNIT III

Women development and development organizations.

Impact of development on gender.

UNIT IV

Policies and current debates on women rights.

Role of UN in establishing gender equality.

Violence against women and need for reforms.

Text and Reference Books:

S.No.	Author(S)	Year	Title	Publisher

1	Jayachandran, Seema	2014	The Roots of Gender Inequality in Developing Countries	NBER Working Paper No.20380. Issued in August 2014
2	Duflo, Esther	2012	Women's Empowerment and Economic Development	*Journal of Economic Literature, 50(4): 1051-79.*

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

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

Understanding the need, basic guidelines, content and process for Value Education, Understanding Happiness and Prosperity correctly.
Understanding Harmony in the Human Being : Understanding the harmony with self and the Body: Sanyam and Swasthya.

UNIT II:Harmony in Human Relationship:

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

UNIT III: Understanding of Harmony on Professional Ethics:

Ability to utilize the professional competence for augmenting universal human order, Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems

.

UNIT IV:Strategy for transition from the present state to Universal Human Order:

At the level of individual, at the level of society. **Case studies**: typical holistic technologies, management models and production systems

Recommended Books

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

Course Code	**ENG004**
Course Title	**Communication Skills and Personality Development**
Type of course	**ID**
L T P	2 0 2
Credits	3 0 0
Course prerequisite	10+2 (Non Medical or Medical) or Equivalent
Course objective	Main objective of the extension subject is to introduce the students to communication skills and personality development.
Course Outcome	Students will use their communication skills and personality effectively.

Theory

UNIT-1 Communication Skills: Structural and functional grammar; meaning and process of communication, verbal and nonverbal communication.

UNIT-1I

Listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures.

UNIT-III

Reading and comprehension of general and technical articles, precise writing, summarizing, abstracting.

UNIT-1V

Individual and group presentations, impromptu presentation, public speaking; Group discussion. Organizing seminars and conferences.

Practical

1. Listening and note taking, writing skills, oral presentation skills.
2. Field diary and lab record; indexing, footnote and bibliographic procedures.
3. Reading and comprehension of general and technical articles, precise writing, summarizing, abstracting; individual and group presentations.

Recommended Books:

S. No	Name	Author(S)	Publisher
1	Agriculture Demonstration and Extension Communication	Ram Krishan	P S Jayasinghe Asia Publishing House
2	Communication Skills and Personality Development		Kalyani Publishers. Ludhiana,
3	Communication Skills and Personality Development		Nirali Prakashan

Semester	**III-VI**
Course Code	
Course Title	**Practical Training**
Type of course	Ability Enhancement Course
L T P	0 0 72
Credits	NC
Course prerequisite	NA
Course Objective	The course would develop soft skills of students, scientific aptitude, critical thinking, writing and research presentation.
Course Outcomes	The students will be able to: 1. Investigate various practical aspects related to the chemistry, Physics, mathematics and computers. 2. Appreciate the literature and its relevance to his/her topic of interest how to write a report on a given topic. 3. Technical write and presentation on a given topic of training

- **Practical training of 72 hours (Non credit based) have been included in course curriculum of B.Sc Non Medical: : Students have to complete their practical training in 3 year degree tenure and have to be evaluated on the basis of final submission of report and presentation before the Departmental Committee .**

- **For report compilation,** Student will contact the respective mentors/practical training coordinator at allocated schedule to:
- Conduct the literature survey of the topic/project allotted.
- Prepare a detail report in consultation with mentor.

Students should complete their practical Training during (minimum 72 hours) in intradepartmental and interdepartmental labs/workshops) and the student will give final presentation of their practical training before the departmental committee.