SCHEME & SYLLABUS
B.Sc Non-Medical
(4 year programme as per NEP)

Department of Physical Sciences
University Institute of Sciences (UIS)
Sant Baba Bhag Singh University
2022

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.

BSc. Non medical (Bachelor of Science in Non Medical)

(4 year Programme as per NEP)

B.Sc (Non medical) is a four 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

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

4 Years

CAREER PATHWAYS

Areas that offer jobs for B.Sc. degree holder are: -Education, College, Universities, Research firms, Environmental management and conservation, Forest services, Chemical industry, Biotechnology, Pharmaceutical companies, Geological survey department, Wastewater plants, Testing laboratories, Engineering firms, Oil Companies, 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 Jobs: After B.Sc (Non Medical) student can do B.Ed, M.Sc., M.phil. and Ph.D.

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 constructs a bridge between the theoretical and practical aspects of Physical Sciences & inculcates 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 ethics and goals.

PO11: Communication Skills: Effective communication is a much desirable attribute across courses. However, a Physics, Chemistry and Mathematics student is expected to assimilate technical information about Physics, Chemistry and Mathematics 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.

CURRICULUM STRUCTURE AS PER NEP

B.Sc. (Non Medical) degree programme will have a curriculum with Syllabi consisting of following type of courses:

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

II. **Elective Courses:** Elective course is generally a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/subject of study or 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 SpecificElective.

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

III. **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.

IV. 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.

2. NOMENCLATURE USED:

A. Graduate Core Courses
i. Core Courses. Major Courses (MC)
ii. Theory subject (T)
iii. Practical (P)

B. Ability Enhancement Courses/Minor Courses (AEC):
i. Ability Enhancement Compulsory Courses (AECC)
ii. Skill Enhancement Courses (SEC).

C. Elective Courses (EL-Major)
i. Discipline Specific Elective (DSE)

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MATHEMATICS COURSES				
Core Courses/Major Courses(semester-I to IV)				
S.No	**Subject Code**	**Subject Name**	**Semester**	**Page number**
1.	**MAT161**	Calculus and Matrices	Semester-I	96
2.	**MAT162**	Differential Equations	Semester-II	97
3.	**MAT261**	Real Analysis	Semester-III	98
4.	**MAT262**	Algebra	Semester-IV	99
Discipline Subject Elective courses (semester-V,VI) Any two of each subject in both semesters				
5.	**MAT361**	Linear Algebra	Semester-V	100
6.	**MAT363**	Theory of Equations	Semester-V	101
7.	**MAT362**	Integral Calculus	Semester-VI	102
8.	**MAT364**	Introduction to Operation Research	Semester-VI	103
Discipline Subject Elective courses (semester-VII,VIII) Any Three theory subject in both semesters Any One practical subject in VII sem and Any Two practical subjects in VIII sem				
9.	**MAT461**	Advanced Real Analysis-I	Semester-VII	104
10	**MAT463**	Abstract Algebra-I	Semester-VII	105
11	**MAT465**	Advanced Differential Equations	Semester-VII	106
12	**MAT467**	Introduction to Statistics	Semester-VII	107
13	**MAT469**	Mathematical Tools and Software- Practical	Semester-VII	108
14	**MAT462**	Advanced Real Analysis -II	Semester-VIII	109
15	**MAT464**	Abstract Algebra-II	Semester-VIII	110
16	**MAT466**	Numerical Analysis	Semester-VIII	111
17	**MAT468**	Fourier Series and Integral Equations	Semester-VIII	112
18	**MAT470**	Calculus and Matrices- Practical	Semester-VIII	113
19	**MAT472**	Statistical Lab	Semester-VIII	114
Skill enhancement courses/Minor Courses (semester-III to VI)				
20	**MAT265**	Logic and Graph theory	Semester-III	115
21	**MAT266**	Number theory	Semester-IV	116
22	**MAT369**	Vector Calculus	Semester-V	117

23	**MAT364**	Probability and Statistics	Semester-VI	118
AECC-Ability Enhancement Compulsory Courses (semester I - VIII)				
24	**ENG 121**	Communication Skill I	Semester-I	119
25	**ENG 123**	Communication Skill I Lab	Semester-I	120
26	**ENG 114**	Communication Skill II	Semester-II	121
27	**ENG 116**	Communication Skill II Lab	Semester-II	122
28	**EVS001**	Environmental science	Semester-III	123
29	**SSC001**	Gender Equity	Semester-IV	124
30	**SSC006**	Human values and professional ethics	Semester-V	125
31	**CSE014**	Basics of Computer Sciences	Semester-VI	126
32	**CSE016**	Basics of Computer Sciences Lab	Semester-VI	127-128
33	**RM401**	Research Methodology &Intellectual Property Rights	Semester-VII	129-130
34	**RLS401**	Review of Literature & Seminar	Semester-VII	131
35	**DPR402**	Dissertation / Project report	Semester-VIII	132

Course Scheme for B.Sc. Non Medical (As Per NEP)

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	Major (Core)	PHY161	Physics I: Mechanics	4:0:0	4:0:0	4	4
2	Major (Core)	CHM161	Chemistry I : Atomic Structure,Bonding, General Organic Chemistry & Aliphatic Hydrocarbons	4:0:0	4:0:0	4	4
3	Major (Core)	MAT161	Calculus and Matrices	5:1:0	5:1:0	6	6
4	Minor(AEC)	ENG121	Communication Skill-I	2:0:0	2:0:0	2	2
5	Minor (Skill)	PT161/PT163/PT165	NSO/NCC/NSS	2:0:0	Non-credit	2	NC

II. Practical Subjects

1	Major (Core)	PHY163	PhysicsI: Mechanics(Practical)	0:0:4	0:0:2	4	2
2	Major (Core)	CHM163	Chemistry I : Atomic Structure, Bonding, General Organic Chemistry &Aliphatic Hydrocarbons (Practical)	0:0:4	0:0:2	4	2
3	Minor(AEC)	ENG123	Communication Skill-I Lab	0:0:2	0:0:1	2	1
	Total					**28**	**21**

Total Contact Hours: 28

Total Credit Hours: 21

Major/CR- Core Course

Minor/AEC-Ability Enhancement Compulsory Courses

Course Scheme for B.Sc. Non Medical (As Per NEP)

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	Major (Core)	PHY162	Physics II: Electricity and Magnetism	4:0:0	4:0:0	4	4
2	Major (Core)	CHM162	Chemistry II : Chemical Energetics, Equilibrium& FunctionalGroups Organic Chemistry-I	4:0:0	4:0:0	4	4
3	Major (Core)	MAT162	Differential Equations	5:1:0	5:1:0	6	6
4	Minor(AEC)	ENG114	Communication Skill-II	2:0:0	2:0:0	2	2
5	Minor (Skill)	PT162/PT164/PT166	NSO/NCC/NSS	2:0:0	Non-credit	2	NC

II. Practical Subjects

1	Major (Core)	PHY164	Physics II: Electricity andMagnetism (Practical)	0:0:4	0:0:2	4	2
2	Major (Core)	CHM164	Chemistry II : Chemical Energetics,Equilibrium & FunctionalGroup Organic Chemistry-I (Practical)	0:0:4	0:0:2	4	2
3	Minor(AEC)	ENG116	Communication Skill-II Lab	0:0:2	0:0:1	2	1
	Total					**28**	**21**

Total Contact Hours: 28

Total Credit Hours: 21

Major/CR- Core Course

Minor.AECC-Ability Enhancement Compulsory Courses

Course Scheme for B.Sc. Non Medical (As Per NEP)

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	Major (Core)	PHY261	Physics III: Thermal Physics	4:0:0	4:0:0	4	4
2	Major (Core)	CHM261	Chemistry III : Solutions, Phase Equilibrium, Conductance,Electrochemistry & Functional Group Organic Chemistry-II	4:0:0	4:0:0	4	4
3	Major (Core)	MAT261	Real Analysis	5:1:0	5:1:0	6	6
4	Minor(AEC)	EVS001	Environmental Science	3:0:0	3:0:0	3	3
5	Minor(SEC-I)	PHY265 CHM265 MAT265	Elective subject (Skill Enhancement Course)-I(any one of the following) Physics Workshop Skill Basic Analytical chemistry Logic and Graph Theory	2:0:0	2:0:0	2	2

II. Practical Subjects

1	Major (Core)	PHY263	Physics III: Thermal Physics (Practical)	0:0:4	0:0:2	4	2
2	Major (Core)	CHM263	Chemistry III : Solutions, Phase Equilibrium, Conductance,Electrochemistry & Functional Group Organic Chemistry-II (Practical)	0:0:4	0:0:2	4	2
			Total			**27**	**23**

Total Contact Hours: 27

Total Credit Hours: 23

Major/CR- Core Course

Minor/AECC-Ability Enhancement Compulsory Courses

SEC-Skill Enhancement Course

Course Scheme for B.Sc. Non Medical (As Per NEP)

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	Major (Core)	PHY262	Physics IV: Waves and Optics	4:0:0	4:0:0	4	4
2	Major (Core)	CHM262	Chemistry IV : Transition Metal &Coordination Chemistry, States of Matter & Chemical Kinetics	4:0:0	4:0:0	4	4
3	Major (Core)	MAT262	Algebra	5:1:0	5:1:0	6	6
4	Minor/AEC	SSC001	Gender Equity	3:0:0	3:0:0	3	3
5	Minor (SEC-II)	PHY266 CHM270 MAT266	Elective subject (Skill Enhancement Course)-II(any one of the following) Electric Circuits and Network Skills Green Methods in Chemistry Number Theory	2:0:0	2:0:0	2	2

II. Practical Subjects

1	Major (Core)	PHY264	Physics IV: Waves and Optics (Practical)	0:0:4	0:0:2	4	2
2	Major (Core)	CHM264	Chemistry IV : 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

Course Scheme for B.Sc. Non Medical (As Per NEP)

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	Major(DSE-I)	PHY363 PHY367	Discipline specific Elective course-I(any one of the following) PhysicsV A : Digital, analog Circuits and Instrumentation Physics V B : Elements of Modern Physics	4:0:0	4:0:0	4	4
2	Major(DSE-I)	CHM361 CHM365 CHM369	Discipline specific Elective course-I(any one of the following) Chemistry VA: Molecules of Life Chemistry VB: Organometallic, Bioinorganic Chemistry, Polynuclear Hydrocarbons and UV, IR Spectroscopy Chemistry VC: Industrial chemicals and Environment	4:0:0	4:0:0	4	4
3	Major(DSE-I)	MAT361 MAT363	Discipline specific Elective course-I(any one of the following) Linear Algebra Theory of Equations	5:1:0	5:1:0	6	6
4	Minor(AEC)	SSC006	Human values and professional ethics	3:0:0	3:0:0	3	3
5	Minor(SEC-III)	PHY361 CHM375 MAT369	Elective subject(Skill Enhancement Course)-III(any one of the following) Renewable and Energy Harvesting Fuel Chemistry Vector Calculus	2:0:0	2:0:0	2	2

II. Practical Subjects

1	Major(DSE-I)	PHY365 PHY369	Discipline specific Elective Practical-I (any one of the following) PhysicsV A : Digital, analog Circuits and Instrumentation (Practical) Physics V B : Elements of Modern Physics (Practical)	0:0:4	0:0:2	4	2
2	Major(DSE-I)	CHM363 CHM367 CHM371	Discipline specific Elective Practical-I(any one of the following) Chemistry V A: Molecules of Life(Practical) Chemistry V B: Organometallic, Bioinorganic Chemistry, Polynuclear Hydrocarbons and UV, IR Spectroscopy(Practical) Chemistry V C: Industrial chemicals and Environment(Practical)	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

Course Scheme for B.Sc. Non Medical (As Per NEP)

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	Major(DSE-II)	PHY362 PHY366 PHY370	Discipline specific Elective course-II(any one of the following Physics VI A : Solid State Physics Physics VI B : Embedded System: Introduction to Microcontroller Physics VI C : Nuclear & Particle Physics	4:0:0	4:0:0	4	4
2	Major(DSE-II)	CHM362 CHM366 CHM370	Discipline specific Elective course-II(any oneof the following Chemistry VI A: Chemistry of main group elements, theories of acids and bases Chemistry VI B: Analytical method in chemistry Chemistry-VI C: Inorganic Materials of Industrial Importance	4:0:0	4:0:0	4	4
3	Major(DSE-II)	MAT362 MAT366	Discipline specific Elective course-II(any oneof the following) Integral Calculus Introduction to operation Research	5:1:0	5:1:0	6	6
4	Minor(SEC-IV)	PHY374 CHM374 CHM376 MAT374	Elective subject(SkillEnhancementCourse)-IV(any one of the following) Radiology and Safety Basic Pharmaceutical Chemistry Chemistry of Cosmetics and Perfumes Probability and Statistics	2:0:0	2:0:0	2	2
5	Minor(ID/SEC)	CSE014	Basics of Computer Sciences	2:0:0	2:0:0	2	2

II. Practical Subjects

1	Major(DSE-II)	PHY364 PHY368 PHY372	Discipline specific Elective Practical-II(any one of the following) Physics VI A : Solid State Physics (Practical) Physics VI B : Embedded System: Introduction to Microcontroller (Practical) Physics VI C : Nuclear & Particle Physics (Practical)	0:0:4	0:0:2	4	2
2	Major(DSE-II)	CHM364 CHM368 CHM372	Discipline specific Elective Practical-II(any one of the following) Chemistry VIA: Chemistry of main group elements, theories of acids and bases (Practical) Chemistry VIB: Analytical method in chemistry (Practical) Chemistry-VIC: Inorganic Materials of Industrial Importance (Practical)	0:0:4	0:0:2	4	2
3	Minor(ID/SEC)	CSE016	Basics of Computer Sciences Lab	0:0:2	0:0:1	2	1
	Total					**28**	**23**

Total Contact Hours: 28

Total Credit Hours: 21

DSE-Discipline Specific Elective

SEC-Skill Enhancement Course

Course Scheme for B.Sc. Non Medical (As Per NEP)

Semester-VII

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	Major (DSE-III) Any one specialization	PHY461 PHY465 PHY469	Discipline specific Elective course- III(any three of the following) Physics VII - A : Electronics Physics VII - B : Electromagnetic Theory Physics VII - C : Classical Mechanics	4:0:0	4:0:0	4	4
2		CHM461 CHM463 CHM465 CHM467 CHM469	Discipline specific Elective course- III(any three of the following) Chemistry VII - A :Main Group Chemistry Chemistry VII - B :Organic Reaction Mechanism-I Chemistry VII - C :Chemical Thermodynamics and its applications Chemistry VII - D :Industrial Chemical analysis & Quality Control Chemistry VII - E :Nano-Science & Nano Chemistry	4:0:0	4:0:0	4	4
3		MAT461 MAT463 MAT465 MAT467	Discipline specific Elective course- III(any three of the following) Advanced Real Analysis-I Abstract Algebra-I Advanced Differential Equations Introduction to Statistics	4:0:0	4:0:0	4	4
4	Minor/ (SEC-IV)	RM401	Research Methodology & Intellectual Property Rights	4:0:0	4:0:0	4	4

IIPractical Subjects

1	Major (SEC)	RLS401	Review of Literature & Seminar	0:0:8	0:0:4	8	4
2	Major (DSE-III) Any one specialization	PHY463 PHY467	Discipline specific Elective Practical-III(any one of the following) Physics VII A : Electronics (Practical) Physics VII B : Electromagnetic Theory (Practical)	0:0:4	0:0:2	4	2
3		CHM471	Discipline specific Elective Practical-III Chemistry VII F :Inorganic Chemistry (Practical-1)	0:0:4	0:0:2	4	2
4		MAT469	Discipline specific Elective Practical-III(any one of the following) Mathematical Tools and Software-(Practical)	0:0:4	0:0:2	4	2
	Total					**28**	**22**

Total Contact Hours: 28
Total Credit Hours: 22

DSE-Discipline Specific Elective
SEC-Skill Enhancement Course

Course Scheme for B.Sc. Non Medical (As Per NEP)

Semester-VIII

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	Major (DSE-IV) Any one specialization	PHY462 PHY464 PHY468 PHY472	Discipline specific Elective course- IV (any three of the following) Physics VIII A : Statistical Mechanics Physics VIII B : Condensed Matter Physics Physics VIII C : Physics of Nanomaterials Physics VIII D : Quantum Mechanics	4:0:0	4:0:0	4	4
2		CHM462 CHM464 CHM466 CHM468 CHM470	Discipline specific Elective course- IV (any three of the following) Chemistry VIII A: Chemistry of Natural Products & Heterocyclic Chemistry ChemistryVIII B: Chemical Kinetics & Chemical Equilibrium Chemistry VIII C: Coordination Chemistry Chemistry VIII D: Bio-Organic Chemistry Chemistry VIII E: Industrial Chemistry	4:0:0	4:0:0	4	4
3		MAT462 MAT464 MAT466 MAT468	Discipline specific Elective course- IV (any three of the following) Advanced Real Analysis -II Abstract Algebra-II Numerical Analysis Fourier Series and Integral Equations	4:0:0	4:0:0	4	4

II. Practical Subjects

1	Major(SEC)	DPR402	Dissertation/ Project report	0:0:12	0:0:6	12	6
2	Major (DSE-IV) Any one specialization	PHY466 PHY470	Discipline specific Elective Practical-IV (both are compulsory) Physics VIII B : Condensed Matter Physics (Practical) Physics VIII C : Physics of Nanomaterials (Practical)	0:0:4	0:0:2	4	2
3		CHM472 CHM474	Discipline specific Elective Practical-IV (both are compulsory) Organic Chemistry Practical-1 Physical Chemistry Practical-I	0:0:4	0:0:2	4	2
4		MAT470 MAT472	Discipline specific Elective Practical-IV (both are compulsory) Calculus and Matrices- Practical Statistical Lab	0:0:4	0:0:2	4	2
	Total					**32**	**22**

Total Contact Hours: 32
Total Credit Hours: 22

DSE-Discipline Specific Elective
SEC-Skill Enhancement Course

Course Scheme Summary

Semester	L	T	P	Contact hrs/wk	Credits	CR	AEC	SEC	DSE
1	**15**	**1**	**5**	**28**	**21**	**18**	**2**		
2	**15**	**1**	**5**	**28**	**21**	**18**	**2**		
3	**18**	**1**	**4**	**27**	**23**	**18**	**3**	**2**	
4	**18**	**1**	**4**	**27**	**23**	**18**	**3**	**2**	
5	**18**	**1**	**4**	**27**	**23**		**3**	**2**	**18**
6	**15**	**1**	**5**	**28**	**23**		**1**	**4**	**18**
7	**16**		**6**	**28**	**22**		**4**	**4**	**14**
8	**12**		**10**	**32**	**22**			**6**	**16**
Total	**127**	**6**	**43**	**223**	**178**	**72**	**18**	**20**	**66**

SCHEME & SYLLABUS
of
Physics
for
B.Sc Non-Medical

4 year programme

(As Per NEP)

(Major Courses)

CORE COURSES

(Semester I-IV)

SEMESTER I

Semester	**I**
Course Code	**PHY161**
Course Title	**Physics I: 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 this course is to** 1. Enhance the knowledge of students in mechanics. 2. Impart the knowledge of Carstein coordinates, central forces, rotational system.
Course Outcomes (CO)	**By the end of this course, students will be 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.

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 linearmomentum & 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-II

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-III

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 σby 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.	Title	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.

Semester	**I**
Course Code	**PHY163**
Course Title	**Physics-I: Mechanics (Practical)**
Type of course	Practical
L T P	0:0:4
Credits	2
Course prerequisite	10+2 physics with a core subject
Course Objective	**The aim of this course is to** 1. Impart practical knowledge to the students and provide them with exposure of basic measuring instruments in mechanics. 2.Impart practical knowledge of the working principle of instruments
Course Outcomes (CO)	**By the end of this course, students will be 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.	Title	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 IInd

Semester	**II**
Course Code	**PHY162**
Course Title	**Physics II: Electricity and Magnetism**
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 this course is to** 1. Enhance the knowledge of students in Electricity and Magnetism. 2. Ehance understanding of Electromagnetic applications.
Course Outcomes (CO)	**By the end of this course, students will be able to** CO1understand 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:

Sr No.	Title	Author(s)	Publisher
1	Introduction to Electrodynamics	D J Griffith	Prentice-Hall of India
2	Physics Vol 2	Halliday and Resnik	Tata McGraw-Hill
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.

Semester	**II**
Course Code	**PHY164**
Course Title	**Physics II: Electricity and Magnetism (Practical)**
Type of course	Practical
L T P	0:0:4
Credits	2
Course prerequisite	10+2 with physics as core subject
Course Objective	**The aim of this course is to** 1. Impart practical knowledge to the students and provide them with practical exposure of electricity and magnetism. 2. Impart practically the knowledge of role of electric instruments in working of applicances.
Course Outcomes (CO)	**By the end of this course, students will be 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)

Text and Reference Books:

Sr No.	Title	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	Indu Prakash and Ramakrishna	11th Edition, 2011, Kitab Mahal,

	Physics		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 IIIrd

Semester	**III**
Course Code	**PHY261**
Course Title	**Physics III: Thermal physics**
Type of course	Theory
L T P	4:0:0
Credits	4
Course prerequisite	BSc. Ist with physics as core subject.
Course Objective	**The aim of this course is to** 1. Impart theoretical knowledge to the students in thermal, statistical and atomic physics. 2. Impart the understanding of basic thermodynamics.
Course Outcomes (CO)	**By the end of this course, students will be 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.

UNIT-II

Entropy: Second law & Entropy, Carnot's cycle & theorem, changes in reversible & irreversible processes, Entropy-temperature diagrams**,** Third law of thermodynamics, Unattainability of absolute zero, Gibbs, Helmholtz and Internal Energy functions, Maxwell's equations, Clausius- Clapeyron equation, Expression for (CP – CV), CP/CV, TdS equations**.**

UNIT-III

Thermodynamic Potentials: Enthalpy, Joule Thomson effect, Use of Joule Thomson effect in liquefaction of gases, Low temperatures: Production and measurement of very low temperatures, adiabatic demagnetization, Phase transitions of first and second orders, phase diagrams of Helium Gibbs phase and its applications.

UNIT –IV

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

Text and reference books:

S.No	Title	Author	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.

Semester	**III**
Course Code	**PHY263**
Course Title	**Physics III: Thermal physics (Practical)**
Type of course	Practical
L T P	0:0: 4
Credits	2
Course prerequisite	BSc. Ist with physics as core subject
Course Objective	**The aim of this course is to** 1. Impart practical knowledge to the students and provide them with exposure of thermodynamics& and statistical mechanics. 2. Enhance the practical knowledge related to concept of heat, energy.
Course Outcomes (CO)	**By the end of this course, students will be 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 of material.
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	Title	Author	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 IVth

Semester	**IV**
Course Code	**PHY262**
Course Title	**Physics IV: 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 aim of this course is to** 1. Enhance the knowledge of students in wave and optics. 2. Understand the working concepts of wave motion, interference, polarization, diffraction.
Course Outcomes (CO)	**By the end of this course, students will be 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), Determinationof 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	Title	Author	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

Semester	**IV**
Course Code	**PHY264**
Course Title	**Physics IV: Waves and optics (Practical)**
Type of course	Practical
L T P	0:0:4
Credits	2
Course prerequisite	BSc. Ist with physics as core subject.
Course Objective	**The aim of this course is to** 1. Impart practical knowledge among the students and provides them with exposure on wave and optics related experiments. 2.Builds strong practical understanding of optical phenomenons.
Course Outcomes (CO)	**By the end of this course, students will be 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 experimentsfrom 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	Title	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

DISCIPLINE ELECTIVE COURSES (Semester V - VIII)

SEMESTER

Vth

Semester	**V**
Course Code	**PHY363**
Course Title	**Physics VA: Digital and analog circuits and instrumentation**
Type of course	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** **1.** Impart knowledge to the students about digital electronics and analog circuits and instrumentations. 2. Understanding of working principle of electrical devices.
Course Outcomes (CO)	**By the end of this course, students will be 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 andCC 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	Title	Author	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.

Semester	**V**
Course Code	**PHY365**
Course Title	**Physics VA: Digital and analog circuits and instrumentation (Practical)**
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 to** **1.** Impart practical knowledge to the students about digital electronics and analog circuits and instrumentations. 2. Build the strong practical knowledge abouts electrical instruments.
Course Outcomes (CO)	**By the end of this course, students will be 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	Title	Author	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.

Semester	**V**
Course Code	**PHY367**
Course Title	**Physics V B: Elements of modern physics**
Type of course	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** 1. Enhance the knowledge of students about the basic concept of quantum Mechanics and nuclear physics. 2. Understanding of microspic nature of wave functions.
Course Outcomes (CO)	**By the end of this course, students will be 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: 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. Wave-particle duality, Heisenberg uncertainty principle, 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	Title	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.

Semester	**V**
Course Code	**PHY369**
Course Title	**Physics V B: Elements of modern physics (Practical)**
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 to** 1. Impart practical knowledge of quantum mechanics and nuclear physics. 2. Enhance the understanding of functioning of of basic phenomenens,
Course Outcomes (CO)	**By the end of this course, students will be 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 odine Vapour.
9. To study the diffraction patterns of single and double slits using laser source 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	Title	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 publishers4th edition, reprinted 1985

SEMESTER VIth

Semester	**VI**
Course Code	**PHY362**
Course Title	**Physics-VIA: Solid state physics**
Type of course	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** 1. Enhance the knowledge of students in the field of solid state physics. 2. Learn basics of theories of crystal structure,magnetic, dielectric properties
Copurse Outcomes (CO)	**By the end of this course, students will be 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	Title	Author	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

Semester	**VI**
Course Code	**PHY364**
Course Title	**Physics-VIA: Solid state physics (Practical)**
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 to** **1.**Impart practical knowledge to the students about solid state physics. 2. Impart practical knowledge of principle behind the working of instrument like PN junction etc.
Course Outcomes (CO)	**By the end of this course, students will be 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 the approximate value off 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.	Title	Author	Publisher
1	Advanced practical physics for students	B.l. Flint and H.T Worsnop,	Asia publishing house1971
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

Semester	**VI**
Course Code	**PHY366**
Course Title	**Physics VIB: Embedded system: introduction to microcontrollers**
Type of course	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** **1.** Enhance knowledge of the students in the field of microcontrollers. 2. Uses of the microcontrollers in electronics, electrical circuits.
Course Outcomes (CO)	**By the end of this course, students will be able to** CO1: Understand the concept of Embedded system CO2: Understand the concept of microcontroller apply on the systems CO3: Solve the programming of 8085 microcontroller unit.

UNIT-I

Embedded system introduction: Introduction to embedded systems and general purpose computer systems, architecture of embedded system, classifications, applications and purpose of embedded systems, challenges and design issues in embedded systems, operational and non-operational quality attributes of embedded systems, elemental description of embedded processors and microcontrollers.

UNIT-II

8051 microcontroller: Introduction and block diagram of 8051 microcontroller, architecture of 8051, overview of 8051 family, 8051 assembly language programming, Program Counter and ROM memory map, Data types and directives, Flag bits and Program Status Word (PSW) register, Jump, loop and call instructions. Introduction of I/O port programming, pin out diagram of8051 microcontroller, I/O port pins description and their functions, I/O port programming in 8051, (Using Assembly Language), I/O programming: Bit manipulation.

UNIT-III

Programming of 8051: 8051addressing modes and accessing memory using various addressing modes, assembly language instructions using each addressing mode, arithmetic & logic instructions, 8051 programming in C:- for time delay and I/O operations and manipulation, for arithmetic & logic operations, for ASCII and BCD conversions, Programming 8051 timers.

UNIT-IV

Programming Embedded Systems: Structure of embedded program, infinite loop, compiling, linking and locating, downloading and debugging. Embedded system development environment, file types generated after cross compilation, disassembler/decompiler, simulator, emulator and debugging, embedded product.

Text and reference books:

S. no.	Title	Author	Publisher
1	Electronics: fundamentals and applications,	J.d. Ryder, 2004,	Prentice hall..
2	Microelectronic circuits,	M.h. Rashid, 2ndedn.,2011	Cengage learning.
3	Op-amps and linear integrated circuit,	R. A. Gayakwad, 4th edition, 2000,	Prentice hall.

Semester	**VI**
Course Code	**PHY368**
Course Title	**Physics VIB: Embedded system: Introduction to microcontrollers (practical)**
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 to** 1. Impart practical knowledge to the students of microcontrollers, embedded system. 2. Impart practical knowledge of the working of microcontroller and how it is use in building other circuits.
Course Outcomes (CO)	**By the end of this course, students will be able to** CO1: Determine 4 ports of 8051 embedded system. CO2:Determine LED using TIMER application. CO3:Infer LED effect by using embedded system.

LIST OF EXPERIMENTS

1. To find that the given numbers is prime or not.
2. To find the factorial of a number.
3. Use one of the four ports of 8051 for O/P interfaced to eight LED's. Simulate binary counter (8 bit) on LED's.
4. Program to glow first four LED then next four using TIMER application.
5. Program to rotate the contents of the accumulator first right and then left.
6. Program to run a countdown from 9-0 in the seven segment LED display.
7. To interface seven segment LED display with 8051 microcontroller and display 'HELP' in the seven segment LED display.

Text and reference books:

S. no.	Title	Author	Publisher
1	Electronics: fundamentals and applications,	J.d. Ryder, 2004,	Prentice hall..
2	Microelectronic circuits,	M.h. Rashid, 2ndedn.,2011	Cengage learning.
3	Op-amps and linear integrated circuit,	R. A. Gayakwad, 4th edition, 2000,	Prentice hall.

Semester	**VI**
Course Code	**PHY370**
Course Title	**Physics VIC: Nuclear & Particle Physics**
Type of course	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** 1. Impart theoretical knowledge to the students in the field of nuclear physics. 2.Enhances the knowledge of nuclear structure physics.
Course Outcomes (CO)	**By the end of this course, students will be 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.	Title	Author	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

Semester	**VI**
Course Code	**PHY372**
Course Title	**Physics VI C: Nuclear & Particle Physics (Practical)**
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 to** 1. Impart practical aspects of nuclear Physics to the students. 2. Understanding the working of GM counter and how it works in detecting radioactive particles.
Course Outcomes (CO)	**By the end of this course, students will be 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.	Title	Author	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	Introductory nuclear Physics	Kenneth S. Krane .	Wiley (1978)

SEMESTER VIIth

Semester	**VII**
Course Code	**PHY461**
Course Title	**Physics VII A: Electronics**
Type of course	Theory
L T P	4: 0: 0
Credits	4
Course prerequisite	B.Sc. IIIrd yrs with physics as one of major subjects
Course Objective (CO)	**The aim of this course is to** 1. Enhance the knowledge of students about various electronic circuits, electronic devices and its applications. 2. Understanding of working concept of various electrical and electronic devices.
Course Outcomes (CO)	**By the end of this course, students will be able to** CO1: To get to known about the working of various electronic devices. CO2: To gain basic knowledge of OPAMP and their applications in different areas. CO3: To understand the basics of digital electronics. CO4: To analyze various combinational and sequential circuits.

UNIT-I

Semiconductor Devices: Energy Bands, Intrinsic carrier concentration, Donors and Acceptors, Direct and Indirect band semiconductors, Determination of band gap by optical method,FET,MESFET MOSFET, Charge Coupled(CCDs) devices, Unijunction transistor (UJT), four layer (PNPN) devices, construction and working of PNPN diode, Semiconductor controlled rectifier (SCR), Thyristor, solar cells, photo-detectors, LEDs.

UNIT-II

Electronic Circuits: Differential amplifier, Operational amplifier (OP-AMP), Open loop Op-Amp, OP-AMP as inverting and non-inverting, scalar, summer, integrator, differentiator, Difference and Common mode gain, Common Mode rejection ratio. Schmitt trigger, Comparator.

Digital Principles: Binary and Hexadecimal number system, Binary arithmetic, Logic gates, Boolean equation of logic circuits

UNIT-III

Combinational Circuits: Digital-to-Analog Converter, Ladder type, Analog-to-digital Convertor, Successive Approximation converter.

Combinational Logic: The transistor as a switch, OR, AND, NOT Gates, NOR and NAND, Exclusive OR gates, Boolean algebra, Demorgan's theorems, Parity generators and checkers, Adder-Subractor circuits. Karnaugh maps, Decoder/Demultiplexer, Data selector/multiplexer, Encoder.

UNIT-IV

Sequential Circuits: RS Flip Flops, D Flops, JK flip flop, JK Master Slave, T flip flop, Shift Registers, Up/Down counters, Synchronous and Asynchronous counters, Mod counters, Memory devices: static and dynamic Random Access memories, SRAM and DRAM, CMOS and NMOS.

Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	Electronic Devices and Circuits	Millman and Halkias	Tata McGraw-Hill
2	Solid State Electronic Devices	Ben G Streetman and Banerjee	Prentice-Hall of India
3	Digital Principles and Applications	P. Malvino and D.P.Leach	Tata McGraw-Hill

Semester	**VII**
Course Code	**PHY463**
Course Title	**Physics VII A: Electronics (Practical)**
Type of course	Practical
L T P	0:0:4
Credits	2
Course prerequisite	B.Sc. IIIrd yrs with physics as one of major subjects
Course Objective (CO)	**The aim of this course is to** **1.** To impart practical knowledge to the students about Electronics devices, and have an understanding of how it works. 2. Increase the practical knowledge of different electrical sequential, combinational devices.
Course Outcomes (CO)	**By the end of this course, students will be able to** CO1: To perform the analysis and design of electrical circuits. CO2: To understand the practical concept behind the design of any electrical designs. CO3: To study the output in different operating modes of different semiconductor devices. CO4: To make mini as well as major projects related to electronics.

***Note: From each section students has to do any of the two experiments.**

Electronic devices:

1. To Study the DC characteristics and applications of DIAC.
2. To study the DC characteristics and applications of SCR.
3. To study the DC characteristics and applications of TRIAC.
4. Investigation of the DC characteristics and applications of UJT.
5. Investigation of the DC characteristics of MOSFET.
6. Study the characteristics of FET.

Multivibrators:

1. Study of bi-stable multivibrators.
2. Study of mono-stable multivibrators.
3. Study of astable multivibrators.

Study of Op-Amps and their applications:

1. Study of Op-Amps as an amplifier (inverting, non-inverting).
2. Study of basic properties of Op-Amps as scalar.
3. Study of basic properties of Op-Amps as summer.
4. Study of basic properties of Op-Amps as differentiator.
5. Study of basic properties of Op-Amps as integrator.

Combinational Circuits:

1. Study of logic gates using discrete elements and universal gates.
2. Study of encoder, decoder circuit.
3. Study of arithmetic logic unit (ALU) circuit.
4. Study of half and full adder circuits.
5. Study of A/D and D/A circuits.
6. Digital logic trainer (logic gates, Boolean's identity and de-Morgan's theorem).
7. Parity generator and checker.

Sequential Circuits:

1. Study of shift registers.
2. To study JK, MS and D-flip flops.
3. To study 4-bit counter (Synchronous and asynchronous).
4. Study of RAM kit.

Microprocessor 8085:

1. Study of microprocessor 8085 for simple programming in addition.
2. Study of microprocessor 8085 for simple programming in subtraction.
3. Study of microprocessor 8085 for simple programming in multiplication.
4. Study of microprocessor 8085 for simple programming in division.

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Text and Reference Books:

S.No.	Name/Title	Author	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

Semester	**VII**
Course Code	**PHY465**
Course Title	**Physics VII B: Electromagnetic Theory**
Type of course	Theory
L T P	4:0:0
Credits	4
Course prerequisite	B.Sc. IIIrd yrs with Physics as one core subject
Course Objective (CO)	**The aim of this course is to** 1. Impart knowledge in the fields of magnetism, electromagnetic theory, & properties of matter. 2. Understanding of Wave guides uses in electromagnetic system.
Course Outcomes (CO)	**By the end of this course, students will be able to** 1. Learn the principle, and application of Electrostatics. 2. Learn the principle, and application of Magetism. 3. Understand the electromagnetic theory.

UNIT-I

Maxwell Equations: Review of Maxwell's equations, Displacement Current, Vector and Scalar Potentials, Gauge Transformations, Lorentz and Coulomb Gauge Boundary Conditions at Interface between Different Media. Wave Equations, Plane Waves in Dielectric Media, Poynting Theorem and Poynting Vector. Electromagnetic (EM) Energy Density. Physical Concept of Electromagnetic Field Energy Density, Momentum Density and Angular Momentum Density.

UNIT-II

EM Wave Propagation in Unbounded Media: Plane EM waves through vacuum and isotropic dielectr medium, transverse nature of plane EM waves, refractive index anddielectricconstant,waveimpedance.Propagationthroughconductingmedia,relaxation time, skin depth. Wave propagation through dilute plasma, electrical conductivity of ionized gases, plasma frequency, refractive index, skin depth, application to propagation through ionosphere. **EM Wave in Bounded Media:** Boundary conditions at a plane interface between two media. Reflection & Refraction of plane waves at plane interface between two dielectric-media, Brewster's law. Reflection & Transmission coefficients. Total internal reflection, evanescent waves. Metallic reflection (normal Incidence).

UNIT-III

Polarization of Electromagnetic Waves: Description of Linear, Circular and Elliptical Polarization. Propagation of E.M. Waves in Anisotropic Media. Symmetric Nature of Dielectric Tensor. Fresnel'sFormula. Production & detection of Plane, Circular and EllipticallyPolarizedLight.PhaseRetardationPlates: Quarter-WaveandHalf-Wave Plates. Babinet Compensator and its Uses.Analysis of Polarized Light Rotatory Polarization: Optical Rotation. Biot'sLaws forRotatory Polarization

UNIT-IV

Wave Guides: Planar optical wave guides. Planar dielectric wave guide. Condition of continuityat interface. Phase shift on total reflection. Eigenvalue equations. Phase and group velocity of guided waves. Field energy and Power transmission.

Optical Fibres:-Numerical Aperture. Step and Graded optical fibres.

Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	Introduction to Electrodynamics	D.J. Griffiths	Benjamin Cummings 3rd Ed., 1998
2	ElementsofElectromagnetics	M.N.O.Sadiku,2001	OxfordUniversityPress
3	IntroductiontoElectromagneticTheory	T.L.Chow,2006	Jones&BartlettLearning

Semester	**VII**
Course Code	**PHY467**
Course Title	**Physics VII B: Electromagnetic Theory (Practical)**
Type of course	Practical
L T P	0:0:4
Credits	2
Course prerequisite	B.Sc. IIIrd yrs with Physics as one core subject
Course Objective (CO)	**The aim of this course is to** 1Impart knowledge in the fields of magnetism, electromagnetic theory, & properties of matter. 2. Enhance practical knowledge of electromagnetic phenomenon.
Course Outcomes (CO)	**By the end of this course, students will be able to** 4. Learn the principle, and application of Electrostatics. 5. Learn the principle, and application of Magetism. 6. Understand the electromagnetic theory.

i. To verify the law of Malus for plane polarizedlight.
ii. To determine the specific rotation of sugar solution using Polarimeter.
iii. To analyse elliptical polarized light by using Babinet compensator.
iv. To study dependence of radiation on angle of prism dipole antenna.
v. To determine wavelength and velocity of ultrasonic waves in liquid by studing diffraction by ultrasonic grating.
vi. To study reflection, refraction of radiowaves.
vii. To study polarization and double slit interference in microwaves.
viii. To determine the refractive index of liquid by TIR using Wollastone air film.
ix. To determine refractive index of liquid and glass using Gaussian eyepiece.
x. To study polarization of light by reflection and determine polarization angle.
xi. To study stefan's law of radiation and determine Stefan constant.
xii. To determine Boltzmann constant by V-I characteristic of PN junction diode.

Text and Reference Books:

S.No	Name/Title	Author	Publisher
1	Advanced Practical Physics for students	B.L. Flint and H.T. Worsnop,1971	Asia PublishingHouse.
2	Advanced level Physics Practical	Michael Nelson and Jon M. Ogborn, 1985	4th Edition, reprinted Heinemann EducationalPublishers

Semester	**VII**
Course Code	**PHY469**
Course Title	**Physics VII C:Classical Mechanics**
Type of course	Theory
L T P	4:0:0
Credits	4
Course prerequisite	B.Sc. IIIrd yrs with physics as one of major subjects
Course Objective (CO)	**The aim of this course is to** 1. Impart the knowledge of Classical Mechanics to students. 2. Calculate the general problems related to lagrangian, Hamiltonian principle.
Course Outcomes (CO)	**By the end of this course, students will be able to** CO1: To understand about the mechanics of system of particles, Lagrangian and Hamiltonian formulations in classical mechanics. CO2: To determine distinct problems related with central force including Kepler's laws of motion. CO3: To understand the idea about Euler's equations of motion of rigid body. CO4: To apply the theories and mathematical equations related to Canonical Transformations.

UNIT - I

Lagrangian Mechanics: Newton's laws of motion, mechanics of a system of particles, constraints, D' Alembert's principle and Lagrange equations of motion. Velocity dependent potentials and dissipation function. Some applications of Lagrangian formulation, Hamilton's principle, derivation of Lagrange equations from Hamilton's principle. Conservation theorems and symmetry properties.

UNIT-II

Central Force Problem: Two body central force problem, reduction to equivalent one body problem, the equation of motion and first integrals, the equivalent one dimensional problem, and classification of orbits. The differential equation for the orbit and integrable power-law potential. The Kepler problem. Scattering in a central force.

UNIT-III

Rigid Body Dynamics: The independent coordinates of a rigid body, orthogonal transformation, Euler's angles. Eulers' theorem on the motion of rigid body, finite and infinitesimal rotations, rate of change of a vector, angular momentum and kinetic energy about a point for a rigid body, the inertia tensor and moment of inertia, Eigen values of the moment inertia tensor and the principal axis transformation. Euler's equations of motion, torque free motion of a rigid body.

UNIT-IV

Canonical Transformations: Legendre transformation and Hamilton equations of motion, cyclic coordinates and conservation theorems, derivation of Hamilton's equations from a variational principle, the principle of least action. The equations of canonical transformation, examples of canonical transformations, Poisson brackets. Equations of motion, infinitesimal canonical transformations and conservation theorems in the Poisson bracket formulation.

Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	Classical Mechanics	Herbert Goldstein	Narosa Pub. House, New Delhi,
2	Mechanics	L. D. Landau and E. M. Lifshitz	Pergamon Press, Oxford, 1982
3	Classical Mechanics	N. C. Rana and P. S. Joag	Tata Mc Graw Hill, New Delhi,

SEMESTER VIIIth

Semester	**VIII**
Course Code	**PHY462**
Course Title	**Physics VIII A:Statistical Mechanics**
Type of course	Theory
L T P	4:0:0
Credits	4
Course prerequisite	B.Sc. IIIrd yrs with physics as one of major subjects
Course Objective (CO)	**The aim of this course is to** 1. Evaluate of the laws of classical thermodynamics for macroscopic systems using the properties of its atomic particles. 2. Know the difference between classical and statistical and quantum statistical mechanics
Course Outcomes (CO)	**By the end of this course, students will be able to** CO1: To identify the link between statistics and thermodynamics, classical and quantum statistics and its applications. CO2: To describe the fundamentals of classical statistical mechanics and learn about phase space, various ensembles and their application in some cases. CO3: To learn about the quantum mechanical theory of statistics and its application in various important cases of Bosons and Fermions.CO4: To understand the behaviour of ideal Bose and Fermi gases

UNIT-I

Classical Stat. Mech. I: Foundation of statistical mechanics; specification of states in a system, contact between statistics and thermodynamics, the classical ideal state, the entropy of mixing Gibbs paradox, The phase space of classical systems, Liouville's theorem and its consequences.

UNIT-II

Classical Stat. Mech. II: The microcanonical ensemble with examples. The canonical ensemble and its thermodynamics, partition function, classical ideal gas in canonical ensemble theory, energy fluctuations in the canonical ensemble. A system of harmonic oscillators. The statistics of paramagnetism. The grand canononical ensemble, the physical significance of the statistical quantities, examples, fluctuation of energy and density. Cluster expansion of classical gas, the virial equation of state.

UNIT-III

Quantum Stat. Mech.I : Quantum states and phase space, the density matrix, statistics of various ensembles. Example of electrons in a magnetic field, a free particle in a box and a linear harmonic oscillator. Significance of Boltzmann formula in classical and quantum statistical mechanics.

UNIT-IV

Quantum Stat. Mech. II: An ideal gas in quantum mechanical microcanonical ensemble. Statistics of occupation numbers, concepts and thermodynamical behavior of an ideal gas. Bose Einstein condensation, Discussion of a gas of photons and phonons, Thermodynamical behavior of an ideal Fermi gas, electron gas in metals, Pauli paramagnetism, and statistical equilibrium of white dwarf stars.

Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	Statistical Mechanics	R.K. Patharia	Butten Worth Heinemann, 1996
2	Statistical and Thermal Physics	F. Reif	Mc-Graw Hill, 1965
3	Statistical Mechanics	Kerson Huang	Wiley, 1963

Semester	**VIII**
Course Code	**PHY464**
Course Title	**Physics VIII B : Condensed Matter Physics**
Type of course	Theory
L T P	4:0:0
Credits	4
Course prerequisite	B.Sc. IIIrd yrs with Physics as one core subject
Course Objective (CO)	**The aim of this course is to** **1.** Provide knowledge on the basic of condensed matter Physics. 2. Understand the concept of band structure, defects occurring in crystal, phenomenon of superconductivity.
Course Outcomes (CO)	**By the end of this course, students will be able to** CO1:Understand crystal structures in solid CO2: Understands the defects in solids CO3: Provide ith the knowledge of magnetism and superconductors.

UNIT-I

Band structure of crystal: Electronic Band Structure Electronic band structure in solids, Electrons in periodic potentials,Elasticproperties, phonons, lattice specific heat. Free electron theory and electronic specific heat. Response andrelaxation phenomena. Drude model of electrical and thermal conductivity. Hall effect and thermoelectric power, Free Electron Theory Free electrons in solids, density of states, Bloch's Theorem,Tight-binding model : density of states, examples of band structures.

UNIT-II

Defects and Diffusion in Solids: Point defects: Impurities, Vacancies- Schottky and Frankel vacancies, Color centers and coloration of crystals, F-centres, Line defects (dislocations), Edge and screw dislocations, Berger Vector, Planar (stacking) Faults, Grain boundaries, Low angle grain boundaries, the Hydration energy of ions, Activation energy for formation of defects in ionic crystals, Ionic conductivity in pure alkali halides.

UNIT-III

Magnetism: Classification of magnetic materials, magnetic dipoles, diamagnetic susceptibility, classical theory and Quantum theory of para magnetism, cooling by adiabatic demagnetization. Ferromagnetism, Weiss molecular field, the interpretation of the Weiss field. Ferromagnetic domains, Spin waves, quantization of spin waves, Thermal excitations of magnons.sub-lattice model, super exchange interaction, the structure of ferrites, saturation magnetisation, Neel's theory of ferrimagnetism, Curie temperature and susceptibility of ferrimagnets.

UNIT-IV

Superconductivity: Introduction to superconductivity, zero resistivity, criticaltemperature, Meissner effect, Type I and Type II superconductors, specific heat and thermalconductivity, BCS theory, Ginzsburg-Landou theory, Josephson effect: dc Josephson effect, ac Josephson effect, macroscopic quantum interference, high temperature superconductivity.

Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	An Introduction to Solid State Physics	C. Kittle-Wiley, 1958	Wiley, 1958
2	Solid State Physics	A.J. Dekker	Prentice Hall, 1965
3	Principles of Solid State Physics	R.A. Levey	Academic Press, 1968
4	An Introduction to Solid State Physics	C. Kittle-Wiley, 1958	Wiley, 1958

Semester	**VIII**
Course Code	**PHY466**
Course Title	**Physics VIII B : Condensed Matter Physics (Practical)**
Type of course	Practical
L T P	0:0:4
Credits	2
Course prerequisite	B.Sc. IIIrd yrs with physics as one of major subjects
Course Objective (CO)	**The aim of this course is to** 1. Impart practical knowledge to the students about the measurement of different physical properties (electric, magnetic, dielectrics etc.) using different methods. 2. Understanding working and role of semiconductor in different experiments.
Course Outcomes (CO)	**By the end of this course, students will be able to** CO1: To study the band gap, magneto resistance, resistivity and charge carrier concentration in semiconductors. CO2: To know how to determine the crystal structure, lattice parameter and crystallite size? CO3: To understand measurement and analysis of various types of transport. CO4: To explain optical characterization of solid, magnetic and dielectric behavior of solids.

***Note: Students has to do 6 experiments from each of the section given below.**

Semiconductor:

1. To determine Hall coefficient by Hall Effect.
2. To determine the band gap of a semiconductor using p-n junction diode.
3. To determine the energy gap and resistivity of the semiconductor using four probe method.
4. To study temperature-dependence of conductivity of a given semiconductor crystallizing four probe method.
5. To study the characteristics of a PN junction with varying temperature & the capacitance of the junction.
6. To find magneto resistance of semiconductor.
7. To measure magneto resistance of a thin (0.5 mm) sample of p-doped (or n-doped) germanium as a function of magnetic field for 3 different sample current.

Magnetic effects & dielectrics:

1. To determine the magnetic susceptibility of a material using Quink's method.
2. To determine the g-factor using ESR spectrometer.
3. To trace hysteresis loop and calculate retentivity, coercivity and saturation magnetization.
4. To determine dielectric constant.
5. To study the series and parallel characteristics of a photovoltaic cell.
6. To study the spectral characteristics of a photovoltaic cell.

Text and Reference Books:

S.No.	Name/Title	Author	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

Semester	**VIII**
Course Code	**PHY468**
Course Title	**Physics VIII C : Physics of Nanomaterials**
Type of course	Theory
L T P	4:0:0
Credits	4
Course prerequisite	B.Sc. IIIrd yrs with physics as one of major subjects
Course Objective (CO)	**The aim of this course is to** **1.** Introduce students to the basic physics of Nano materials and latest advance in it. 2. Understand the role of nanotechnology in studying the quantum well, particle size.
Course Outcomes (CO)	**By the end of this course, students will be able to** 1 CO1: To develop fundamental knowledge of nanomaterials. CO2: To correlate the properties of nano structures with their size, shape and surface characteristics. CO3: To explain the effects of quantum confinement on the electronic structure & corresponding physical and chemical properties of materials at nanoscale. CO4:To understand the physics of carbon nano tubes involving their synthesis and applications in different areas.

UNIT I

Free electron theory and its features: Idea of band structure of metals, insulators and semiconductors. Density of state in one, two and three dimensional bands and its variation with energy, Effect of crystal size on density of states and band gap, Examples of nanomaterials. Top- down and bottom-up approaches, Physical and chemical methods for the synthesis of nanomaterials with examples.

UNIT II

Determination of particle size: Determination of particle size and study of texture and microstructure, Increase in x-ray diffraction peaks of nanoparticles, shift in photoluminescence peaks, variation in Raman spectra of nanomaterials, photoemission and X-ray spectroscopy, magnetic resonance, microscopy: transmission electron microscopy, scanning probe microscopy.

UNIT III

Introduction to quantum wells wires and dots: preparation using lithography; Size and dimensionality effects: size effects, conduction electrons and dimensionality, potential wells, partial confinement, properties dependent on density of states, surface passivation and core/shell nanoparticles, Nanostructured semiconductors and films, single electron tunneling; Application: Infrared detectors, Quantum dot Lasers.

UNIT IV

Carbon molecules: nature of carbon bond; new carbon structures; Carbon clusters: small carbon clusters, structure of C60, alkali doped C60; Carbon nanotubes and nanofibres: fabrication, structure, electrical properties, vibrational properties, mechanical properties, Application of carbon nanotubes: field emission and shielding, fuel cells, chemical sensors, catalysis.

Text and Reference Books:

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S.No.	Name/Title	Author	Publisher
1	Physics of Semiconductor Nanostructures.	D.Bimerg, M. Grundmann and N.N. Ledentsov	S JohnWiley&Sons,1989

Semester	**VIII**
Course Code	**PHY470**
Course Title	**Physics VIII C : Physics of Nanomaterials (Practical)**
Type of course	Practical
L T P	0:0:4
Credits	2
Course prerequisite	B.Sc. IIIrd yrs with physics as one of major subjects
Course Objective (CO)	**The aim of this course is to** 1 Introduce students to the basic physics of Nano materials and latest advance in it. 2. Learn the synthesis of nanoparticle by different methods.
Course Outcomes (CO)	**By the end of this course, students will be able to** CO1: To develop fundamental knowledge of nanomaterials. CO2: To correlate the properties of nano structures with their size, shape and surface characteristics. CO3: To explain the effects of quantum confinement on the electronic structure & corresponding physical and chemical properties of materials at nanoscale. CO4:To understand the physics of carbon nano tubes involving their synthesis and applications in different areas.

1. Synthesis of metal nanoparticles by chemical route.
2. Synthesis of semiconductor nanoparticles.
3. Surface Plasmon study of metal nanoparticles by UV-Visible spectrophotometer.
4. XRD pattern of nanomaterials and estimation of particle size.
5. To study the effect of size on color of nanomaterials.
6. To prepare composite of CNTs with other materials.
7. Growth of quantum dots by thermal evaporation.
8. Prepare a disc of ceramic of a compound using ball milling, pressing and sintering, and study its XRD.
9. Fabricate a thin film of nanoparticles by spin coating (or chemical route) and study transmittance spectra in UV-Visible region.

Prepare a thin film capacitor and measure capacitance as a function of temperature or frequency.

Text and Reference Books

S.No.	Name/Title	Author	Publisher
1	Physics of Semiconductor Nanostructures.	D.Bimerg, M. Grundmann and N.N. Ledentsov	S JohnWiley&Sons,1989

Semester	**VIII**
Course Code	**PHY472**
Course Title	**Physics VIII D : Quantum Mechanics**
Type of course	Theory
L T P	4:0:0
Credits	4
Course prerequisite	B.Sc. IIIrd yrs with physics as one of major subjects
Course Objective (CO)	**The aim of this course is to** 1. Introduce students to the basic of microscopic field in Physics. 2. Understand concept with the help of schrodinger equations.
Course Outcomes (CO)	**By the end of this course, students will be able to** CO1: To develop fundamental knowledge of Schrodinger equation, operators, wavefunction. CO2: To correlate the mathematical analysis of harmonic oscillator CO3: To explain the Zeeman effects and atom in electric and magnetic field.

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. Eigenvalues and Eigenfunctions. Position, momentum & Energy operators; commutator of position and momentum operators; Expectation values of position and momentum. Wave Function of a Free Particle

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 eigenfunctions 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 land m; s, p, d,.. shells

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 AntisymmetricWave Functions. Periodic table. 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:

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S.No.	Name/Title	Author	Publisher
1	Quantum Mechanics	Leonard I. Schiff, 3rdEdn. 2010,	Tata McGraw Hill
2	Quantum Mechanics	Leonard I. Schiff, 3rdEdn. 2010,	Tata McGraw Hill

(Minor Courses)

SKILL ENHANCEMENT COURSES

(Semester III - VI)

Semester	**III**
Course Code	**PHY265**
Course Title	**Physics workshop skill**
Type of course	Skill Enhancement Courses
L T P	2 :0:0
Credits	2
Course prerequisite	B.Sc Ist year with Physics as core subject
Course Objective (CO)	**The aim of this course is to** **1.**Enable the students to familiar and experience with various mechanical and electrical tools through hands-on. 2. Impart practical workshop knowledge of different measuring instruments.
Course outcome(CO)	**By the end of this course, students will be 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 meterscale, 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 withmotor axel. Lever mechanism, lifting of heavy weight using lever. Braking systems, pulleys.

Text and reference books:

S. No	Title	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

Semester	**IV**
Course Code	**PHY266**
Course Title	**Electrical circuits and network skills**
Type of course	Skill Enhancement Courses
L T P	2:0:0
Credits	2
Course prerequisite	B.Sc Ist year with Physics as core subject
Course Objective (CO)	**The aim of this course is to** 1. Enable the students to design and trouble shoots the electrical circuits, networks and appliances. 2. Learn about basic devics, their symbols, working of motors and wiring in circuits.
Course Outcome (CO)	**By the end of this course, students will be able to:** CO1: Acquire the basic knowledge of role of electricity inelectrical 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 anddelta 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.

Basic knowledge of legal aspects of Medical Records including Factories Act, Workmen Compensation Act & Consumer Protection Act. Procedures of Medical Auditing & its importance, Government Regulations & requirements

Text and Reference Books

S. No.	Author(s)	Title	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.

Semester	**V**
Course code	**PHY361**
Course title	**Renewable and Energy Harvesting**
Type of course	Skill enhancement Course
LTP	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** **1.** Enhance knowledge of students about Renewable sources and Energy Harvesting. 2. Enhance knowledge how these renewable sources are used in different sectors.
Course outcome(CO)	**By the end of this course, students will be able to:** CO1: Explain renewable sources and fundamentals of energy harvesting. CO2 Understand the physics of geothermalenergy, thermal & hydro energy. CO3 Classify different tools for energy harvesting.

UNIT-I

Fossil fuels and Alternate Sources of energy: Fossil fuels and Nuclear Energy, theirlimitation, 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-III

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.	Title	Author	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).

Semester	**VI**
Course Code	**PHY374**
Course Title	**Radiology and Safety**
Type of course	Skill enhancement Course
L T P	2:0:0
Credits	2
Course prerequisite	B.Sc IInd year with Physics as a core subject
Course Objective	**The aim of this course is to** **1.** Enable the students to enhance their knowledge of radiation physics & their safety procedure. 2. Understanding of radioactive nuclei.
Course outcome(CO)	**By the end of this course, students will be 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 IV

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.

SCHEME & SYLLABUS
of
CHEMISTRY
for
B.Sc NonMedical &
B.Sc Medical

4 year programme

(As Per NEP)

(Major Courses)

CORE COURSES

(Semester I-IV)

SEMESTER

Ist

Semester	**I**
Course Code	**CHM 161**
Course Title	**Chemistry-I: 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** 1. Enhance the knowledge of students in Chemical bonding atomic / molecular structure. 2. Impart basic knowledge of concepts of organic chemistry. 3. To 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 ofmatter and radiation, de Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure. What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydogenic wavefunctions (atomic orbitals) and their variations for 1s, 2s , 2p, 3s, 3p and 3d orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers ml and ms . Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (ms). Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Energies of atomic orbitals, Anomalous electronic configurations.

Unit-II

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

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

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

Unit-III

Fundamentals of Organic Chemistry: Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyper-conjugation. Cleavage of Bonds: Homolysis and Heterolysis.

Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals.

Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule.

Stereochemistry: Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms).

Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; cis - trans nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems).

Unit-IV

Aliphatic Hydrocarbons Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Alkanes: (Upto 5 Carbons). Preparation: Catalytic hydrogenation, Wurtz reaction,Kolbe's synthesis, from Grignard reagent. Reactions: Free radical Substitution : Halogenation.

Alkenes: (Upto 5 Carbons) Preparation: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). Reactions: cis-addition (alk. $KMnO_4$) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidatioN

Alkynes: (Upto 5 Carbons) Preparation: Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides.

Reactions: formation of metal acetylides, addition of bromine and alkaline KMnO4, ozonolysis and oxidation with hot alk. $KMnO_4$

Text and Reference Books :

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

Semester	**I**
Course Code	**CHM 163**
Course Title	**Chemistry-I: Atomic Structures , Bonding , General Organic and Chemistry and Aliphatic Hydrocarbons (Practical)**
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** 1 Impart practical knowledge to the students about the separation of organic molecules 2. To study and perform experiments based upon 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).
**Perform any four experiments from each section*

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 IInd

Semester	**II**
Course Code	**CHM 162**
Course Title	**Chemistry-II: Chemical Energetic, Equilibrium and Functional Group Organic – 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** 1. Enhance the knowledge of students regarding Physical concepts of chemistry like Chemical Energetic, Chemical Equilibrium. 2. Provide coherent knowledge of 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

Semester	**II**
Course Code	**CHM 164**
Course Title	**Chemistry-II: Chemical energetic, Chemical Equilibrium and Functional Group organic-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** 1. Provide practical knowledge about the preparation of organic compounds. 2. To perform various experiments based on 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

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

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 IIIrd

Semester	**III**
Course Code	**CHM 261**
Course Title	**Chemistry-III: Solutions , Phase Equilibrium, conductance, electrochemistry and functional group organic-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** 1. Impart knowledge to the students about basic of solution chemistry, phase equilibia, 2. Impart knowledge to the students about Electrochemistry. 3. To provide coherent knowledge of 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 (openchain 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

Semester	**III**
Course Code	**CHM 263**
Course Title	**Chemistry-III: Solutions , Phase equilibrium, Conductance, Electrochemistry and Functional Organic-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	**The aim of this course is to** 1. Provide practical knowledge about conductometry, potentiometry. 2. Perform qualitative organic analysis.
Course outcome	**By the end of the course, students will be able to:** CO1demonstrate and calculate various parameters ofdistribution & phase equilibria CO2Calculate molar and normal solution of various concentrations. CO3perform and evaluate outcomes of conductometric & potentiometric titrations. CO4Study 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 possessingmonofunctional 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,
03	Laboratory Manual in Organic Chemistry	R.K. Bansal,	Wiley Eastern
04	Experimental Physical Chemistry	C. Das, B. Behera	Tata McGraw Hill Publishing Company Limited.

SEMESTER IVth

Semester	**IV**
Course Code	**CHM 262**
Course Title	**Chemistry-IV: 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** 1. Impart knowledge to the students about basic of transition elements 2. Provide knowledge of bonding of transition elements. 3. Impart knowledge of 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, and 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

Semester	**IV**
Course Code	**CHM 264**
Course Title	**Chemistry-IV: 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** 1. Impart practical knowledge to the students about semi micro qualitative analysis. 2. To study practically 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,

DISCIPLINE ELECTIVE COURSES (Semester V - VIII)

SEMESTER

Vth

Semester	**V**
Course Code	**CHM 361**
Course Title	**Chemistry-VA: 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** 1. Impart coherent knowledge to the students about biomolecules 2. To study various structure, properties of biomacromolecules.
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.

Semester	**V**
Course Code	**CHM 363**
Course Title	**Chemistry-VA: 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** 1. Impart practical knowledge to the biochemical analysis. 2. To perform extraction and biomolecules.
Course outcome	**On completion of this course, the students will be able to:** CO1 Identify and carry out qualitative &quantitative analysis of biomolecules in stock solutions. CO2 Analyze 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.

Semester	**V**
Course Code	**CHM 365**
Course Title	**Chemistry-V B: 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** 1. Impart coherent knowledge to the students about organometallic chemistry. 2. To study polynuclear hydrocarbons. 3. To impart basic knowledge of 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
1	Concise Inorganic Chemistry	1.D. Lee	ELBS
2	Inorganic Chemistry: Principles of Structure and Reactivity	James E. Huheey, Ellen Keiter & Richard Keiter	Pearson Publication.
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	Biological Inorganic Chemistry: Structure and Reactivity	Harry B. Gray, Edward I. Stiefel et al.,	University Science Books.
6	Inorganic Chemistry	G.L. Miessler & Donald A. Tarr	Pearson Publication.
7	Basic Inorganic Chemistry	F.A. Cotton & G. Wilkinson:	John Wiley & Sons
8	Shriver & Atkin's Inorganic Chemistry (5^{th} Edition),	P Atkins, T. Overton, J. Rourke, M. Weller, F. Armstrong, M. Hagerman	Oxford University Press,
9	Organic Chemistry (Vol. I & II),	I.L. Finar	E.L.B.S.
10	Applications of Absorption Spectroscopy of Organic Compounds,	John R. Dyer:	Prentice Hall.
11	Spectroscopic Identification of Organic Compounds	R.M. Silverstein, G.C. Bassler & T.C. Morrill	John Wiley & Sons
12	Organic Chemistry,	R.T. Morrison & R.N. Boyd	Prentice Hall.
13	A Guide Book to Mechanism in Organic Chemistry	Peter Sykes:	Orient Longman.

Semester	**V**
Course Code	**CHM 367**
Course Title	**Chemistry-VB: 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** 1. Impart practical knowledge to the students about organometallic chemistry 2. Perform 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

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

Semester	**V**
Course Code	**CHM 369**
Course Title	**Chemistry-VC: 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 aim of this course is to** **1.** Make students aware about the concepts of different gases and their industrial production, uses, storage and hazards. 2. Manufacturing, applications, analysis and hazards of the Inorganic Chemicals, Air and Water pollution. 3. 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.

Semester	**V**
Course Code	**CHM 371**
Course Title	**Chemistry-VC: 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** 1. Impart practical knowledge to the students in Industrial processes. 2. To analyse environment pollutants .
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.

SEMESTER VIth

Semester	**VI**
Course Code	**CHM 362**
Course Title	**Chemistry-VIA: 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** 1. Impart detailed knowledge of Main group elements. 2. Study of 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	J.E. Huheey	Harper Inter science

	Structure and Reactivity		
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.

Semester	**VI**
Course Code	**CHM 364**
Course Title	**Chemistry-VIA: 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** 1. Impart practical knowledge of iodometric, complexometric analysis. 2. To perform 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 salt

(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

Semester	**VI**
Course Code	**CHM 366**
Course Title	**Chemistry-VI B: 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 aim of this course is to** 1. Make the student aware about concepts of analytical Chemistry various spectrophotometric, electroanalytical and themal methods of analysis 2. Make the students aware about the 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.

Semester	**VI**
Course Code	**CHM 368**
Course Title	**Chemistry-VI B: 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** 1. Impart practical knowledge of analytical methods of chemical analysis. 2. Impart practical knowledge to use latest instrumentation and they learn to detect analytes in a mixture.
Course Outcome	**By the end of this course, students will be able to:** CO1Perform 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).

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 (CuSO4, KMnO4, CoCl2, CoSO4)
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.

Semester	**VI**
Course Code	**CHM370**
Course Title	**Chemistry-VIC: Inorganic Materials of Industrial Importance**
Type of course	DSE
L T P	4:0:0
Credits	4
Course prerequisite	B.Sc I and B.Sc II year with as Chemistry as core subject
Course Objective (CO)	**The aim of this course is to** 1. Introduces learners to the diverse roles of inorganic materials in the industry. 2. Gives an insight into how these raw materials are converted into products used in day to day life. 3. Learn about silicates, fertilizers, surface coatings, batteries, and engineering materials for mechanical construction as well as the emerging area of nano-sized materials. 4. Helps develop the interest of students in the frontier areas of inorganic and material chemistry.
Course Outcomes	**By the end of the course, the students will be able to:** CO1 Learn the composition and applications of the different kinds of glass. CO2 Understand glazing of ceramics and the factors affecting their porosity. CO3 Give the composition of cement and discuss the mechanism of setting of cement. CO4 Explain the suitability of fertilizers for different kinds of crops and soil. CO5 Explain the process of formulation of paints and the basic principle behind the protection offered by the surface coatings. CO6 Explain the principle, working and applications of different batteries. CO7 List and explain the properties of engineering materials for mechanical construction used in day to day life. CO8 Explain the synthesis and properties of nano-dimensional materials, various semiconductor and superconductor oxides.

Unit I

Silicate Industries *Glass:* Glassy state and its properties, classification (silicate and non-silicate glasses). Manufacture and processing of glass. Composition and properties of the following types of glasses: Soda lime glass, lead glass, armoured glass, safety glass, borosilicate glass, fluorosilicate, coloured glass, photosensitive glass.

Ceramics: Important clays and feldspar, ceramic, their types and manufacture. High technology ceramics and their applications, superconducting and semiconducting oxides, fullerenes carbon nanotubes and carbon fibre.

Cements: Classification of cement, ingredients and their role, Manufacture of cement and the setting process, quick setting cements.

Unit II

Fertilizers: Different types of fertilizers. Manufacture of the following fertilizers: Urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates; polyphosphate, superphosphate, compound and mixed fertilizers, potassium chloride, potassium sulphate.

Surface Coatings: Objectives of coatings surfaces, preliminary treatment of surface, classification of surface coatings. Paints and pigments-formulation, composition and related properties. Oil paint, Vehicle, modified oils, Pigments, toners and lakes pigments, Fillers, Thinners, Enamels, emulsifying agents. Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint), Dyes, Wax polishing, Water and Oil paints, additives, Metallic coatings (electrolytic and electroless), metal spraying and anodizing.

Unit III

Batteries: Primary and secondary batteries, battery components and their role, Characteristics of Battery. Working of following batteries: Pb acid, Li-Battery, Solid state electrolyte battery. Fuel cells, Solar cell and polymer cell.

Alloys: Classification of alloys, ferrous and non-ferrous alloys, Specific properties of elements in alloys. Manufacture of Steel (removal of silicon decarbonization, demanganization, desulphurization dephosphorisation) and surface treatment (argon treatment, heat treatment, nitriding, carburizing). Composition and properties of different types of steels.

Unit IV

Catalysis: General principles and properties of catalysts, homogenous catalysis (catalytic steps and examples) and heterogenous catalysis (catalytic steps and examples) and their industrial applications, Deactivation or regeneration of catalysts.

Phase transfer catalysts, application of zeolites as catalysts.

Chemical explosives: Origin of explosive properties in organic compounds, preparation and explosive properties of lead azide, PETN, cyclonite (RDX). Introduction to rocket propellants.

Reference Books:

1. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
2. R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, WileyPublishers, New Delhi.
3. W. D. Kingery, H. K. Bowen, D. R. Uhlmann: *Introduction to Ceramics*, WileyPublishers, New Delhi.
4. J. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
5. P. C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.
6. R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry*, Vikas Publications, New Delhi.
7. Sharma, B.K. & Gaur, H. *Industrial Chemistry*, Goel Publishing House, Meerut(1996).

Semester	**VI**
Course Code	**CHM372**
Course Title	**Chemistry-VIC: Inorganic Materials of Industrial Importance Practical**
Type of course	DSE
L T P	0:0:4
Credits	2
Course prerequisite	B.Sc I and B.Sc II year with as Chemistry as core subject
Course Objective (CO)	**The aim of this course is to** 1. Introduces learners to the diverse roles of inorganic materials in the industry. 2. Gives an insight into how these raw materials are converted into products used in day to day life. 3. Learn about silicates, fertilizers, surface coatings, batteries, engineering materials for mechanical construction. 4. Helps develop the interest of students in the frontier areas of inorganic and material chemistry.
Course Outcomes	**By the end of the course, the students will be able to:** Able to perform qualitative and quantitative analysis of industrially important chemicals. Able to analyse composition of alloy, cement and fertilizers Able to prepare industrially significant pigments.

List of Experiments:

1. Electroless metallic coatings on ceramic and plastic material.
2. Determination of composition of dolomite (by complexometric titration).
3. Analysis of (Cu, Ni); (Cu, Zn) in alloy or synthetic samples.
4. Analysis of Cement.
5. Preparation of pigment (zinc oxide).
6. Detection of constituents of Ammonium Sulphate fertilizer (Ammonium and Sulphate ions) by qualitative analysis and determine its free acidity.
7. Detection of constituents of CAN fertilizer (Calcium, Ammonium and Nitrate ions) fertilizer and estimation of Calcium content.
8. Detection of constituents of Superphosphate fertilizer (Calcium and Phosphate ions) and estimation of phosphoric acid content.
9. Detection of constituents of Dolomite (Calcium, Magnesium and carbonate ions) and determination of composition of Dolomite (Complexometric titration).
10. Analysis of (Cu, Ni) in alloy or synthetic samples (Multiple methods involving Complexometry, Gravimetry and Spectrophotometry).
11. Analysis of (Cu, Zn) in alloy or synthetic samples (Multiple methods involving Iodometry, Complexometry and Potentiometry).

Reference Books:

1. E. Stocchi: *Industrial Chemistry,* Vol-I, Ellis Horwood Ltd. UK.
2. R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley
3. Publishers, New Delhi.
4. Svehla, G.(1996),Vogel's Qualitative Inorganic Analysis, Prentice Hall. 2. Banewicz, J. J.; Kenner, C.T. Determination of Calcium and Magnesium in Limestones and Dolomites, Anal. Chem., 1952, 24 (7), 1186–1187.

SEMESTER VIIth

Semester	**VII**
Course Code	**CHM461**
Course Title	**Chemistry VII A: Main Group Chemistry**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc I , B.Sc I I and B.Sc III year with as Chemistry as core subject
Course Objective	**The aim of this course is to** 1 Introduce the importance of H-bonding, reactivity of metals and inert pair effect , formation of coordination complexes, tendency of lighter elements to form electron deficient compounds, 2. To study deeply structural features of silicates and organosilcon. 2. Know chemistry of inter-halogens, compounds of xenon and krypton and to recognize the importance of group 12 elements
Course Outcomes	**By the end of the course, the students will be able to:** CO1. Importance of H-bonding in natural processes is appreciable CO2. Recognition of capability of s-block elements and group 12 elements to form coordination complexes as the latter are having many similarities with the former. CO3. Realization of importance of silicon as it is the second most abundant element on earth's crust after oxygen and it occurs as SiO2 and silicate materials.

Unit I

Chemistry of hydrogen :

Isotopes and ionized forms of hydrogen, Protonic acids and bases, hydrides, The Hydrogen Bond, its influence on Properties and influence on structure, Strength of hydrogen bonds and theoretical description, some natural elegant examples of H-bonding, Information about H-bonding from various techniques like IR, NMR and X-ray.

Noble gases: introduction and oxidation state survey, noble gas clathrates ,haides, oxidesand other compounds : synthesis, reactivity and stereochemistry.

Unit II

Chemistry of S-block metals: Introduction and oxidation state survey, standard redox potentials of alkali and alkaline earth metals, lattice energy and hydration energy and diagonal relationship. Structure and synthesis of Hydrides, Halides, Oxides, Peroxides, Superoxides, Suboxides, Hydroxides, Oxoacid salts, compounds with nitrogen and carbon and complexes of s-block elements. Coordination Complexes of Crowns and Crypts of Alkali and Alkaline EarthMetals ions.

Chemistry of group 12 elements: Introduction, Similarities and differences between these elements and traditional elements, oxidation state, Chemistry of the elements : reactivity ,standard redox potentials, their combination with halides. Chalcogenides and their related compounds, oxygen, sulphur and halogen compounds, Formation of coordination complexes, Low valent compounds. (5 lectures)

Unit III

Chemistry of Boron, Aluminum and Silicon: Borides, Boranes, Bonding in boranes, topology of boranes, synthesis and reactivity. Wade's rules,Carboranes and metallocarboranes,Borazine and boron nitride. Chemistry of boron and Aluminum Halides, Amphoteric nature of Aluminium oxides. Potash alum and Aluminum Alkyls. Low oxidation state Alcompounds.Organosilicon Compoundslike carbosilanes, stability of disilenesand silicones.

Unit IV

Chemistry of halogens: Interhalogens, Introduction, Diatomic, Tetraatomic, hexaatomic and octa-atomic interhalogens: Synthesis, physical properties, chemical reactions, fluorinating agent, as ionizing solvent and electrical conductivity, Lewis acid behavior. Polyhalide and polyhalonium ions of diatomic interhalogens, Reactivity sequence of various interhalogens. Structures and bonding in some polyiodide anions, Pseudohalogens, Cholorofluorocarbons.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Main Group Chemistry	W. Henderson	Royal Society of Chemistry(2000)
2	Chemistry of Elements	N. N. Greenwood	Pergamon Press(2000)
3	Inorganic Chemistry, Principles of structure and reactivity	J. E. Huheey, Fourth edition	Pearson(2005)
4	Inorganic Chemistry 4th edition	D. F. Shriver and P. W. Atkins,	Oxford University, Oxford(2006)
5	Advanced Inorganic Chemistry	F. A. Cotton and G. Wilkinson , Sixth edition	John Wiley & Sons (2003)
6	Concepts & Model of Inorganic Chemistry	B. Douglas , third edition	John Wiley & Sons(2001)

emester	**VII**
Course Code	**CHM463**
Course Title	**Chemistry VII B: Organic Reaction Mechanism- I**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc I , B.Sc I I and B.Sc III year with as Chemistry as core subject
Course Objective	**The aim of this course is to** 1. Impart knowledge of stereochemical aspects of organic compounds reactive intermediates 2. To study mechanism of general organic reactions including substitution, elimination and addition.
Course Outcomes	**By the end of the course, the students will be able to:** CO1. Understand Coherent Knowledge of mechanistic aspects in nucleophilic ,electrophilic substitution, addition and elimination reactions. CO2.Analyze reaction conditions, products formation and mechanisms of some named reactions. CO3.Apply various reaction pathways to develop new and notable organic compounds.

Unit I

Stereochemistry: Elements of symmetry, chirality, projection formulae,configurational and conformational isomerism in acyclic and cyclic compounds, molecules with more than one chiral center. Threo and erythro isomers, methods of resolution, optical purity. stereogenicity, stereoselectivity, diastereoselectivity, D/L, R/S, *E*/*Z* and *cis*/*trans* configurational notations Prochirality – enantiotopic and diastereotopic atoms, groups. Stereospecific and stereoselective synthesis. Asymmetric synthesis.Optical activity in absence of chiral carbon (Biphenyls, Allenes, Spiranes). conformational analysis of cyclic compounds such as cyclopentane, cyclohexane, cyclohexanone derivatives, decalins, 1,2, 1,3-, 1,4-disubstituted cyclohexane derivatives and D-Glucose, effect of conformation on reactivity.

Unit II

Nature of Bonding in Organic Reactions: Aromaticity in Benzenoid and non-benzenoid compounds. Huckel Rule, Alternant and non alternant hydrocarbons. Energy levels of Π(pi) molecular orbitals in simple systems. Annulenes, Antiaromaticity, Homoaromaticity, PMO approach.

Reaction Mechanism, Structure and Reactivity: Types of mechanisms in different reactions, thermodynamic and kinetic requirements, Kinetic and thermodynamic control in product formation. Transition states and reaction intermediates, Isotope effects, Hard and Soft Acid Base concept, Study of reactive intermediates – Types of intermediates, isolation and detection of intermediates, trapping of intermediates.

Unit III

Aliphatic Nucleophilic Substitution: The S_N2, S_N1 and S_Ni mechanisms, mixed S_N1 & $S_N2$mechanism, SET mechanism. The neighbouring group mechanism (anchimeric assistance). Neighbouring group participation by pi and sigma bonds, Classical non-classical & phenonium cations, Rearrangements in carbocations (general survey). Ester hydrolysis. Nucleophilic substitution at allylic, aliphatic trigonal and vinylic carbon.

Aromatic Electrophilic Substitution: The arenium ion mechanism, orientation and reactivity in mono substituted and di substituted aromatics. Energy profile diagrams. The ortho/para ratio, ipso attack, orientation in other ring systems. Gatterman-Koch reaction, Pechmann reaction, Houben – Hoesch reaction, Fries rearrangement.

Aromatic Nucleophilic Substitution: ArS_N1, ArS_N2 and ArSN via benzyne (Arynes) mechanisms. Reactivity effect of substrate structure, leaving group and nucleophile. The von Richter, Sommelet-Hauser and Smiles rearrangements.

Unit IV

Free Radical Reactions: Type of free radical reactions, free radical substitution mechanism at an aromatic substrate, neighbouring group assistance. Reactivity for aliphatic and aromatic substrates at a bridgehead. Reactivity in the attacking radicals. The effect of solvents on reactivity.Allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids, auto-oxidation. Coupling of alkynes and arylation of aromatic compounds by diazonium salts. Sandmeyer reaction. Free Radical Rearrangement. Hunsdiecker reaction, Kolbe reaction, Hydroxylation of aromatics by Fenton's reagent.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Highlights of Organic Chemistry	W.J. L. Nobel	An Advanced Text Book
2	Advanced organic chemistry part-A. 5th Ed	F. A. Carey and R. J. Sundberg	Springer (2007)
3	A guidebook to mechanism in organic chemistry, 6th Ed	Peter Sykes	Orient Longman

4	Stereochemistry conformation and Mechanism	P. S. Kalsi	New Age International
5	Stereochemistry of carbon compounds	Ernest Eliel	McGraw Hill, New York (1962).

Semester	**VII**
Course Code	**CHM 465**
Course Title	**Chemistry VII C: Chemical Thermodynamics and its applications**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc I , B.Sc I I and B.Sc III year with as Chemistry as core subject
Course Objective	**The aim for this course is to** 1.Understanding the concept of system, variables, heat, work, and laws of thermodynamics 2. Understanding the concept of heat of reactions and use of equations in calculations of bond energy, enthalpy
Course Outcomes	**By the end of the course, the students will be able to:** CO1. Understand Coherent Knowledge of different thermodynamic parameters for chemical reactions. CO2. Analyze advanced classical and statistical thermodynamics. CO3. Interpret irreversible thermodynamics for biological systems.

Unit I

Introduction to thermodynamics: Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics. *First law:* Concept of heat, *q*, work, *w*, internal energy, *U*, and statement of first law; enthalpy, *H*, relation between heat capacities, calculations of *q*, *w*, *U* and *H* for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions

.**Unit II**

Thermochemistry: Heats of reactions: standard states; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data, effect of temperature (Kirchhoff's equations), pressure on enthalpy of reactions.

Unit III

Second Law Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics; molecular and statistical interpretation of entropy. Calculation of entropy change for reversible and irreversible processes.

Third law of thermodynamics: Third Law of thermodynamics, residual entropy, calculation of absolute entropy of molecules.

Unit IV

Free Energy Functions Gibbs and Helmholtz energy; variation of S, G, A with T, V, P; Free energy change and spontaneity. Relation between Joule-Thomson coefficient and other thermodynamic parameters; inversion temperature; Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state.

Partial molar quantities: Partial molar quantities, dependence of thermodynamic parameters on composition; Gibbs-Duhem equation, chemical potential of ideal mixtures, change in thermodynamic functions in mixing of ideal gases..

Text and Reference Books:

1 Atkins P. and De Paula, J. *Physical Chemistry* Tenth Ed., OUP, 2014.
2 Castellan, G. W. *Physical Chemistry 4th Ed.*, Narosa, 2004.
3 Engel, T. and Reid, P. *Physical Chemistry 3rd Ed.*, Prentice Hall, 2012.
4 McQuarrie, D. A. and Simon, J. D. *Molecular Thermodynamics* Viva Books, 2004.
5 Roy, B. N. Fundamentals of Classical and Statistical Thermodynamics Wiley, 2001
6 Commonly Asked Questions in Thermodynamics. CRC Press, 2011.
7 Levine, I .N. *Physical Chemistry* 6th Ed., Tata Mc Graw Hill, 2010.
8 Metz, C.R. *2000 solved problems in chemistry,* Schaum Series, 2006.

Semester	**VII**
Course Code	**CHM467**
Course Title	**Chemistry VII D: Industrial Chemical analysis & Quality Control**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc I , B.Sc I I and B.Sc III year with as Chemistry as core subject
Course Objective	**The aim for this course is to** 1. Impart basic knowledge of basic Industrial Chemical analysis. 2. To study Quality Control processes.
Course Outcomes	**By the end of the course, the students will be able to:** CO1.Acquire Coherent and advanced knowledge of the basic of Industrial Chemical analysis & Quality Control processes. CO2.Analyze Chemical, biological and radiation hazards in laboratory and safety followed during analysis of Special Industrial Material. CO3.Apply & Design analytical sample preparation and the analyze the clinical samples and chemical Sensors.

Unit I

Analytical Chemometrics : General introduction and its application in optimisation, Modelling and parameter estimation, Sampling, calibration, Factor analysis, Resolution, Signal processing, Structure-property relationship, Pattern recognition, Propagation of measurement uncertainties (inaccuracy and imprecision), Analytical validation techniques, Non-linear regression analysis, Good manufacturing practice (GMP), Good lab practice (GLP), lab and industrial safety.

Unit II

Analysis of Special Industrial Material (General Strategy for Analysis) : Analysis of dairy products, oils, soaps and synthetic detergents, food additives, petrochemicals (including liquid and gaseous fuels) pesticides, drugs and pharmaceuticals, fertilizers and paints.

Unit III

Clinical Analysis : Sampling and selective analysis of biological fluids (using routine and automatic instruments), glucose, bilirubins, total cholesterol, haemoglobin, creatinine, total proteins, albumin, urea-nitrogen, carticosteroids and barbiturates. Immunological methods of analysis: ELISA, RIA and Immunodiffusion.

Unit IV

Chemical Sensors : Principles, types of chemical sensors based on the modes of transductions, Types of chemical sensor based on the chemically sensitive materials (solid electrolyte, gas, semiconductor), Humidity sensors, Biosensors, Electrochemical sensors (Potentiometric sensors, Ion-selective electrodes, Membrane electrodes, Amperometric sensors, Clark and Enzyme electrodes).

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Green chemistry frontiers in benign chemical synthesis and processes	P. Anastas and H. Williamson	Oxford University Press.
2	Chemical management: Reducing wast and cost through innovative supply strategies	Lerma and W. Straat	Willey Sons
3	Real world cases in green chemistry	M.C. Cann and M. E. Connelly	ACS Publications.
4	Policies for cleaner Technologies	T. Clayton	Earthscan
5	New Trends in Green Chemistry	V. K. Ahluwalia and M. Kidwai	AnamayaPublisher, New Delhi.

Semester	**VII**
Course Code	**CHM469**
Course Title	**Chemistry VII E: Nano-Science & Nano-Chemistry**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc I , B.Sc I I and B.Sc III year with as Chemistry as core subject
Course Objective	**The aim for this course is to** 1.To impart knowledge of nano chemistry 2. To impart coherent knowledge of nanomaterials. carbon nanotubes and their applications
Course Outcomes	**By the end of the course, the students will be able to:** CO1.Acquire knowledge of Nanotechnology, properties and applications of nanomaterials. CO2.Cognitive skills to analyse the methodology and fabrication and characterization of nanomaterials, Apply use of carbon nanotubes based nanomaterials. CO3.Various supramolecular aspects of interaction between two chemical systems.

Unit I

Nanochemistry Basics: Nanochemistry, self assembly, Self assembling materials, two dimensional assemblies, Mesoscale self assembly, coercing colloids.

Chemical Patterning, Lithography & Nanocontact Printing: Soft lithography, Dip pen nanolithography, Nanoplotters, Nanoblotters,

Unit II

Nanomaterials: Nanoparticles: zero dimensional nanostructure, homogeneous and heterogeneous nucleation, metallic nanoparticles- synthesis and applications; nanowires and nanorods: one dimensional nanostructures, spontaneous growth, VLS, electro spinning, lithography; thin film: two dimensional nanostructure- preparation techniques; Langmuir-Blodgett (LB) film growth techniques, photolithography properties and applications.

Unit III

Carbon nanostructures: Carbon molecules, clusters, carbon nanotubes and their applications. Nanorod, Nanotube, Nanowire Self- Assembly: Nanorod devices, Nanowire sensors, diodes & transistors. Instrumentation techniques SEM,TEM,AFM for characterization of nano meterials. **Scope and opportunities**: Nanoscale materials, Nanocrystals, nanotechnology enabled sensors, microelectronics, drug delivery, Bionanoinformation.

Unit IV

Supramolecular chemistry: Definition and development of supramolecular chemistry, nature of binding interactions in supramolecular structures: ion-ion, ion-dipole, dipole-dipole, h-bonding, cation---interactions, supramolecular chemistry in life, ionophores, porphyrin and other tetrapyrrollic macrocycles, coenzymes, neurotransmitters, DNA and biochemical self-assembly. Classification of supramolecular host-guest compounds, pre- organization and complementarily, receptors, nature of supramolecular interactions.

Supromolecular structures.Host-guest chemistry: synthesis and structure of crown ethers, lariat ether and podands, cryptands, spherands, calixarenes, cylcodextrins, cyclophanes, carcerands and hemicarcerands. Concepts of selectivity, macrocyclic, macrobicyclic synthesis and template effects.

Supramolcular chemistry of dendrimers and its assembly, dendritic nanodevices, Supramolecular polymers including amphiphilic block polymers and molecular imprinter polymers, biological self assembly in amyloids, actins and fibrin, COF and supramolecular gels.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Nanochemistry, A Chemical approach to Nanomaterials	G. A. Ozin & Andre, C. Arsenault	Royal society of Chemists, 2005.
2	Introduction to Nanotechnology	C. P. Poole, Jr., F. J. Owens	Wiley interscience
3	Real world cases in green chemistry	M.C. Cann and M. E. Connelly	ACS Publications.
4	Policies for cleaner Technologies	T. Clayton	Earthscan
5	New Trends in Green Chemistry	V. K. Ahluwalia and M. Kidwai	Anamaya Publishers, New Delhi.

Semester	**VII**
Course Code	**CHM471**
Course Title	**Chemistry VII F:Inorganic Chemistry Practical-1**
Type of course	Practical
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc I , B.Sc I I and B.Sc III year with as Chemistry as core subject
Course Objective	**The aim for this course is to** 1. Synthesize the coordination complexe. 2. To impart knowledge of various techniques for analysis of inorganic compounds.
Course Outcomes	**By the end of the course, the students will be able to:** CO1. Acquire Coherent Knowledge of analytical data forTitrimetric and gravimetric analysis of different cations and anions. CO2. Understand the principles, and methodology involved in precipitations and its titrations for assaying different ions. CO3. Discuss and apply the principles involved in the redox titrations and Prepare different types of inorganic compounds.

List of Experiments ***Note: Perform at least any two three experiments from each section.***

A.Inorganic Preparations & Estimation

Preparation of Reinecke salt,Trinitrotriamine cobalt (III),
Preparation of Potassium trioxalatomangnate(III), Ferrous ammonium sulphate,
Preparation of Potassium trioxalatechromate(III).
Estimation of metal in complexes by Electronic Spectroscopy
Determine the total hardness of water.

B.Oxidation-Reduction Titrations

Standardization with sodium oxalate of $KMnO_4$ and determination of Ca^{2+} ion.
Standardization of ceric sulphate with Mohr's salt and determination of Cu^{2+}, NO_3 -1 and C_2O_4 ions.
Standardization of $K_2Cr_2O_7$ with Fe^{2+} and determination of Fe^{3+} (Ferric alum)
Standardization of hypo solution with potassium iodate / $K_2Cr_2O_7$ and determination of available Cl_2 in bleaching powder, Sb^{3+} and Cu^{2+}.
Determination of hydrazine with KIO_3 titration.

C.Precipitation Titrations

$AgNO_3$ standardization by Mohr's method by using adsorption indicator.
Volhard's method for Cl^- determination.
Determination of ammonium / potassium thiocyanate.

D.Complexometric Titrations

Analysis of two cation-system using EDTA
Determination of Cu^{2+} and Ni^{2+} by using masking reagent by EDTA titration.
Determination of Ni^{2+} (back titration).
Determination of Ca^{2+} (by substitution method).

E. Gravimetric Analysis

Determination of Ba^{2+} as its chromate.
Estimation of lead as its lead molybdate.
Estimation of chromium (III) as its lead chromate.
Estimation of Cu^{2+} using Ammonium/ Sodium thiocyanate.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Vogel's quantitative analysis 6 Edn	Mendham, Denny	Pearson Education 2002
2	Synthesis and Technique in Inorganic chemistry	G. S.Girlomi; R.J. Angleci	3rd edn.; University Science Books.
3	Advanced Practical Inorganic Chemistry	Ayodha Singh	Campus Books 2002

SEMESTER VIIIth

Semester	**VIII**
Course Code	**CHM462**
Course Title	**Chemistry VIII A:Chemistry of Natural Products & Heterocyclic Chemistry**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc I , B.Sc I I and B.Sc III year with as Chemistry as core subject
Course Objective	**The aim for this course is to** 1. To impart knowledge about classification, occurrence. 2. To biosynthesis of various natural products. 3. To study synthesis of organic compounds containing N, O, and S like compounds.
Course Outcomes	**By the end of the course, the students will be able to:** CO1.Gain Coherent and advanced knowledge of various types of natural products, their biosynthesis CO2.Analyse structure, identify complex structure of natural products CO3.Acquaint knowledge about heterocyclic compounds, their structure, synthetic routes CO4. Predict and elaborate structure and properties of heterocyclics.

Unit-I

Terpenoids and Carotenoids: Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule. Structure determination, stereochemistry, biosynthesis and synthesis of the following representative molecules: Citral, Geraniol, α-Terpeneol, Menthol, Farnesol, Zingiberene, Santonin, Phytol, Abietic acid and β-Carotene.

Alkaloids: Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring, role of alkaloids in plants. Structure, stereochemistry, synthesis and biosynthesis of Ephedrine, (+)- Coniine, Nicotine, Atropine, Quinine and Morphine.

Unit-II

Steroids: Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry. Isolation, structure determination and synthesis of Cholesterol, Bile acids, Androsterone, Testosterone, Estrone, Progestrone, Aldosterone. Biosynthesis of steroids

Plant Pigments: Occurrence, nomenclature and general methods of structure determination. Isolation and synthesis of Apigenin, Luteolin, Quercetin, Myrcetin, Quercetin-3-glucoside, Vitexin, Diadzein, Butein, Aureusin, Cyanidin-7-arabinoside, Cyanidin, Hirsutidin. Biosynthesis of flavonoids: Acetate pathway and Shikimic acid pathway.

Unit-III

Nomenclature of Heterocycles: Replacement and systematic nomenclature (Hantzsch-widman System) for monocyclic fused and bridged hetrocycles

Aromatic and Non aromatic Heterocycles: General chemical behaviour of aromatic heterocycles classification (structural type) criteria of aromaticity(bond length ring current and chemical shift in H NMR- Spectra empirical resonance energy delocalization energy and Dewar resonance energy)**,** Principles of heterocyclic synthesis involving cyclization reactions and cycloaddition reaction.

Strain-bond angle and torsional strains and their conseqences in small ring heterocycles. Conformation of six-membered heterocycles with reference to molecular Geometry

Unit-IV

Small Ring Heterocycles: Three-membered and four-membered heterocyclic –synthesis and reactions of aziridines,oxiranes, thiiranes, azetidines, oxetanes and thietanes

Benzo-Fused Five-Memberd Heterocycles

Synthesis and reaction including medicinal applications of benzopyrroles, benzofurans and benzothiophenes

Reagents in Organic Synthesis: Use of the following reagents in organic synthesis and functional group transformations; Complex metal hydrides, Gilman's reagent, lithium dimethylcuprate, lithium disopropylamide (LDA) dicyclohexylcarbodimide. 1,3-Dithiane (reactivity umpolung), trimethylsilyl iodide, Woodward and prevost hydroxylation, osmium tetroxide, DDQ, selenium dioxide, phase transfer catalysts, crown ethers and Merrifield resin, Peterson's synthesis, Wilkinson's catalyst, Baker yeast.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Organic Chemistry, Vol. 2, 5th edition	Finar, I.L.	ELBS, 1975.
2	1. Chemistry, Biological and Pharmacological Properties of Medicinal Plants from the Americas	Hostettmann, Kurt; Gupta, M.P.; Marston, A.	Harwood Academic Publishers.

3	Introduction to Flavonoids	Aggarwal, O.P.	2. Harwood Academic Publishers.
4	3. Natural Products: Chemistry and Biological Significance,	Mann, J.; Davidson, R.S.; Hobbs, J.B.; Banthrope, D.V.; Harborne, J.B.	. Longman, Esse
5	Organic Chemistry	Jerry March	Wiley & Sons
6	Heterocyclic Chemistry	Acheson.	Wiley-Interscience; 3rd edition (March 11, 1985)
7	Advanced Organic Chemistry	F.R.Carey, R.J. Sunberg.	Wiley Publishers
8	Highlights of Organic Chemistry	W.J.L. Nobel	An Advanced Text Book
9	Organic Chemistry	Jerry March	Wiley & Sons

Semester	**VIII**
Course Code	**CHM464**
Course Title	**Chemistry VIII B: Chemical Kinetics and Chemical Equilibrium**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc I , B.Sc I I and B.Sc III year with as Chemistry as core subject
Course Objective	**The aim of this course is to** 1. Study the properties that deals with kinetics and equilibrium of a chemical reaction. 2. To study chemical changes occurring in the reaction medium with time.
Course Outcomes	**By the end of the course, the students will be able to:** CO1.Acquire basic knowledge of Kinetics of a chemical reaction and relation between reactant concentration and time in a reaction CO2.Understading basic concepts of Chemical Kinetics, order, molecularity, rate laws of a reaction, Temperature dependence of reaction rates and their applications CO3.Apply law of chemical equilibrium, van't hoff reaction isotherm and Le Chatelier's principle in a chemical reaction.

Unit I:

The rate of a reaction : reaction of molecular bromine and formic acid, decomposition of hydrogen peroxide, reaction rates and stoichiometry, elementary and multistep reaction, relation between reactant concentration and time: order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential rate laws for first order, differential rate laws for second order, differential rate laws for zero order reaction, integrated rate laws for first order reaction, integrated rate laws for second order reaction and integrated rate laws for zero order reaction, pseudounimolecular reactions, determination of the order, kinetics of complex reactions (limited to first order).

Unit II:

Temperature dependence of reaction rates: Arrhenius equation, derivation of arrhenius equation, calculation of activation energy graphically, calculation of activation energy by two different temperature, collision theory of reaction rates, Lindemann mechanism, qualitative treatment of the theory of absolute reaction rates. opposing reactions (ii) parallel reactions and (iii) consecutive reactions and their differential rate equations (steady-state approximation in reaction mechanisms) (iv) chain reactions.

Reaction mechanisms: rate laws and elementary steps, hydrogen peroxide decomposition, the hydrogen iodide reaction, experimental support for reaction mechanisms, catalysis, heterogeneous catalysis, the haber synthesis of ammonia, homogeneous catalysis, enzyme catalysis

Unit III:

Spontaneous reactions: free energy of spontaneous reaction, role of temperature, standard free energy change, standard free energy of formulation of compounds, the concept of chemical equilibrium, Law of mass action, thermodynamic derivation of law of chemical equilibrium, van't hoff reaction isotherm, distinction between ΔG and ΔG^0, relation between K_p, K_c, K_x, relation between K_p and K_c for ideal gas mixture, relation between K_p and K_c for liquid state, calculations of K_p and K_c for different reaction,

Unit IV:

chemical equilibria: De Donder's treatment of chemical equilibria, degree of advancement of chemical reaction, thermodynamic relation for chemical affinity, enthalpy and affinity, internal energy and affinity, homogeneous equilibrium, Intregrated form of Vant's equation, pressure dependence of equilibrium constant K_p, pressure dependence of equilibrium constant Kc, pressure dependence of equilibrium constant K_x, heterogeneous equilibrium, dissociation of calcium carbonates, equilibrium constants of reactions involving real gas, Le Chatelier's principle: effect of change of temperature, effect of change of pressure, Le Chatelier's principle in physical equilibrium, Vapour pressure of liquid, effect of pressure on the boiling point of the liquid, effect of pressure on the frizing point of the liquid, effect of temperature on solubility, linear free energy relationship, Hammett equation: substituent constant, reaction constant, Hammett equation as a linear free energy relationship, reeaction mechanism, Hammett constants and curved Hammett plot, separation of polar, resonance and steric effects.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Principles of Physical Chemistry	B. R. Puri , Madan S. Pathania L.R. Sharma	Vishal Publishing Company (2020)

2	Atkins' Physical Chemistry,thermodynamics and kinetics	Peter Atkins, Julio de Paula	Oxford University press,(2014)
3	A Textbook of Physical Chemistry, Thermodynamics and Chemical Equilibrium(volume Two)	K. L. Kapoor	McGraw Hill Education(2019)
4	A Textbook of Physical Chemistry (Vol. Five)	K. L. Kapoor	Macmillan Indian press.2009
5	An introduction to Chemical Kinetics	Claire Vallance	Morgan & claypool publishers, US, 7017

Semester	**VIII**
Course Code	**CHM466**
Course Title	**Chemistry VIII C:Coordination Chemistry**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc I , B.Sc I I and B.Sc III year with as Chemistry as core subject
Course Objective	**The aim of this course is to** 1. Study the coordination complexes, reactions and their applications.
Course Outcomes	**By the end of the course, the students will be able to:** CO1.Understand Formation, reaction mechanism of coordination complexes, their Kinetic and thermal stability, and determinations. CO2.stability of coordination complexes. CO3.Able to interpret the electronic and magnetic properties of coordination compounds.

Unit - I

Coordination Chemistry and bonding

Nomenclature, isomerism and methods of preparation of coordination complexes- types of ligands. Bonding: Valence bond theory- Crystal field theory – Crystal field effects in tetrahedral, octahedral and square planar symmetries. Crystal field stabilization energy - weak and strong fields- spectrochemical series. Molecular orbital theory: based on group theoretical approach. M.O. diagram of Oh. Td & square planar symmetries involving pi bonding- experimental evidence for the presence of pi bonding. Magnetic behaviour of the transition metal ions in crystal field and molecular orbital theories.

Unit-II

Electronic Spectra and Magnetic Properties of Transition Metal Complexes-I

Term symbols for d configuration. calculations of Dq, B and β parameters, Characteristics of d-d transition -- selection rules rules for electronic spectra. Weak and strong field limits. Spectroscopic ground states, correlation ,Orgel diagram and Tanabe – Sugano energy level diagrams. Spectrochemical series, Jahn-Teller tetrahedral distortion and spin orbit couplings. Nephelauxetic effect -charge transfer spectra. Luminescence spectra.
Magnetic moments based on crystal field ground term, Perturbation Theory and its application.

Unit – III

Reaction Mechanisms of Transition Metal Complexes

Introduction, potential energy diagram and reactivity of metal complexes, ligand substitution reactions, labile and inert metal complexes, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, anation reaction, ligand displacement reactions in octahedral and square planar complexes, Trans effect, mechanism of the substitution reaction reactions without metal ligand bond cleavage, Electron transfer reactions: Inner sphere and outer sphere process.
Stepwise and overall formation constant and their interaction, trends in stepwise constants, Factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand, chelate effect and its thermodynamic origin.

Unit-IV

Metal II–Complexes: Metal carbonyls, structure and bonding, vibrational spectra of metal carbonyls for bonding and structure elucidation, important reaction of metal carbonyls. Preparation, bonding structure and important reactions of transition metal nitrosyl, Complexes of unsaturated hydrocarbons- alkenes, allyl and pentadienyl complexes.
Arene complexes-complexes of biochemical importance: Cytochromes, Haemoglobin, Myoglobin, Cyanocobalamine, Chlorophyll- structure and functions.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Inorganic Chemistry- Principles of Structure and Reactivity (IV Edition).	Huheey, J. E., Keitler, E. A., & Keitler, R. L. (2012).	Singapore: Pearson Education.
2	Basic Inorganic Chemistry (III Edition).	Cotton, F. A., Wilkinson, G., & Paul. L. (2007).	New York: John Wiley & Sons.
3	Inorganic Chemistry	D.F.Shriver, P.W.Atkins and C.H.Langford,	Oxford, 2nd. edn. 1994.
4	Magnetism and Transition Metal Complexes	F. E. Mabbs and D. J. Machin	(Chapman and Hall) London (1973).
5	Introduction to Magnetochemistry	A. Earnshaw	Academic Press, (1968)

6	Co-ordination Chemistry.(Ist Edition)	Sarn, K. (2005).	New Delhi: Rajat Publications.
7	An Introduction to Inorganic Chemistry	K.F.Purcell and J.C.Kotz	Saunders 1990, Chapter 14.
8	Organotransition Metal Chemistry	Anthony F.Hill	Royal Society of Chemistry, Tutorial Chemistry Text, 2002. Chapters 1 to 7.
9	Comprehensive Coordination Chemistry	Vol.1. G Wilkinson (Ed)	Wiley, New York, 1967
10	Inorganic Chemistry,	Gary L. Miessler, Paul J. Fischer and Donald A. Tarr, (2013).	Pearson

Semester	**VIII**
Course Code	**CHM468**
Course Title	**Chemistry VIII D: Bio-Organic Chemistry**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc I , B.Sc I I and B.Sc III year with as Chemistry as core subject
Course Objective	**The aim of this course is to** 1. Provide knowledge of structure, function, and physicochemical properties of biomolecules. 2. Aware students about the metalloenzymes, heme proteins, oxygen carriers, and non-heme proteins and therapatic Agents.
Course Outcomes	**By the end of the course, the students will be able to:** CO1.Understand structure, function and physicochemical properties of biomolecules. CO2.Interpret Structure & Properties of enzymes, Mechanism of Enzyme Action metalloenzymes heme proteins and oxygen carriers. CO3.Apply and use of non-heme proteins and therapatic Agents.

Unit-I

Enzymes : Basic considerations. Proximity effects and molecular adaptation. Introduction and historical prospective, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation. Nomenclature and classification, extraction and purification. Fischer's lock and key and koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labelling and enzyme modification by site-directed mutagenesis.

Co-Enzyme Chemistry: Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes.Structure and biological function of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD+, NADP+, FMN, FAD, LIPOIC ACID, vitamin B12. Mechanisms of reactions catalysed by the above cofactors.

Unit-II

Mechanism of Enzyme Action : Enzyme kinetics, Michaelis-menten and lineweaver-Burk plots, reversible andirreversible inhibition. Transition-state theory, orientation and steric effect, acid-base catalysis, covalent catalysis, strain or distortion. Examples of some typical enzyme mechanisms for chymotrypsin, ribonucleases, lysozyme and carboxypeptidase A

Metalloenzymes: Definitions: Apoenzyme, Coenzyme, Metalloenzyme, structure and functions of carbonic anhydrase A & B, carboxy peptidases.

Unit-III

Vitamins: Introduction of fat soluble and water soluble vitamins, sources, structure, requirements and functions of vitamin A,D,E and vitamin B1 and C.

Antibiotics: ß- Lactumrings, structure and synthesis of penicillin – G, penicillin-V, Amoxycillin, cholamphenicol, streptomycin.

Unit-IV

Transport and storage of metals: The transport mechanism, transport of alkali and alkaline earth metals, ionophores, transport by neutral macrocycles and anionic carriers, sodium/potassium pump, transport and storage of Iron (Transferrin & Ferritin). Transport of Iron in microorganisms (sidrophores), types of sidrophores (catecholate and Hydroxmato siderophores).

Inorganic compounds as therapatic Agents:- Introduction chelation therapy, synthetic metal chelates as antimicrobial agents, antiarthritis drugs, antitumor, anticancer drugs (Platinum complexes), Lithium and mental health.

Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	The Inorganic Chemistry of Biological processes	M. N. Hughes	John Wiley & Sons Ltd
2	Medicinal Chemistry-the role of organic chemistry in drug research	C. R. Ganellin, and S. M. Roberts	Mount Kisko, NY 1973
3	Bio Inorganic Chemistry	Robert Wittay	
4	Advanced Inorganic Chemistry (4^{th} Edn)	Cotton and Wilkinson	
5	Topics in current chemistry (Inorganic Biochemistry) vol. 64 (1976)	Davison and Coworkers	
6	Inorganic chemistry	James E. Huheey.	

Semester	**VIII**
Course Code	**CHM470**
Course Title	**Chemistry VIII E: Industrial Chemistry**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc I , B.Sc I I and B.Sc III year with as Chemistry as core subject
Course Objective	**The aim of this course is to** 1. To provide knowledge of basic industrial processes and Industrial Chemicals
Course Outcomes	**By the end of the course, the students will be able to:** CO1. Understand various industrial chemicals and their synthesis

Unit-I

Chemical Technology: Basic principles of distillation, solvent extraction, solid-liquid leaching and liquid-liquid extraction, separation by absorption, and adsorption. An introduction to the scope of different types of equipment needed in chemical technology, including reactors, distillation columns, extruders, pumps, mills, emulgators. Scaling up operations in the chemical industry. Introduction to clean technology.

Industrial Gases and Inorganic Chemicals :(a) 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.(b) 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

Surface Coatings & Dyes: A. Objectives of coatings surfaces, preliminary treatment of the surface, classification of surface coatings. Paints and pigments-formulation, composition, and related properties. Oil paint, Vehicle, modified oils, Pigments, toners, lakes pigments, Fillers, Thinners, Enamels, emulsifying agents. Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint), Dyes, Wax polishing, Water and Oil paints, additives, Metallic coatings (electrolytic and electroless), metal spraying, and anodizing.

B. Dyes: General introduction and classification with special reference to textile and edible dyes and fabric brighteners. Industrial preparation and uses of methyl orange, malachite green, indigo, bismark brown, alizarin.

Unit-III

Oils and Fats : Classification of oils, fat splitting, distillation of completely miscible and non-miscible oils, hydrogenation of oils, rancidity, saponification value, iodine number, acid value, Soap, and Synthetic Detergent, preparation of soap and detergent, different types of soap and their composition, surfactants (LAS, ABS, LABS), detergent binders and builders. Lubricants: Classification of lubricants, lubricating oils (conducting and non-conducting) Solid and semisolid lubricants, synthetic lubricants. Properties of lubricants (viscosity index, cloud point, pore point) and their determination. Food chemistry: Food additives A general study of food flavours, colours and preservatives, artificial sweeteners.

Unit-IV

Practical Industrial Chemistry

Preparation of cosmetics: Talcum powder, soap, shampoo, enamels, hair remover, face cream, nail polish and nail polish remover.

Preparation of simple organophosphates, phosphonates and thiophosphates, magnesium bisilicate (Antacid).

Separation of essential oils by soxhlet extractor.

Analysis of oils and fats (iodine value, saponification value, acid value).

Testing of turmeric powder, milk, and mustard oil for adulterants.

Extraction of natural colouring and flavouring agents from flowers and fruits

Preparation of dyes: Malachite Green, Methyl Orange.

Polymeric synthesis: Maleic Anhydride/ glyptal resin, caprolactum, phenol-formaldehyde and urea-formaldehyde, Preparation of Hexamethylenediamine and Adipic acid, Preparation of nylon 6,6.

Reference Books:

1.E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
2.R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, WileyPublishers, New Delhi.
3.W. D. Kingery, H. K. Bowen, D. R. Uhlmann: *Introduction to Ceramics*, WileyPublishers, New Delhi.
4.J. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.

5.P. C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.
6.R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry*, Vikas Publications, New Delhi.
7.Sharma, B.K. & Gaur, H. *Industrial Chemistry*, Goel Publishing House, Meerut(1996).

Semester	**VIII**
Course Code	**CHM472**
Course Title	**Chemistry VIII F:Organic Chemistry Practical-1**
Type of course	Practical
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc I , B.Sc I I and B.Sc III year with as Chemistry as core subject
Course Objective	**The aim of this course is to** 1. To learn the basic organic preparations. 2. To perform various organic preparations using organic reagents like reducing agents and oxidizing agents.
Course Outcomes	**By the end of the course, the students will be able to:** 1. Adopt safe laboratory practices by handling laboratory glassware, equipment and chemicals. 2. Understand the basic nature of reagents like reducing agents and oxidizing agents. 3. Apply & propose starting materials, functional groups, mechanism, and typical reaction conditions.

List of Experiments

Synthesis: Synthesis, purification and identification of organic compounds by recrystallization/functional group identification:

i. Oxidation: Adipic acid from cyclohexanol
ii. Aldol condensation: Dibenzal acetone from benzaldehyde
iii. Sandmeyer reaction: p-Chlorotoluene from p-toluidine
iv. Cannizzaro reaction: Benzyl alcohol and benzoic acid from benzaldehyde
v. Aromatic electrophilic substitutions: p-nitroaniline from aniline
vi. Aromatic electrophilic substitutions: Picric acid from phenol
vii. Beckmann Rearrangement: Benzanilide ← Benzophenone oxime ← Benzaldehyde
viii. Reduction: Benzhydrol from benzophenone [$NaBH_4$ reduction]
ix. Esterification: Methyl benzoate from benzoic acid
x. Carbohydrate Modification: Osazone derivative from carbohydrates
xi. Haloform reaction: Iodoform synthesis from acetone / ethyl alcohol
xii. Sublimation: Synthesis/purification of Phthalic anhydride from Phthalic acid
xiii. Preparation of p- Iodonitrobenzene from p-nitroaniline.
xiv. Preparation of benzyl alcohol and benzoic acid (Cannizzaro's reaction).
xv. Preparation of Dibenzal acetone from benzaldehyde (Claisen-Schmidt reaction).
xvi. Preparation of Acetanilide, bromoacetanilide, bromoaniline.

Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1	Experimental Organic Chemistry,	Harwood, L.M., Moody, C.J.	1st edition, Blackwell Scientific Publishers, 1989.
2	Text Book of Practical Organic Chemistry	Vogel, A.I.	ELBS, IVth edition, Longman Group Ltd., 1978.
3	Practical Organic Chemistry	. Mann, F.G.; Saunders, B.C.	4th edition, New Impression, Orient Longman Pvt. Ltd., 1975

Semester	**VIII**
Course Code	**CHM474**
Course Title	**Chemistry VIII G: Physical Chemistry Practical- I**
Type of course	Practical
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc I , B.Sc I I and B.Sc III year with as Chemistry as core subject
Course Objective	**The aim of this course is to** 1. Impart knowledge and hand-on experiences of different analytical techniques. 2. To study various thermodynamic techniques (conductometry, pHmetry and other viscosity and surface tension measurements) for chemical and biomolecular analysis.
Course Outcomes	**By the end of the course, the students will be able to:** CO1.Acquire basic knowledge about analytical techniques such as conductometric, pH metric and potentiometry techniques. CO2.Understand and apply different thermodynamic techniques like viscosity and surface tension measurements for solutions. CO3.Analyze determination of solubility of different inorganic and organic salt.

1. **Viscosity:**

(i) To determine the coefficient of viscosity of given liquid by Ostwald's viscometer.

(ii) Determination of relative and absolute viscosity of a given liquid.

(iii) Determination of percentage composition of a liquid mixture by viscosity measurement.

(iv) Determination of molecular weight of a high polymer (say polystyrene) by viscosity measurement.

2. Surface Tension:

(i) Determination of surface tension of given liquid by drop no. method by stalgmometer.

(ii) To determine the C.M.C. of a soap (sodium or potassium lauryl sulphate by surface tension measurements and to compare cleansing power of two detergents.

(iii) Determination of surface tension of alcohols & Determination of Parachor value of $>CH_2$ group.

(iv) To measure interfacial tension and to test the validity of Antonoff's rule.

3. **Solubility:**

(i)Determination of solubility of inorganic salt in water at different temperatures and hence to draw the solubility curve.

(ii)Determination of heat of solution of a substance by solubility method

(iii) To study the effect of addition of an electrolyte on the solubility of an organic acid.

(iv) To study the variation of solubility of Ca $(OH)_2$ in NaOH solution and hence determine the solubility product.

(v)Determine the solubility (g/litre) of sparingly soluble lead sulphate from conductance measurements.

(vi)To obtain the mutual solubility curve of phenol + H2O, and hence the Upper Consolute point,

4. Colloidal State:

(i) To compare the precipitation power of Na^+, Ba^{+2}& $A1^{+3}$ ions for As_2S_3 sol.

(ii) To study interaction between arsenious sulphide and ferric hydroxide sol.

5. Potentiometric/ conductometric titrations:

(i) Preparation of buffers and measurement of their pH.

(ii) To determine the strength, dissociation constant of given acid pH metrically.

(iii)Titration of weak acid /Weak base conductometrically.

(iv)Titration of strong acid /strong base conductometrically.

(v)To determine dissociation constant of given acid conductometrically.

(vi)Compare the relative strength of CH_3COOH and $ClCH_2COOH$ from conductance measurements.

(vii)Titrate a given mixture of HCl and CH_3COOH against NaOH solution conductometrically

(viii)Determine the dissociation constant of acetic acid in DMSO, DMF and dioxane by titrating it with KOH.

(ix)Determine the activity coefficient of an electrolyte at different molalities by e.m.f. measurements.

Colorimetry:

1. Verify Lambert-Beer's law and determine the concentration of CuSO4/KMnO4/K2Cr2O7 in a solution of unknown concentration.
2. Determine the concentrations of KMnO4 and K2Cr2O7 in a mixture.
3. Study the kinetics of iodination of propanone in acidic medium.
4. Determine the amount of iron present in a sample using 1, 10-phenanthroline.
5. Determine the dissociation constant of an indicator (phenolphthalein).

6. Study the kinetics of interaction of crystal violet/ phenolphthalein with sodium hydroxide.

Note: Perform at least any three from each section.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Experimental Physical Chemistry	Arthur M. Halpern, George C. McBane	Freeman,2006.
2	Experiments in Physical Chemistry, 5th ed.,	Schoemaker et al.	MGH, 1989
3	Chemistry Experiments for Instrumental Methods	Sawyer, Heineman, Beebe	Wiley, 1984 .
4	Physical Chemistry Practical.	Maity S., and Ghosh, N.(	New Central Book Agency (P) Ltd. 2012).
5	Senior Practical Physical Chemistry.	Khosla, B.D., Garg, V.C., and Gulati A.R.	S. Chand and Sons. (2007).
6	Advanced Practical Physical Chemistry.	Yadav, J. B.	Krishna Prakashan Media. (2006).
7	Experiments in Physical Chemistry,	Ghosh, J.C.	Bharati Bhavan. (1990).

(Minor Courses)

SKILL ENHANCEMENT COURSES

(Semester III - VI)

Semester	**III**
Course Code	**CHM 265**
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 aim of this course is to** 1. make student aware about concepts of analytical Chemistry various spectrophotometric, electroanalytical methods of analysis 2. Exposed students 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.

Semester	**IV**
Course Code	**CHM 270**
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** 1. Impart coherent knowledge principles and scope of Green chemistry. 2. To study 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 processesthat 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

Semester	**V**
Course Code	**CHM 375**
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 aims of this course to** 1. 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. 2. 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, Refiningand different types of petroleum products and their applications. Fractional Distillation (Principle and process), Cracking (Thermal and catalytic cracking)

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 Methods of analysis	D. A. Skoog and D.M.West	Saunder's College Publ. 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).

Semester	**VI**
Course Code	**CHM 374**
Course Title	**Basic 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 aim of this course is to** 1.Develop basic understanding of drugs discovery, design, development and their side effects, 2 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 1

Introduction

Drug discovery, design and development: Sources of drugs: biological, marine, minerals and plant tissue culture, physio-chemical aspects (optical, geometric and bioisosterism) of drug molecules and biological action, drug receptor interaction, basic retro-synthetic approach for development of drug. Cause of side effect of drugs like ibuprofen, cetirizine, thalidomide. Difference between drug and poison.

Unit II

Drugs and Pharmaceuticals

Study of pharmaceutical aids like talc, diatomite, kaolin, bentomite, gelatin and natural colours. Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti-inflammatory agents (Aspirin); antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim); antiviral agents (Acyclovir), central nervous system agents (Phenobarbital, Diazepam), Cardiovascular (Glyceryl trinitrate), antilaprosy (Dapsone), HIV-AIDS related drugs (AZT- Zidovudine).

Unit III

Fermentation

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

UnitIV

1. Preparation of aspirin and its analysis.
2. Preparation of paracetamol and its analysis.
3. Preparation of sulphacetamide of sulphonamide and its analysis.
4. Determination of alcohol contents in liquid drugs/galenical.
5. Determination of ascorbic acid in vitamin C tablets by iodometric or coulometric titrations.
6. Synthesis of ibuprofen.
7. Analysis of commercial vitamin C tablets by iodometric and coulometric titrimetry.

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	Hakishan, V.K. Kapoor	Vallabh

	Chemistry,		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

Semester	**VI**
Course Code	**CHM 376**
Course Title	Chemistry of Cosmetics and Perfumes
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** 1. Introduce the students of chemistry to the world of cosmetic chemistry. 2. Impart the theoretical and practical knowledge on basic principles of cosmetic chemistry, manufacture, formulation of various cosmetic products.
Course outcome	**By the end of this course, students will be able to:** CO1.Learn basic of cosmetics, various cosmetic formulation, ingredients and their roles in cosmetic products. CO2. Learn the use of safe, economic and body-friendly cosmetics CO3. Prepare new innovative formulations.

Unit I

Cosmetics- Definition, History, Classification, Ingredients, Nomenclature, Regulations. Face Preparation: Structure of skin, Face powder, Compact powder, Talcum powder.

Unit II

Skin Preparation: Face cream, vanishing cream, cold cream, suntan cream, lather shaving cream,
Hair preparation: Structure of hair, classification of hair, Hair dye- classification – temporary, semipermanent, demi permanent, permanent, formulation, hair sprays, shampoo- types of shampoo, conditioners

Unit III

Colored preparation: Nail preparation Structure of nail, Nail lacquers, Nail polish remover Lipsticks , Personal hygiene products: Antiperspirants and deodorants, oral hygiene products, flavours and essential oils

Unit IV

Practicals

Preparation of: 1. Talcum powder. 2. Shampoo. 3. Enamels. 4. Face cream. 5. Nail polish and nail polish remover. 6. Hand wash 7. Hand sanitizer 8. Body lotion 9. Soap 10. Tooth powder 11. Tooth paste

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Handbook of Cosmetic Science and Technology,	Barel, A.O.; Paye, M.; Maibach, H.I.(2014)	CRC Press.
2	Text Book of Cosmetics	Garud, A.; Sharma, P.K.; Garud, N. (2012),	Pragati Prakashan
3	Pharmaceutics and Cosmetics,	Gupta, P.K.; Gupta, S.K.(2011),	Pragati Prakashan
4	Poucher's Perfumes, Cosmetic and Soap,	Butler, H. (2000),	Springer
5	Chemistry of Cosmetics	Kumari, R.(2018),	Prestige Publisher

SCHEME & SYLLABUS
of
MATHEMATICS
for
B.Sc NonMedical

4 year programme

(As Per NEP)

(Major Courses)

CORE COURSES

(Semester I-IV)

SEMESTER Ist

Semester	**I**
Course Code	**MAT161**
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** 1. Introduce calculus Students will be familiarized to the concepts and applications of limits, derivatives, integrals and Matrices. 2. Introduce the hyperbolic function , derivatives.
Course outcomes	**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 $\int \sin nx\,dx$, $\int \cos nx\,dx$, $\int \tan nx\,dx$, $\int \sec nx\,dx$, $\int (\log x)^n\,dx$, $\int \sin(nx)\sin(mx)\,dx$, parametric equations, parameterizing a curve, arc length, arc length of parametric curves, area of surface of revolution.

Unit-III

Rolle's theorem, Mean value theorems, Taylor's theorem with Lagrange's and Cauchy's form of remainder, Taylor's series, Maclaurin's series, 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:

Sr No.	Book Title	Author	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

SEMESTER IInd

Semester	**II**
Course Code	**MAT162**
Course Title	**Differential Equations**
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** 1. Develop the knowledge about Differential Equations and partial equations. 2. Develop the knowledge of Wronskian properties.
Course Outcomes (CO)	**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:

Sr No.	Book Title	Author	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

SEMESTER IIIrd

Semester	**III**
Course Code	**MAT261**
Course Title	**Real analysis**
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	**The aim of the subject is to** 1. Have the knowledge of basic properties of field of real numbers, convergence of sequences and metric space. 2. Develop knowledge of finite infinite sets,Cauchy theorem.
Course Outcomes (CO)	**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.

Text and reference books:

Sr No.	Title	Author	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
4	Introduction to Real Analysis	R.G. Bartle and D. R Sherbert	John Wiley and Sons

SEMESTER IVth

Semester	**IV**
Course Code	**MAT262**
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** 1. Make the students learn fundamental concepts of Groups, Ring, Field and trigonometry concepts. 2.Learn the concept of group theory, Devier theorem.
Course Outcomes (CO)	**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.	Title	Author	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

DISCIPLINE ELECTIVE COURSES

(Semester V - VIII)

SEMESTER

Vth

Semester	**V**
Course Code	**MAT361**
Course Title	**Linear Algebra**
Type of course	Discipline Elective Courses (Theory)
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 aim of this course is to** 1. Provide the knowledge of basic Quotient Space, linear transformation, invertibility and Isomorphism on vector space. 2. Provide knowledge of vector spaces, dimensions.
Course Outcomes (CO)	**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

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Semester	**V**
Course Code	**MAT363**
Course Title	**Theory of Equations**
Type of course	Discipline Elective Courses (Theory)
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** 1. Impart knowledge to the students about theory of equations. 2. Impart knowledge of Polynomial, symmetric functions.
Course Outcomes (CO)	**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

SEMESTER VIth

Semester	**VI**
Course Code	**MAT364**
Course Title	Introduction to Operation Research
Type of course	Discipline Elective Courses (Theory)
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** 1. Help to understand Simplex Method, Big M Method, and Primal – dual Relationship. 2. Understand the concept of operation research.
Course Outcomes	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

SEMESTER VIIth

Semester	**VII**	
Course Code	**MAT461**	
Course Title	**Advanced Real Analysis-I**	
Type of course	Core	
L T P	4 0 0	
Credits	4	
Course prerequisite	B.Sc. with Mathematics or B.A with Mathematics	
Course Objective	The aim of this course is to 1. Learn fundamental concepts of metric spaces, the Riemann-Stieltjes integral as a generalization of Riemann Integral, the calculus of several variables and basic theorem. 2. Learn fundamental of advanced analysis in detail.	
Course Outcome	CO1	describe fundamental properties of the real numbers that lead to the formal development of real analysis.
	CO2	comprehend rigorous arguments developing the theory underpinning real analysis.
	CO3	demonstrate an understanding of limits and how they are used in sequences, series, differentiation and integration.

UNIT: I

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

UNIT: II

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

UNIT: III

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

UNIT: IV

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

Text and Reference books:

S.No.	**Name/Title**	**Author**	**Publisher**
1	Principles of Mathematical Analysis	Walter Rudin	McGraw-Hill Ltd .
2	A course of Mathematical Analysis	Shanti Narayan	S.Chand
3	Mathematical Analysis	S.C.Malik	Wiley Eastern.
4	Introduction to Real Analysis	R. G. Bartle	John Wiley and Sons
5	Elements of Real Analysis	H. S. Gaskill and P.P.Narayanaswami	Printice Hall,
6	Real Analysis	H.L. Royden	Macmillan Company Collier-Macmillan

Semester	**VII**	
Course Code	**MAT463**	
Course Title	**Abstract Algebra-I**	
Type of course	Core	
L T P	4 0 0	
Credits	4	
Course prerequisite	B.Sc. with Mathematics or B.A with Mathematics	
Course Objective	**The aim of this course is to** 1. covers some advanced topics of Group Theory and basic concept of ring theory, which are two most important branches of algebra. 2. Solve different equation based on abstract algebra.	
Course Outcome	CO1	demonstrate insight into abstract algebra with focus on axiomatic theories..
	CO2	demonstrate knowlegde and understanding of fundamental concepts including groups, subgroups, normal subgroups, homomorphisms and isomorphism.
	CO3	demonstrate knowlegde and understanding of rings, fields and their properties.

UNIT: I

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

UNIT: II

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

UNIT: III

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

UNIT: IV

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

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Schaum‘s outline of modern abstract algebra	Frank Ayres	Schaum‘s outline series
2	Basic Abstract Algebra	P.B. Bhattacharya, S.K. Jain& S.R. Nagpaul	Cambridge University Press
3	A Course in Abstract Algebra	Vijay K Khanna and S K Bhambri	Vikas Publishing house
4	Contemporary Abstract Algebra	J. A. Gallian.	NarosaPublisihng House
5	A First Course in Abstract Algebra	J. B. Fraleigh	Addison-WeseleyPublising

Semester	**VII**	
Course Code	**MAT 467**	
Course Title	**Introduction to Statistics**	
Type of course	CORE (Theory)	
L T P	4:0:0	
Credits	4	
Course prerequisite	B.Sc. with Mathematics or B.A with Mathematics	
Course Objective	**The aim of this course is to** 1. covers some advanced topics of Statistics. 2. Explain cocept of central tendency, bivariate data, fitting.	
Course Outcome	CO1	demonstrate insight into Statistics, sample data
	CO2	demonstrate knowlegde and understanding of fundamental concepts of Measures of Central Tendency
	CO3	demonstrate knowlegde and understanding of Bivariate data

UNIT: 1

Introduction: Definition and scope of Statistics, concepts of statistical population and sample. Data: quantitative and qualitative, attributes, variables, scales of measurement - nominal, ordinal, interval and ratio. Presentation: tabular and graphic, including histogram and ogives.

UNIT: II

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

UNIT: III

Bivariate data: Definition, scatter diagram, simple, partial and multiple correlation (3 variables only), rank correlation. Simple linear regression, principle of least squares and
fitting of polynomials and exponential curves.

UNIT: IV

Theory of attributes, consistency of data, independence and association of attributes, measures of association and contingency.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Fundamentals of Statistics	Goon A.M., Gupta M.K. and Dasgupta B.	Vol. I & II, 8th Edn. The World Press, Kolkata.
2	Mathematical Statistics with Applications.	Miller, Irwin and Miller, Marylees	Pearson Education, Asia..
3	Introduction to the Theory of Statistics	Mood, A.M. Graybill, F.A. and Boes, D.C.	Tata McGraw-Hill Pub. Co. Ltd.

Semester	**VII**	
Course Code	**MAT 469**	
Course Title	**Mathematical Tools and Software-Practical**	
Type of course	CORE (Practical)	
L T P	0:0:4	
Credits	2	
Course prerequisite	B.Sc. with Mathematics or B.A with Mathematics	
Course Objective	**The aim of this course is to** 1 covers some mathematical tool and softwares such as MATLAB, SCILAB, LATEX. 2. Run and compile different problemswith MATLAB,SCILAB.	
Course Outcome	CO1	They will learn about the mathematical tool
	CO2	They will learn softwares such as MATLAB, SCILAB, LATEX,

List of Practicals
1. Introduction to MATLAB and basic commands
2. Introductions to SCILAB and basic commands
3. Introduction to C or C++ and basic commands
4. Introduction to Latex and basic commands

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Fundamentals of Statistics	Goon A.M., Gupta M.K. and Dasgupta B.	Vol. I & II, 8th Edn. The World Press, Kolkata.
2	Mathematical Statistics with Applications	Miller, Irwin and Miller, Marylees	Pearson Education, Asia.
3	Introduction to the Theory of Statistics	Mood, A.M. Graybill, F.A. and Boes, D.C.	Tata McGraw-Hill Pub. Co. Ltd.

SEMESTER VIIIth

Semester	**VIII**	
Course Code	**MAT462**	
Course Title	**Advanced Real Analysis-II**	
Type of course	Core	
L T P	4 00	
Credits	4	
Course prerequisite	B.Sc. with Mathematics or B.A with Mathematics	
Course Objective	The aim of this course is to 1. study the convergence of sequences and measure in an abstract setting after having studied Lebesgue measure on real line. The general LP spaces are also studied. 2. Impart Understanding of Advanced real analysis in detail.	
Course Outcome	CO1	Improve and outline the logical thinking.
	CO2	Illustrate how to communicating with: Peers, Lecturers and Community
	CO3	Define and recognize the basic properties of the field of real number.

UNIT: I

Convergence and continuity, Uniform convergence and integration, Uniform convergence, nowhere differentiable functions, Weierstrass's non-differentiable function, Weierstrass Approximation Theorem, Stone-Weierstrass's Theorem.

UNIT: II

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

UNIT: III

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

UNIT: IV

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

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Principles of Mathematical Analysis (3rd Edition).	Walter Rudin.	McGraw-Hill Ltd.
2	Mathematical Analysis	S.C.Malik	Wiley Eastern
3	Elements of Real Analysis	H.Gaskill andNarayanaswami	Printice Hall
4	Introduction to Real Analysis	R. G. Bartle	John Wiley and Sons
5	Elementary Analysis: The Theory of Calculus	K. Ross	Springer Int. Edition

Semester	**VIII**	
Course Code	**MAT464**	
Course Title	**Abstract Algebra-II**	
Type of course	Core	
L T P	5 0 0	
Credits	5	
Course prerequisite	B.Sc. with Mathematics or B.A with Mathematics	
Course Objective	**The aim of this course is to** 1. Introduce the advanced concepts of ring theory and modules. 2. Enhance knowledge of Rings, modules in detail.	
Course Outcome	CO1	recognise technical terms and appreciate some of the uses of algebra
	CO2	simplify some formulas
	CO3	solve simple linear equations

UNIT: I

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

UNIT: II

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

UNIT: III

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

UNIT: IV

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

Text and Reference books:

S. No.	Name/Title	Author	Publisher
1	Topics in Algebra	I. N. Herstein	Xerox Publishing Company Mass
2	Schaum‘s outline of modern abstract algebra	Frank Ayres	Schaum‘s outline series
3	Basic Abstract Algebra	P.B. Bhattacharya, S.K. Jain, &S.R. Nagpaul.	Cambridge University Press.
4	A Course in Abstract Algebra	Vijay K Khanna and S. K.Bhambri	Vikas Publishing house
5	Contemporary Abstract Algebra	J. A. Gallian	NarosaPublisihng

Semester	**VIII**	
Course Code	**MAT466**	
Course Title	**Numerical Analysis**	
Type of course	Theory Course	
L T P	4 0 0	
Credits	4	
Course prerequisite	B.Sc. /B.A. Ist, IInd year with Mathematics as core subject	
Course Objective	**The aim of the subjects is** 1. That students will be familiar with the notation and terminology related to finding the errors, significant numbers 2.able to interpolate the problems using numerical methods	
Course Outcome	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 1:
Alogarithm, convergence, error, relative absolute, round off, Truncation Transcental & polynomial equation, Bisection method, Newton Raphson method, secant method, rate of convergence.

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

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

UNIT: IV
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/Title	Author	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

Semester	**VIII**	
Course Code	**MAT468**	
Course Title	**Fourier Series and Integral Equations**	
Type of course	Core	
L T P	4 0 0	
Credits	4	
Course prerequisite	B.Sc. with Mathematics or B.A with Mathematics	
Course Objective	**The aim of this course** 1. To acquaint the students with the application of Laplace, Fourier transform and integral equations. 2. Enhance more knowledge of fourier sin-cos series and integral equation.	
Course Outcome	CO1	Solve problems using mathematics in unfamiliar settings.
	CO2	engage in analyzing, solving, and computing real-world applications.
	CO3	use mathematical concept while solving various problems of Engineering.

UNIT 1:
Fourier series, Half range fourier sine series, Half range fourier cosine series,Euler method..
UNIT: II
Fourier Transform: Definition, existence and basic properties, Inversion formula of Fourier transform Convolution theorem, Parseval's relation. Fourier transform of derivatives and integrals, Fourier sine and cosine transform, Inverse Fourier transform, Solution of linear ordinary differential equations and partial differential equations.
UNIT: III
Linear integral equations, Special types of kernels, Singular integrals equations, Connection of integral equations with differential equations, Integral equations of the convolution type.
UNIT: IV
Solution of Fredholm Equations with iterated kernel, Fredholm Equations with general kernel: Solution by the method of successive approximations, adomian decomposition method, Volterraintegral equations: Solution by the method of successive approximations, adomian decomposition method.
Text and Reference books:

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

Semester	**VIII**	
Course Code	**MAT 470**	
Course Title	**Calculus and Matrices –Practical**	
Type of course	**Practical**	
L T P	0:0:4	
Credits	2	
Course prerequisite	B.Sc. with Mathematics or B.A with Mathematics	
Course Objective	The aim of this course is to 1. learn about the role of MATLAB,SCILAB in Calculus and Matrices. 2. Enhance practical knowledge of different applications using MATLAB,SCILAB	
Course Outcome	CO1	learn to operate the softwares
	CO2	learn about the role of MATLAB,SCILAB in Calculus and Matrices

List of Practicals (Use any one of the software MATLAB/ SCILAB/C++)
1. Find the addition, subtraction, multiplications of matrices using any softwares.
2. To find the adjoint of matrices using any of the software.
3. To find the inverse of a matrices using any of the software.
4. To find eigen value of a matrices using any of the above softwares.
5. To prove Distributive Law, Commutative laws, Associative laws using any softwares
6. Find derivatives of functions, exponential, trigonometric functions and hyperbolic functions using any software.
7. To find derivatives using Chain rules using any one of the above software.
8. Find integration and definite integrals using any software.
9. Find root of nonlinear equations using Newton‘s Method.
10. To find numerical integrations using Trapezoidal rule, Simpson Rules.

Text and Reference books:

S.No.	Name/Title	Author	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

Semester	**VIII**	
Course Code	**MAT 472**	
Course Title	**Statistical Methods –Practical**	
Type of course	Laboratory Course	
L T P	0 0 4	
Credits	2	
Course prerequisite	B.Sc. with Mathematics or B.A with Mathematics	
Course Objective	The aim of this course is to 1. learn about the graphical representation of data . 2. Enhance understanding in data, measures, moments, polynomial practically.	
Course Outcome	CO1	Students will observe the different Graphical representation of data.
	CO2	Students will solve Problems based on measures of central tendency, dispersion, and variance.
	CO3	Students will learn about the different curve fitting

PRACTICAL/ LAB WORK

List of Practical

1. Graphical representation of data
2. Problems based on measures of central tendency
3. Problems based on measures of dispersion
4. Problems based on combined mean and variance and coefficient of variation
5. Problems based on moments, skewness and kurtosis
6. Fitting of polynomials, exponential curves
7. Karl Pearson correlation coefficient
8. Partial and multiple correlations
9. Spearman rank correlation with and without ties.
10. Correlation coefficient for a bivariate frequency distribution
11. Lines of regression, angle between lines and estimated values of variables.
12. Checking consistency of data and finding association among attributes.Text and Reference books:

S. No.	Name/Title	Author	Publisher
1	Fundamentals of Statistics	Goon A.M., Gupta M.K.and Dasgupta B.	Vol. I & II, 8th Edn. The World Press, Kolkata.
2	Mathematical Statistics with Applications	Miller, Irwin and Miller,Marylees	Pearson Education, Asia.
3	Introduction to the Theory of Statistics	Mood, A.M. Graybill, F.A. and Boes, D.C.	Tata McGraw Hill Publishing Co. Bombay – New Delhi.

(Minor Courses)

SKILL ENHANCEMENT COURSES

(Semester III - VI)

Semester	**III**
Course Code	**MAT265**
Course Title	**Logic and Graph theory**
Type of course	**Skill Enhancement Courses**
L T P	2 0 0
Credits	2
Course prerequisite	B.Sc. /B.A. 1st year with Mathematics as one core subject
Course Objective	**The aim of the subjects is** 1. That students have basic knowledge of sets, relation and graph theory. 2. Learn logic truth tables,propositional equivalence, relations, graph.
Course Outcome	**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.

Text and Reference Books

S.No	Title	Author(s)	Publisher
1	Discrete Mathematics and Combinatorial Mathematics	R.P. Grimaldi	Pearson Education (Singapore) P. Ltd
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

Semester	**IV**
Course Code	**MAT266**
Course Title	**Number theory**
Type of course	Theory
L T P	2 00
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** 1. Develops the knowledge about number theory and combinations of numbers. 2. Develop skills of doing examples of division algorithm, phi function.
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

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.	Title	Author	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

Semester	**V**
Course Code	**MAT369**
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	**The aim of the subjects to** 1. Learn the students about vector function, field, and its properties and apply different operations on vector field. 2.Learn basic of vector analysis.
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.	Title	Author	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

Semester	**VI**
Course Code	**MAT364**
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	**The aim of this course is to** 1. Provide knowledge with the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and sciences. 2. understand probality and statistic in more detail
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:

S. No.	Title	Author	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 Statistics	S.C. Gupta, V.K. Kapoor	Sultan Chand & Sons,2014.

(AEC)

Ability Enhancement Courses

Semester I - VIII

Semester	**I**
Course Code	**ENG121**
Course Title	**Communication skills-I**
Type of course	Theory
L T P	2 0 0
Credits	2
Course prerequisite	+2 with any stream
CourseObjective (CO)	Objectives of the course is to: 1. Equip the learner with proficiency in reading comprehension.. 2. Enable the learner with improved writing skills and command over official/ corporate communication. 3. Enhance the learners' range of vocabulary and knowledge of the essentials of grammar.
Course Outcome	At the conclusion of the course the learner will be able to: 1. Have fairly good proficiency in reading comprehension. 2. Have enhanced writing skills and command in official/ corporate communication. 3. Develop confidence in making presentation: oral or documentary.

UNIT-I

Basics of Communication Skills: Communication, Process of Communication, Types of Communication-Verbal and Non-verbal communication, Channels of Communication-Upward, Downward, Horizontal, Barriers to Communication, Role of Communication in society.

UNIT-II

Listening Skills: Listening Process, Hearing and Listening, Types of Listening, Effective Listening, Barriers to Effective Listening, Note Taking.

Reading Skills: Purpose of reading, Process of reading, Reading skills Models and strategies, scanning, skimming, SQ3R, Approaches of Reading, Comprehension passages for practice.

UNIT III

Writing Skills: Purpose of writing, Effective writing, Types of writing, Business Correspondence, Precis writing, Memo writing, Minutes of meeting.

UNIT-IV

Speaking Skills: Speech process, Skills for effective speaking, Role of audience, Feedback Skill, Oral Presentation.

Recommended Books:

Sr No	Author(s)	Title	Publisher
1.	Bhupender Kour	Effectual Communication Skills	S.K. Kataria and Sons
2.	R. Datta Roy and K.K. Dheer	Communications Skills	Vishal Publishing Company
3	The Essence of Effective Communication	Ludlow and Panton	Prentice Hall of India
4	Essentials of Business Communication	Pal and Korlahalli	S. Chand and Sons. New Delhi

Semester	**I**
Course Code	**ENG123**
Course Title	**Communication Skills-1 Lab**
Type of Course	Practical
L T P	0 0 2
Credits	1
Course pre-requisite	NA
Course Objectives	Objectives of the course is to: 1. Equip the learner with proficiency in reading comprehension.. 2. Enable the learner with improved writing skills and command over official/ corporate communication. 3. Enhance the learners' range of vocabulary and knowledge of the essentials of grammar.
Course Outcome	At the conclusion of the course the learner will be able to: 1. Have fairly good proficiency in reading comprehension. 2. Have enhanced writing skills and have command in official/ corporate communication. 3. Develop confidence in making presentation; oral or documentary.

UNIT-I

Speaking and Discussion Skills: Oral Presentation, Planning and organizing content for presentation, Use of audio /visual Aids, Making Slides for presentation , Group Discussion ,Debate, Extempore speaking, Interview Skills, Mock interview, Mock Dialogues (Pair Speaking),Cue Card Speaking, Meeting/ Conferences.

UNIT-II

Listening Skills: Listening to any recoded material and asking oral/written questions for listening comprehension. **Reading Skills:** Active reading of passages for Reading comprehensions, paraphrase, Summary writing.

UNIT-III

Writing Skills: Guidelines of effective writing, Paragraph Writing, Email Writing.

UNIT-IV

Grammar and Vocabulary:

Parts of Speech, Tenses, GRE words (List of 50 Words).

Recommended Books:

Sr No	Author(s)	Title	Publisher
1.	Bhupender Kour	Effectual Communication Skills	S.K. Kataria and Sons
2.	R. Datta Roy and K.K. Dheer	Communications Skills	Vishal Publishing Company
3	The Essence of Effective Communication	Ludlow and Panton	Prentice Hall of India
4	Essentials of Business Communication	Pal and Korlahalli	S. Chand and Sons. New Delhi

Semester	**II**
Course Code	**ENG114**
Course Title	**Communication Skills-II**
Type of Course	Theory
LTP	2 0 0
Credits	2
Course pre-requisite	NA
Course Objectives (CO)	Objectives of the course is to: 1. Equip the learner with proficiency in reading comprehension.. 2. Enable the learner with improved writing skills and command over official/ corporate communication. 3. Enhance the learners' range of vocabulary and knowledge of the essentials of grammar.
Course Outcome	At the conclusion of the course the learner will be able to: 1. Have fairly good proficiency in reading comprehension. 2. Have enhanced writing skills and have command in official/ corporate communication. 3. Develop confidence in making presentation; oral or documentary.

UNIT-I

Grammar: Parts of Speech, Use of appropriate tense, Voice , Reported Speech, Sentence Structure; Simple, Compound, Complex, Vocabulary-One word substitution.

UNIT-II

Writing Skills: Application for employment , Resume Writing ,Paragraph Writing Construction-Kinds of Paragraphs, Preparing of Matter for meeting : Notice, agenda, Conference

UNIT-III

Speaking Skills: Effective oral Presentation, Slide making, Use of audio-visual aids.

UNIT-IV

Oral Communication and its Application:

Group Discussion, Customer Care Relations (PR Skills), Interview Skills (Conducting and appearing for interviews), and Telephone handling manners.

Recommended Books

S.no	Name	Author(s)	Publisher
1	Business Communication	K. K. Sinha	Galgotia Publishing Company,
2	Media and Communication Management	C. S. Rayudu	- Himalaya Publishing House,
3	Essentials of Business Communication	Rajendra Pal and J. S. Korlahalli	Sultan Chand & Sons, New Delhi

Semester	**II**
Course Code	**ENG116**
Course Title	**Communication Skills-II Lab**
Type of Course	Practical
L T P	0:0:2
Credits	1
Course pre-requisite	+ 2 with any stream
Course Objectives	Objectives of the course is to: 1. Equip the learner with proficiency in reading comprehension.. 2. Enable the learner with improved writing skills and command over official/ corporate communication. 3. Enhance the learners' range of vocabulary and knowledge of the essentials of grammar.
Course Outcome	At the conclusion of the course the learner will be able to: 1. Have fairly good proficiency in reading comprehension. 2. Have enhanced writing skills and have command in official/ corporate communication. 3. Develop confidence in making presentation; oral or documentary.

UNIT-I
Grammar:
To recognize part of speech of particular word in given sentence, To use appropriate tense , Exercise on: Voice, Reported speech and Sentence Structure, Vocabulary-One word substitution.

UNIT-II
Writing Skills:
Job Application, Resume Writing, Paragraph Writing, Preparing of Matter for meeting: Notice, agenda, Conference.

UNIT- III
Speaking Skills: How to deliver an effective power point Presentation, Slide making, Effective use of audio Visual aids,

UNIT-IV
Oral Communication and its Application:
Group Discussion, Mock Interview (Conducting and appearing for interviews), and Role plays. Conducting a successful official meeting.

Recommended Books

S. No	Name	Author(s)	Publisher
1	Business Communication	K. K. Sinha	Galgotia Publishing Company,
2	MediaandCommunication Management	C. S. Rayudu	- Himalaya Publishing House,
3	EssentialsofBusiness Communication	Rajendra Pal and J. S. Korlahalli	Sultan Chand & Sons, New Delhi

Semester	**III**
Course Code	**EVS001**
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

Semester	**IV**
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.*

Semester	**V**
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

Semester	VI
CourseCode	**CSE014**
CourseTitle	**BasicsofComputerSciences**
TypeofCourse	Theory
L T P	2 00
Credits	2
CoursePrerequisites	BasicofComputer
Course Objectives(CO)	Tounderstandthebasicconceptsofcomputer,officeautomation,informationtechnologyandinternet.
Course Outcomes	The students will be able to: 1. Understand basics of computer and its operating system 2. Distinguish the types of software Learn the MS-Windows basics and applications

UNIT-I
IntroductiontoComputers
Define a Computer System, Block diagram of a Computer System and its working, Applicationsofcomputersystem,InputandOutputdevice,memories,RAM,ROM,secondarystoragedevices,ComputerSoftwareandHardware.

UNIT-II
OperatingSystem: Definition,Needforoperatingsystem,Functionsofoperatingsystem(ProcessorManagement,MemoryManagement,FileManagementandDeviceManagement),Workingwith GUIoperatingSystem.
ComputerLanguages: Machinelanguage,assemblylanguage,higherlevellanguage.

UNIT-III
WorkingKnowledgeofComputerSystem
WordProcessor-
Introductiontowordprocessorsanditsfeatures,creating,editing,printingandsavingdocuments, spellcheck, mail merge
PowerPoint:creatingpowerpointpresentations,creatingspreadsheetsandsimplegraphs,evolutionofInternet anditsapplicationsand services.
Spreadsheets-
Introductiontospreadsheetsanditsfeatures,Usingdifferenttypesofformulae,Creatinggraphsandcharts, Exportingcharts to word processor.

UNIT-IV
IntroductiontoInformationTechnology: Introduction to InformationTechnology and itsapplications.
Introductionofinternet-
Definition,Applicationsofinternet,ImpactofInternetonSocietyCrimeon/through theInternet, E-mail, WWW.

Textand ReferenceBooks

Sr.no.	Name	Author(s)	Publisher
1	FundamentalsofComputers	R.S.Salaria	Salaria PublishingHouse
2	ComputerFundamentals	P.K. Sinha and	BPBPublication
3	Absolute Beginners Guide toComputerBasics	MillerM	PearsonEducation
4	MSOfficeforWindows XP	SagmanS	PearsonEducation

Semester	**VI**
CourseCode	**CSE016**
CourseTitle	**Basicsof Computer Sciences Lab**
Typeof course	Practical
L T P	002
Credits	1
Courseprerequisite	NA
Course Objective(CO)	Tofamiliarizeallthestudentswithbasicconceptsofcomputersincludingof ficeautomation and internet concepts.
Course outcomes	The students will be able to: 3. Understand basics of computer and its operating system 4. Distinguish the types of software Learn the MS-Windows basics and applications

LISTOFEXPERIMENTS

1. GivenaPC,nameitsvariouscomponentsandperipherals.Listtheirfunctions
2. **InstallationofoperatingSystemviz.Windows XP,Windows2007etc.**

FeaturesofWindowsasanoperatingsystem

- Start
- Shutdownandrestore
- Creatingand operatingon theicons
- Openingclosingand sizingthewindows
- Usingelementary jobcommandslike– creating,saving,modifying,renaming,findinganddeleting afile
- Creatingandoperatingonafolder
- Changingsettinglike,date,time,colour(back groundandforeground)
- Usingshortcuts

3. **Usingon linehelpWordProcessing(MSOffice/OpenOffice)**

a) FileManagement:
Opening,creatingandsavingadocument,locatingfiles,copyingcontentsinsomedifferentfile(s),protecting files,givingpassword protection for a file

b) PageSetup:
Settingmargins,tabsetting,ruler,indenting

c) Editingadocument:
Enteringtext,Cut, copy,pasteusingtool-bars

d) Formattingadocument:
Usingdifferentfonts,changingfontsizeandcolour,changingtheappearancethroughbold/italic/underlined, highlighting a text, changing case, using subscript and superscript, using differentunderlinemethods

- Aligningoftext in adocument,justificationofdocument,Insertingbulletsandnumbering
- Formattingparagraph, insertingpagebreaks andcolumnbreaks,linespacing
- Useofheaders,footers:Insertingfootnote,endnote,useofcomments
- Insertingdate,time,specialsymbols,importinggraphicimages,drawingtools

e) Tablesand Borders:
Creatingatable,formattingcells,useofdifferentborderstyles,shadingintables,mergingofcells,partitionofce lls, insertingand deletingarowinatable
Printpreview,zoom, pagesetup,printingoptionsUsingFind, Replaceoptions

f) UsingTools like:
Spellchecker,help,useofmacros,mailmerge,thesauruswordcontentandstatistics,printingenvelopsand lables
Usingshapes and drawingtoolbar,
Workingwith morethanonewindow in MSWord,
Conversionbetweendifferenttexteditors,softwareandMSword

4. **SpreadSheetProcessing(MSOffice/OpenOffice)**

a) Startingexcel,openworksheet,enter,edit,data,formulaetocalculatevalues,formatdata,createch art,printingchart, saveworksheet, switchingbetween differentspread sheets

b) Menucommands:
Create,formatcharts,organize,managedata,solving problembyanalyzing data,exchangewithotherapplications. Programmingwith ExcelWork Sheet,gettinginformation while working

c) Work books:

5. PowerPointPresentation(MSOffice/OpenOffice)

a) IntroductiontoPowerPoint

a. Howtostart PowerPoint
b. Workingenvironment:conceptoftoolbars,slidelayout,templatesetc.
c. Openinganew/existingpresentation
d. Differentviewsforviewingslidesinapresentation:normal, slidesorteretc.

b) Addition,deletionandsavingofslides

c) Insertionofmultimediaelements

e. Addingtextboxes
f. Adding/importingpictures
g. Addingmoviesand sound
h. Addingtables andcharts etc.
i. Addingorganizationalchart

d) Formattingslides

j. Usingslidemaster
k. Textformatting
l. Changingslidelayout
m. Changingslidecolourscheme
n. Changingbackground
o. Applyingdesign template

- Howtoviewtheslideshow?

Semester	**VII**
Course Code	**RM401**
Course Title	**Research Methodology and Intellectual Property Rights**
Type of course	Theory course
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc I , B.Sc I I and B.Sc III year
Course Objective	Student will be understand to how to identify a research problem, know the importance of educational research and role of Intellectual Property Rights (IPR) in research and development
Course Outcomes	The students will be able to: 1. Acquire & Understand significace of IPR, copyright laws in present scinario. 2. Identify a research problem, educational research, interpretation of the results and report writing. 3. Apply role of Intellectual Property Rights (IPR) in research and development.

UNITI

Research Methodology: Types and method of research, Research process; criteria of good research. Defining and formulating the research problem, selecting the problem, necessity of defining the problem, importance of literature review in defining a problem, Meaning of research design; need for research design; important concepts related to research design; different research designs. Writing research proposal: Characteristics of a proposal; content and organization of a proposal.

UNIT II

Interpretation and report writing: Meaning of interpretation; technique of interpretation; precautions in interpretation; significance of report writing; layout of research report; types of reports; Organization and writing of research paper, Presentation of research work- oral, poster and writing of research paper; Precautions for writing research report, Application and uses of common softwares in chemistry and physics.

UNIT III

IPR: Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Copyright, protection under copyright law, rights, transfer of copyright, infringement, Trademarks its objectives, types, rights, protection of goodwill, infringement, passing off, Defenses, Domain name, trade secrets. Design, Geographical Indication.

Introduction to the leading International Instruments concerning Intellectual Property Rights: the Berne Convention, Universal Copyright Convention, The Paris Convention, Patent Co-operation Treaty, TRIPS, The World Intellectual Property Organization (WIPO) and the UNESCO. Infringement. IPR in Pharmaceuticals and drug designing

UNIT IV

Ethical issues: Citation and acknowledgement, Reproducibility, Review of published research in the relevant field, plagiarism.

Patent and Patents Writing, Patent Act 1970 and its amendments. Procedure of obtaining patents,

Chemical safety and ethical handling of chemicals. Safety rules of laboratory acquaintance of experimental set up, importance of safety and security of data.

Industrial Designs its objectives, rights, registration, infringements, and Defenses of Design, Need for Protection of Industrial Designs, The Designs Act, 2000.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Research Methodology: Methods & Techniques (Rev. Ed.)	C.R. Kothari	New Age International. New Delhi

2	An Introduction to Research Methodology	B.L. Garg, R. Karadia, R., F. Agarwal, F. and U.K. Agarwal	RBSA Publishers
3	Qualitative Inquiry and Research Design: Choosing Among Five Approaches	John W. Creswell	SAGE Publication
4	Principles of Intellectual Property	N.S. Gopalakrishnan, and T.G. Agitha	Eastern Book Company
5	Law relating to patents, trade marks, copyright designs and geographical indications	B.L.Wadehra	Universal Law Publishing

Semester	**VII**
Course Code	**RLS401**
Course Title	**Review of Literature & Seminar**
Type of course	Ability Enhancement Course
L T P	0 0 8
Credits	8
Course prerequisite	B.Sc three year completetion
Course Objective	The project would develop scientific aptitude The Objective is to enable student to identify a problem and to carry out literature survey, design an experiment, perform experiment, analyse data and write a report.
Course Outcomes	The students will be able to: 1. Do survey, study and cite published literature on a particular area of interest and analyze current literature research. 2. Correlate the experimental observations with theoretical understanding Design a research problem and prepare synopsis. 3. Plan future experiments in the laboratory & Use laboratory resources judiciously. 4. Work in a team under the supervision of a teacher and develop scientific writing skills.

Content:

Unit 1: Identification of research problem
Unit 2: Survey of literature
Unit 3: Formulation of hypothesis, experimental design and methodology
Unit 4: Analysis of data and interpretation of results, Discussion and conclusion

Project supervisor would be allocated at the start of the semester and research project would be undertaken in discussion with the project supervisor.

Regular evaluation of project progress will be done through regular seminars and presentations as per the schedules.

Upon submission of the project report, the projects would be evaluated based on a project presentation before the departmental committee.

Assessment Methods: The assessment will be through evaluation of the presentation through regular seminars and viva voce involving external and internal examiners.

Semester	**VIII**
Course Code	**DPR402**
Course Title	**Dissertation / Project report**
Type of course	Practical Course /SEC
L T P	0 0 12
Credits	6
Course prerequisite	B.Sc I , B.Sc I I and B.Sc III year with as Chemistry as core subject
Course Objective	The project would develop scientific aptitude, reviewing of literature, critical thinking, hypothesis development, experiment planning, synopsis writing, problem presentation and way to solve the problem.
Course Outcomes	The students will be able to: 1. Explore research aptitude & practicalability of knowledge gained by student in understanding the basics of research 2. Develop critical thinking through the detailed review of literature comprehend expertise for writing the research reports in form of review article as well as research publications. 3. Analyze & generate experimental skills towards the industrial applications. 4. Equiped for the industrial outreach through the experimental knowledge gained through project work.

Content:

Unit 1: Formulation of hypothesis, experimental design and methodology
Unit 2: Experimentation, Characterization/Analysis of data and interpretation of results
Unit 3: Discussion and conclusion
Unit 4: Report writing,

Project supervisor would be allocated at the start of the semester and research project would be undertaken in discussion with the project supervisor.

Regular evaluation of project progress will be done through regular seminars and presentations as per the schedules.

Upon submission of the Project/ Dissertation, the projects would be evaluated based on a project presentation before the departmental committee.

Assessment Methods: The assessment will be through evaluation of the presentation through regular seminars and viva voce involving external and internal examiners.