Scheme for UG Syllabus

Annual System

(Effective from 2018-19)

Under

CHOICE BASED CREDIT SYSTEM (CBCS)

In

Bachelor of Science Physical Science (Physics, Chemistry and Mathematics) And Bachelor of Science with Chemistry

Department of Chemistry Himachal Pradesh University Shimla-5

CHOICE BASED CREDIT SYSTEM (CBCS):

The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/minor or skill based courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Therefore, it is necessary to introduce uniform grading system in the entire higher education in India. This will benefit the students to move across institutions within India to begin with and across countries. The uniform grading system will also enable potential employers in assessing the performance of the candidates. In order to bring uniformity in evaluation system and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations, the UGC has formulated the guidelines to be followed.

Outline of Choice Based Credit System:

1. **Core Course:** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

2. **Elective Course:** Generally a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/ subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

2.1 **Discipline Specific Elective (DSE) Course**: Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).

2.2 **Dissertation/Project:** 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.

3. **Ability Enhancement Courses (AEC)/Competency Improvement Courses/Skill Development Courses/Foundation Course:** The Ability Enhancement (AE) Courses may be of two kinds: AE Compulsory Course (AECC) and AE Elective Course (AEEC). "AECC" courses are the courses based upon the content that leads to Knowledge enhancement. They ((i) Environmental Science, (ii) English/MIL (Modern Indian Language) Communication are mandatory for all disciplines. AEEC courses are value-basedand/or skill-based and are aimed at providing hands-on-training, competencies, skills, etc.

3.1 **AE Compulsory Course (AECC)**: Environmental Science, English Communication/MIL Communication.

3.2 **AE Elective Course (AEEC):** These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based instruction.

Project work/Dissertation is considered as a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problem. A Project/Dissertation work would be of 6 credits. A Project/Dissertation work may be given in lieu of a discipline specific elective paper.

Details of Courses Under Undergraduate Program (B.Sc.)

Course	*Credits	
	Theory+ Practical	Theory +Tutorials
I. Core Course	$12 \times 4 = 48$	$12 \times 5 = 60$
(12 Papers)		
04 Courses from each of the 03 disciplines of choice		
Core Course Practical / Tutorial*	$12 \times 2 = 24$	$12 \times 1 = 12$
(12 Practical/ Tutorials*)		
04 Courses from each of the 03 Disciplines of choice		
II. Discipline Specific Course Elective Course	$6 \times 4 = 24$	$6 \times 5 = 30$
(6 Papers)		
Two papers from each discipline of choice including paper of interdisciplinary nature.		
Discipline Specific Course Practical / Tutorials*	$6 \times 2 = 12$	$6 \times 1 = 6$
(6 Practical / Tutorials*)		
Two Papers from each discipline of choice including paper of interdisciplinary nature		

• **Optional Dissertation or project work in place of one Discipline elective paper (6 credits) in 3rd year**

III. Ability Enhancement Courses

1. **Ability Enhancement Compulsory** $2 \times 4 = 8$ $2 \times 4 = 8$

(2 Papers of 4 credits each)
Environmental Science English/MIL Communication

2. **Skill Enhancement Course** $4 \times 4 = 16$ $4 \times 4 = 16$

(Skill Based)

(4 Papers of 4 credits each)

_____   _____

Total credit= 132   **Total credit= 132**

College should evolve a system/policy about ECA/ General Interest/ Hobby/ Sports/ NCC/ NSS/ related courses on its own.

*wherever there is practical there will be no tutorials and vice –versa.

❖ **In case of theory and tutorial 1 credit will be of 1 hour class room teaching, while in case of Practical/Practical Skill Exam 1 credit will be of 2 hours Laboratory class/project work.**

Scheme for Choice Based Credit System (CBCS) in Bachelor of Science Physical Science and Bachelor of Science with Chemistry Annual Pattern

Year	Core Course (12)	Ability Enhancement Compulsory Course AECC (2)	Skill Enhancement Courses SEC (4)	Elective Course Discipline Specific Elective DSE (6)	Total Credits
I	DSC-1A = 6 Credit DSC-1B = 6 Credit DSC-2A = 6 Credit DSC-2B = 6 Credit DSC-3A = 6 Credit DSC-3B = 6 Credit **Credits = 36**	Eng and EVS = 4 Each Credit **Credits = 08**	NIL	NIL	44
II	DSC-1C = 6 Credit DSC-1D = 6 Credit DSC-2C = 6 Credit DSC-2D = 6 Credit DSC-3C = 6 Credit DSC-3D = 6 Credit **Credits = 36**	NIL	SEC-1 = 4 Credit SEC-2 = 4 Credit **Credits = 08**	NIL	44
III	NIL	NIL	SEC-3 = 4 Credit SEC-4 = 4 Credit **Credits = 08**	DSE-1A = 6 Credit DSE-1B = 6 Credit DSE-2A = 6 Credit DSE-2B = 6 Credit DSE-3A = 6 Credit DSE-3B = 6 Credit **Credits = 36**	44
Total Credits in B.Sc. Physical Science and B.Sc. with Chemistry Degree Courses = 44 × 3					**132**

Credits (hours) Split:

Theory = 04 (4 hours)   **Theory = 05 (5 hours)**
Practical = 02 (4 hours)   **Tutorial = 01(1 hour)**
For SEC:
Theory = 03 (3 hours)
Skill Exam (SE) = 01 (2 hours)

Details of CBCS Scheme for Undergraduate Three Year Degree Course: B.Sc. Physical Science and B.Sc. with Chemistry: Teaching Hours and Credits Plan in Annual System for Three years

S. No.	Name of Course (6 Credits)	*Teaching Hrs.		Credits as per annual Plan				
				Non Practical Course (2Weeks Teaching Hours)		Practical Course (2Weeks Teaching Hours)		Total Credits in a Year
1	Core Courses (12)	1st Week	2nd Week	Theory	Tutorial	Theory	Practical	
a	Discipline Specific Courses (4+4+4 =12)							
i	DSC-1A	03	06	05	01	04	02	06
	DSC-1B	03	06	05	01	04	02	06
	DSC-1C	03	06	05	01	04	02	06
	DCS-1D	03	06	05	01	04	02	06
ii	DSC-2A	03	06	05	01	04	02	06
	DSC-2B	03	06	05	01	04	02	06
	DSC-2C	03	06	05	01	04	02	06
	DCS-2D	03	06	05	01	04	02	06
iii	DSC-3A	03	06	05	01	04	02	06
	DSC-3B	03	06	05	01	04	02	06
	DSC-3C	03	06	05	01	04	02	06
	DCS-3D	03	06	05	01	04	02	06
Total Credits of Core Courses								**72**
2	Ability Enhancement Courses (6)							
a	Ability Enhancement Compulsory Courses (2)							
i	Eng/MIL Communication/EVS	02	04	03	01	--	--	04
	Eng/MIL Communication/EVS	02	04	03	01	--	--	04
Total Credits of Ability Enhancement Compulsory Courses (AECC)								**08**
b	Skill Enhancement Courses (4)					Theory	Practical Skill Exam	
	SEC-1	02	04	04	--	03	01	04
	SEC-2	02	04	04	--	03	01	04
	SEC-3	02	04	04	--	03	01	04
	SEC-4	02	04	04	--	03	01	04
Total Credits of Skill Enhancement Courses (SEC)								**16**
Total Credits of Ability Enhancement Courses (AEC) = 08 + 16								**24**

3	Elective Courses (6)							
a	Discipline Specific Elective Courses					Theory	Practical	
i	DSE-1A	03	06	05	01	04	02	06
	DSE-1B	03	06	05	01	04	02	06
	DSE-2A	03	06	05	01	04	02	06
	DSE-2B	03	06	05	01	04	02	06
	DSE-3A	03	06	05	01	04	02	06
	DSE-3B	03	06	05	01	04	02	06
Total Credits of Discipline Specific Elective (DSE) Courses								**36**
Grand Total Credits in Three Year Degree Course: B.Sc. Physical Science and B.Sc. with Chemistry: 72 + 24 +36								**132**

* *As per teaching hours given in column three above table, each course of 6 credits* **[{4 credits Theory (4 hours) + 2 credits Practical (4 hours)} or {5 credits Theory (5 hours) + 1 credits Tutorial (1 hours)}]** *and of 4 credits* **{3 credits SEC Theory (3hours) + 1 Credit Tutorial (2 hours)}** should be completed within every two weeks of the annual system.

Comprehensive Continuous Assessment (CCA) and yearly Scheme in Chemistry of Three years

B.Sc. Physical Sciences

Scheme of Examination for every course except Skill enhancement course*

English shall be the medium of instructions and Examinations.

Examinations shall be conducted at the end of each year as per the academic calendar notified by H.P. University Shimla-5

Each course of 6 credits will carry 100 marks (theory + practical) and will have following components:

1. Theory	**50 marks**
i) Comprehensive Continuous Assessment	**30 marks**
a) Assignment/Quiz/Seminar/model/ Mid-Term Examination	15 marks
b) Attendance	05 marks
c) Lab Seminar /Lab CCA	10 marks
ii) Yearly Examination	**50 marks**
II. Practical	**20 marks**

Practical examination will have following components:

i) Performing the two practical exercises assigned by the examiner in terms of requirement of chemicals/apparatus/ theory/ reaction (if any) involved, procedure/ scheme/ observations/calculations and results.   10 marks

ii) viva-voce examination   5 marks

iii) Practical note book and regularity during practical classes   5 Marks

{Theory Paper (CCA + Yearly Examination) +Practical [30 +50 +20] =100 marks}

* Each Skill Enhancement course will be of 4 credits and scheme of examination for these courses is as under:

{CCA + Yearly Examination   [30 + 70] =100 marks}

Criterion for marks on the basis of Class-room attendance   (0 - 5 marks)   under component CCA/ IA be defined as follows:

a) Attendance 75 -- 80% = 3 marks

b) Attendance 81 – 90 % =   4 marks

c) Attendance   91% and above = 5 marks

d) Candidates securing 75% Attendance after condonation will not be entitled to get any mark.

HIMACHAL PRADESH UNIVERSITY
SYLLABUS AND SCHEME OF EXAMINATION FOR B.Sc. PHYSICAL SCIENCE (PHYSICS, CHEMISTRY AND MATHEMATICS)

Year	Course Type	Course Code	Title of paper	*Credits
I	CORE COURSE-I	PHYS101TH PHYS101IA	MECHANICS Theory	**4**
		PHYS101PR	MECHANICS Lab	**2**
	CORE COURSE-II	CHEM101TH CHEM101IA CHEM101PR	ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS	**6**
	CORE COURSE-III	MATH101TH MATH101IA	DIFFERENTIAL CALCULUS	**6**
	A.E.C. COURSE-I		ENVIRONMENTAL SCIENCE	**4**
	CORE COURSE-IV	PHYS102TH PHYS102IA	ELECTRICITY, MAGNETISIM AND EMT Theory	**4**
		PHYS102PR	ELECTRICITY, MAGNETISIM AND EMT Lab	**2**
	CORE COURSE-V	CHEM102TH CHEM102IA CHEM102PR	STATES OF MATTER, CHEMICAL KINETICS & FUNCTIONAL ORGANIC CHEMISTRY	**6**
	CORE COURSE-VI	MATH102TH MATH102IA	DIFFERENTIAL EQUATIONS	**6**
	A.E.C.COURSE-II		ENGLISH/MIL COMMUNICATION	**4**
II	CORE COURSE-VII	PHYS201TH PHYS201IA	STATISTICAL AND THERMAL PHYSICS Theory	**4**
		PHYS201PR	STATISTICAL AND THERMAL PHYSICS Lab	**2**
	CORE COURSE-VIII	CHEM201TH CHEM201IA CHEM201PR	SOLUTIONS, PHASE EQUILIBRIUM, CONDUCTANCE, ELECTROCHEMISTRY & ORGANIC CHEMISTRY	**6**
	CORE COURSE-IX	MATH201TH MATH201IA	REAL ANALYSIS	**6**
	CORE COURSE-X	PHYS202TH PHYS202IA	WAVES AND OPTICS Theory	**4**
		PHYS202PR	WAVES AND OPTICS Lab	**2**

	CORE COURSE-XI	CHEM202TH CHEM202IA CHEM202PR	CHEMISTRY OF MAIN GROUP ELEMENTS, CHEMICAL ENERGETICS AND EQUILIBRIA	6
	CORE COURSE-XII	MATH202TH MATH202IA	ALGEBRA	6
	SEC1 (CHOOSE ANY ONE FROM GIVEN THREE)	PHYS203TH PHYS203IA	PHYSICS WORKSHOP SKILLS Theory	3+1 (TH+IA = 3 SE = 1)
		PHYS203SE	PHYSICS WORKSHOP SKILLS Skill Exam	
		PHYS204TH PHYS204IA	COMPUTATIONAL PHYSICS Theory	
		PHYS204SE	COMPUTATIONAL PHYSICS Skill Exam	
		PHYS205TH PHYS205IA	ELECTRICAL CIRCUITS AND NETWORK SKILLS Theory	
		PHYS205SE	ELECTRICAL CIRCUITS AND NETWORK SKILLS Skill Exam	
	SEC2 (CHOOSE ANY ONE FROM GIVEN TWO)	CHEM203TH CHEM203IA	BASIC ANALYTICAL CHEMISTRY	4
		CHEM204TH CHEM204IA	FUEL CHEMISTRY & CHEMISTRY OF COSMETICS & PERFUMES	
III	DISCIPLINE SPECIFIC ELECTIVES DSE:1A (CHOOSE ANY ONE FROM GIVEN THREE)	PHYS301TH PHYS301IA	ELEMENTS OF MODERN PHYSICS Theory	4+2 (TH+IA = 4 PR = 2) OR (TH+IA = 5 TU = 1)
		PHYS301PR	ELEMENTS OF MODERN PHYSICS Lab	
		PHYS302TH PHYS302IA	SOLID STATE PHYSICS AND ELECTRONICS Theory	
		PHYS302PR	SOLID STATE PHYSICS AND ELECTRONICS Lab	
		PHYS303TH PHYS303IA	ASTRONOMY AND ASTROPHYSICS Theory	
		PHYS303TU	ASTRONOMY AND ASTROPHYSICS Tutorials	
	DISCIPLINE SPECIFIC ELECTIVES DSE:2A (CHOOSE ANY ONE FROM GIVEN THREE)	CHEM301TH CHEM301IA CHEM301PR	POLYNUCLEAR HYDROCARBONS, DYES, HETEROCYCLIC COMPOUNDS AND SPECTROSCOPY (UV, IR ,NMR)	6
		CHEM302TH CHEM302IA CHEM302PR	INDUSTRIAL CHEMISTRY AND ENVIRONMENT	
		CHEM303TH CHEM303IA CHEM303PR	QUANTUM CHEMISTRY, MOLECULAR SPECTROSCOPY & PHOTOCHEMISTRY	

	MATH301TH MATH301IA	MATRICES	
DISCIPLINE SPECIFIC ELECTIVES DSE:3A (CHOOSE ANY ONE FROM GIVEN THREE)	MATH302TH MATH302IA	MECHANICS	**6**
	MATH303TH MATH303IA	LINEAR ALGEBRA	
DISCIPLINE SPECIFIC ELECTIVES DSE:1B (CHOOSE ANY ONE FROM GIVEN THREE)	PHYS304TH PHYS304IA	NUCLEAR AND PARTICLE PHYSICS Theory	**5+1 (TH+IA = 5 TU = 1) OR 4+2 (TH+IA = 4 PR = 2)**
	PHYS304TU	NUCLEAR AND PARTICLE PHYSICS Tutorials	
	PHYS305TH PHYS305IA	QUANTUM MECHANICS Theory	
	PHYS305PR	QUANTUM MECHANICS Lab	
	PHYS306TH PHYS306IA	PHYSICS OF DEVICES AND INSTRUMENTS Theory	
	PHYS306PR	PHYSICS OF DEVICES AND INSTRUMENTS Lab	
DISCIPLINE SPECIFIC ELECTIVES DSE:2B (CHOOSE ANY ONE FROM GIVEN THREE)	CHEM304TH CHEM304IA CHEM304PR	CHEMISTRY OF TRANSITION AND INNER TRANSITION ELEMENTS, COORDINATION CHEMISTRY, ORGANOMETTALICS, ACIDS & BASES	**6**
	CHEM305TH CHEM305IA CHEM305PR	POLYMER CHEMISTRY	
	CHEM306TH CHEM306IA CHEM306PR	MOLECULES OF LIFE	
DISCIPLINE SPECIFIC ELECTIVES DSE:3B (CHOOSE ANY ONE FROM GIVEN THREE)	MATH304TH MATH304IA	NUMERICAL METHODS	**6**
	MATH305TH MATH305IA	COMPLEX ANALYSIS	
	MATH306TH MATH306IA	LINEAR PROGRAMMING	
SEC3 (CHOOSE ANY ONE FROM GIVEN TWELVE)	MATH307TH MATH307IA	LOGIC AND SETS	
	MATH308TH MATH308IA	ANALYTIC GEOMETRY	
	MATH309TH MATH309IA	INTEGRAL CALCULUS	

		MATH310TH MATH310IA	VECTOR CALCULUS	**4**
		MATH311TH MATH311IA	BOOLEAN ALGEBRA	
		MATH312TH MATH312IA	NUMBER THEORY	
		MATH313TH MATH313IA	PROBABILITY AND STATISTICS	
		MATH314TH MATH314IA	MATHEMATICAL FINANCE	
		MATH315TH MATH315IA	MATHEMATICAL MODELING	
		MATH316TH MATH316IA	THEORY OF EQUATIONS	
		MATH317TH MATH317IA	TRANSPORTATION AND GAME THEORY	
		MATH318TH MATH318IA	GRAPH THEORY	
	SEC4 (IN CASE OF CHEMISTRY CHOOSE ANY ONE FROM GIVEN TWO)	CHOOSE ANY ONE COURSE OUT OF THE LISTS OF SEC COURSES OF PHYSICS/MATHEMATICS, BUT NOT CHOSEN EARLIER IN SEC1 AND SEC3		**4**
		CHEM307TH CHEM307IA	CHEMICAL TECHNOLOGY & SOCIETY AND BUSINESS SKILLS FOR CHEMISTRY	
		CHEM308 CHEM308IA	PESTICIDE CHEMISTRY & PHARMACEUTICAL CHEMISTRY	

*TH = Theory, IA = Internal Assessment, PR = Practical, TU = Tutorials and SE = Skill Exam

HIMACHAL PRADESH UNIVERSITY
SYLLABUS AND SCHEME OF EXAMINATION FOR B.Sc. WITH CHEMISTRY

Year	Course Type	Course Code	Title of paper	*Credits
I	CORE COURSE-I	PHYS101TH PHYS101IA	MECHANICS Theory	**4**
		PHYS101PR	MECHANICS Lab	**2**
	CORE COURSE-II	CHEM101TH CHEM101IA CHEM101PR	ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS	**6**
	CORE COURSE-III	MATH101TH MATH101IA	DIFFERENTIAL CALCULUS	**6**
	A.E.C. COURSE-I		ENVIRONMENTAL SCIENCE	**4**
	CORE COURSE-IV	PHYS102TH PHYS102IA	ELECTRICITY, MAGNETISIM AND EMT Theory	**4**
		PHYS102PR	ELECTRICITY, MAGNETISIM AND EMT Lab	**2**
	CORE COURSE-V	CHEM102TH CHEM102IA CHEM102PR	STATES OF MATTER, CHEMICAL KINETICS & FUNCTIONAL ORGANIC CHEMISTRY	**6**
	CORE COURSE-VI	MATH102TH MATH102IA	DIFFERENTIAL EQUATIONS	**6**
	A.E.C.COURSE-II		ENGLISH/MIL COMMUNICATION	**4**
II	CORE COURSE-VII	PHYS201TH PHYS201IA	STATISTICAL AND THERMAL PHYSICS Theory	**4**
		PHYS201PR	STATISTICAL AND THERMAL PHYSICS Lab	**2**
	CORE COURSE-VIII	CHEM201TH CHEM201IA CHEM201PR	SOLUTIONS, PHASE EQUILIBRIUM, CONDUCTANCE ELECTROCHEMISTRY & ORGANIC CHEMISTRY	**6**
	CORE COURSE-IX	MATH201TH MATH201IA	REAL ANALYSIS	**6**
	CORE COURSE-X	PHYS202TH PHYS202IA	WAVES AND OPTICS Theory	**4**
		PHYS202PR	WAVES AND OPTICS Lab	**2**

		CHEM202TH	CHEMISTRY OF MAIN GROUP	
	CORE COURSE-XI	CHEM202IA CHEM202PR	ELEMENTS, CHEMICAL ENERGETICS AND EQUILIBRIA	**6**
	CORE COURSE-XII	MATH202TH MATH202IA	ALGEBRA	**6**
	SEC 1	CHEM203TH CHEM203IA	BASIC ANALYTICAL CHEMISTRY	**4**
	SEC 2	CHEM204TH CHEM204IA	FUEL CHEMISTRY & CHEMISTRY OF COSMETICS & PERFUMES	**4**
III	DISCIPLINE SPECIFIC ELECTIVES DSE:1A (CHOOSE ANY ONE FROM GIVEN THREE)	PHYS301TH PHYS301IA	ELEMENTS OF MODERN PHYSICS Theory	**4+2 (TH+IA = 4 PR = 2) OR 5+1 (TH+IA = 5 TU = 1)**
		PHYS301PR	ELEMENTS OF MODERN PHYSICS Lab	
		PHYS302TH PHYS302IA	SOLID STATE PHYSICS AND ELECTRONICS Theory	
		PHYS302PR	SOLID STATE PHYSICS AND ELECTRONICS Lab	
		PHYS303TH PHYS303IA	ASTRONOMY AND ASTROPHYSICS Theory	
		PHYS303TU	ASTRONOMY AND ASTROPHYSICS Tutorials	
	DISCIPLINE SPECIFIC ELECTIVES DSE:2A (CHOOSE ANY ONE FROM GIVEN THREE)	CHEM301TH CHEM301IA CHEM301PR	POLYNUCLEAR HYDROCARBONS, DYES, HETEROCYCLIC COMPOUNDS AND SPECTROSCOPY (UV, IR ,NMR)	**6**
		CHEM302TH CHEM302IA CHEM302PR	INDUSTRIAL CHEMICALS AND ENVIRONMENT	
		CHEM303TH CHEM303IA CHEM303PR	QUANTUM CHEMISTRY, SPECTROSCOPY & PHOTOCHEMISTRY	
	DISCIPLINE SPECIFIC ELECTIVES DSE:3A (CHOOSE ANY ONE FROM GIVEN THREE)	MATH301TH MATH301IA	MATRICES	**6**
		MATH302TH MATH302IA	MECHANICS	
		MATH303TH MATH303IA	LINEAR ALGEBRA	
		PHYS304TH PHYS304IA	NUCLEAR AND PARTICLE PHYSICS Theory	

	DISCIPLINE SPECIFIC ELECTIVES DSE:1B (CHOOSE ANY ONE FROM GIVEN THREE)	PHYS304TU	NUCLEAR AND PARTICLE PHYSICS Tutorials	**5+1** **(TH+IA** **= 5** **TU = 1)** **OR** **4+2** **(TH+IA** **= 4** **PR = 2)**
		PHYS305TH PHYS305IA	QUANTUM MECHANICS Theory	
		PHYS305PR	QUANTUM MECHANICS Lab	
		PHYS306TH PHYS306IA	PHYSICS OF DEVICES AND INSTRUMENTS Theory	
		PHYS306PR	PHYSICS OF DEVICES AND INSTRUMENTS Lab	
	DISCIPLINE SPECIFIC ELECTIVES DSE:2B (CHOOSE ANY ONE FROM GIVEN THREE)	CHEM304TH CHEM304IA CHEM304PR	CHEMISTRY OF TRANSITION AND INNER TRANSITION ELEMENTS, COORDINATION CHEMISTRY, ORGANOMETTALICS, ACIDS & BASES	**6**
		CHEM305TH CHEM305IA CHEM305PR	POLYMER CHEMISTRY	
		CHEM306TH CHEM306IA CHEM306PR	MOLECULES OF LIFE	
	DISCIPLINE SPECIFIC ELECTIVES DSE:3B (CHOOSE ANY ONE FROM GIVEN THREE)	MATH304TH MATH304IA	NUMERICAL METHOD	**6**
		MATH305TH MATH305IA	COMPLEX ANALYSIS	
		MATH306TH MATH306IA	LINEAR PROGRAMMING	
	SEC 3	CHEM307TH CHEM307IA	CHEMICAL TECHNOLOGY & SOCIETY AND BUSINESS SKILLS FOR CHEMISTRY	**4**
	SEC 4	CHEM308TH CHEM308IA	PESTICIDE CHEMISTRY & PHARMACEUTICAL CHEMISTRY	**4**

*TH = Theory, IA = Internal Assessment, PR = Practical, TU = Tutorials and SE = Skill Exam

COURSE CONTENTS

Core Courses (CC) for CHEMISTRY (1-4)

(Credits: 06 each)

First Year

CHEM 101TH
ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS

Max. Marks: 50 **Time Allowed: 3 Hours**
Credits: 4
Note for Examiners and Students:

1. *The question paper will consist of five sections A, B, C, D and E. Section E will be compulsory. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of **10** marks each and may contain more than one part. Section E will be of **10** marks and consists of objective type questions (MCQ/true and false / fill in the blanks etc.) of **one** mark each covering the entire paper.*

2. *The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.*

SECTION -A
Atomic Structure

Review of Bohr's theory and its limitations, dual behaviour of matter and radiation, de Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure. Schrodinger wave equation and meaning of various terms in it. Significance of ψ and ψ^2. 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, Shapes of s, p and d atomic orbitals, nodal planes. Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations. Slater rules and applications.   (14 Hours)

SECTION - B
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. Concept of resonance and resonating structures in various inorganic and organic compounds. 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 up to Ne (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO+. Comparison of VB and MO approaches.   (16 Hours)

SECTION - C
Fundamentals of Organic Chemistry

Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. 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.   (8 Hours)

Stereochemistry

Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newman, Sawhorse and Fischer projections. 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).   (10 Hours)

SECTION – D
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 $KMnO_4$, ozonolysis and oxidation with hot alkaline $KMnO_4$.   (12 Hours)

Reference Books:
1. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
2. Cotton, F.A., Wilkinson, G. & Gaus, P.L. Basic Inorganic Chemistry, 3rd ed., Wiley.
3. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. Concepts and Models in Inorganic Chemistry, John Wiley & Sons.
4. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India, 2006.
5. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. Organic Chemistry, John Wiley & Sons (2014).
6. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
7. Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).
8. Eliel, E.L. Stereochemistry of Carbon Compounds, Tata McGraw Hill education, 2000.
9. Finar, I.L. Organic Chemistry (Vol. I & II), E.L.B.S.
10. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
11. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.

LAB COURSE
CHEM 101 PR
ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS LAB

TIME ALLOWED: 03 HOURS
Max Marks: 20   **Credits – 2**

I. **Inorganic Chemistry - Volumetric Analysis**
   1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
   2. Estimation of oxalic acid by titrating it with $KMnO_4$.
   3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.
   4. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator.
   5. Estimation of Cu (II) ions iodometrically using $Na_2S_2O_3$.

II. **Organic Chemistry**
   1. Purification of organic compounds by crystallization (from water and alcohol) and distillation.
   2. Separation of mixtures by Chromatography: Measure of R_f value of a mixture of two organic compounds.

Reference Books:
1. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
2. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
3. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.
4. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.

CHEM 102TH
STATES OF MATTER ,CHEMICAL KINETICS & FUNCTIONAL ORGANIC CHEMISTRY

Max. Marks: 50   **Time Allowed: 3 Hours**
Credits: 4

Note for Examiners and Students:

1. *The question paper will consist of five sections A, B, C, D and E. Section E will be compulsory. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of* **10** *marks each and may contain more than one part. Section E will be of* **10** *marks and consists of objective type questions (MCQ/true and false / fill in the blanks etc.) of* **one** *mark each covering the entire paper.*

2. *The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.*

SECTION - A

Kinetic Theory of Gases

Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation.

Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. van der Waals equation of state for real gases. Boyle temperature (derivation not required). Critical phenomena, critical constants and their calculation from van der Waals equation. Andrews isotherms of CO_2.

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).   (16 Hours)

SECTION - B

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.

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).   (14 Hours)

SECTION - C

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

Aromatic hydrocarbons

Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid.

Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (upto 4 carbons on benzene). Side chain oxidation of alkyl benzenes (upto 4 carbons on benzene).

Alkyl Halides (Upto 5 Carbons) Types of Nucleophilic Substitution (SN_1, SN_2 and SNi) reactions.

Preparation: from alkenes and alcohols.

Reactions: hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation, Williamson's ether synthesis. 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.   (17 Hours)

SECTION - D

Alcohols, Phenols and Ethers (Upto 5 Carbons)

Alcohols: Preparation: Preparation of 1°, 2° and 3° alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters.

Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. $KMnO_4$, 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): (Formaldehye, acetaldehyde, acetone and benzaldehyde)

Preparation: From acid chlorides and from nitriles.

Reactions: Reaction with HCN, ROH, $NaHSO_3$, NH_2-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemensen reduction and Wolff Kishner reduction. Meerwein-Pondorff Verley reduction.   (15 Hours)

Reference Books:

1. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. Organic Chemistry, John Wiley & Sons (2014).
2. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
3. Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).
4. Finar, I.L. Organic Chemistry (Vol. I & II), E.L.B.S.
5. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
6. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
7. Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
8. Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).
9. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry Cengage Learning India Pvt. Ltd., New Delhi (2009).
10. Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
11. Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985).

LAB COURSE
CHEM 102 PR
STATES OF MATTER, CHEMICAL KINETICS & FUNCTIONAL ORGANIC CHEMISTRY LAB

TIME ALLOWED: 03 HOURS

Max Marks: 20   **Credits – 2**

I   **Physical Chemistry Practicals**

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

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

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

   2. **Viscosity measurement** (use of organic solvents excluded).

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

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

   3 **Chemical Kinetics**

      Study the kinetics of the following reaction:

            i). Acid hydrolysis of methyl acetate with hydrochloric acid.

            ii). Saponification of ethyl acetate.

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

II   **Organic Chemistry**

   1.   Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative. and melting point determinaton.

Reference Books

1. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.
2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.
3. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).

SECOND YEAR
CHEM 201TH
SOLUTIONS, PHASE EQUILIBRIUM, CONDUCTANCE, ELECTROCHEMISTRY & ORGANIC CHEMISTRY

Max. Marks: 50   **Time Allowed: 3 Hours**
Credits: 4

Note for Examiners and Students:
1. *The question paper will consist of five sections A, B, C, D and E. Section E will be compulsory. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of **10** marks each and may contain more than one part. Section E will be of **10** marks and consists of objective type questions (MCQ/true and false / fill in the blanks etc.) of **one** mark each covering the entire paper.*

2. *The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.*

SECTION - A
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. Nernst distribution law and its applications, solvent extraction.

Phase Equilibrium
Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule and its thermodynamic derivation. Derivation of Clausius – Clapeyron equation and its importance in phase equilibria. Phase diagrams of one-component systems (water and sulphur) and two component systems involving eutectics, congruent and incongruent melting points (lead-silver, $NaCl$-H_2O and Mg-Zn only).   (15 Hours)

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

Electrochemistry
Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance. Types of electrodes. Standard electrode potential. Electrochemical series. Thermodynamics of a reversible cell, calculation of thermodynamic properties: ΔG, ΔH and ΔS from EMF data.
Calculation of equilibrium constant from EMF data. Concentration cells with transference and without transference. Liquid junction potential and salt bridge. pH determination using hydrogen electrode and quinhydrone electrode.
                                                                     (15 Hours)

SECTION – C
Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.
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 inter conversion.

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, reaction with HNO_2, Schotten – Baumann Reaction. Electrophilic substitution (case aniline): nitration, bromination, sulphonation. Diazonium salts: Preparation: from aromatic amines. Reactions: conversion to benzene, phenol, dyes. (15 Hours)

SECTION - D

Carbohydrates: Classification, and General Properties, Glucose and Fructose (open chain and cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in monosaccharide. Structure of disaccharides (sucrose, maltose, lactose) and polysaccharides (starch and cellulose) excluding their structure elucidation. (15 Hours)

Reference Books:
1. Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
2. Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).
3. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry, Cengage Learning India Pvt. Ltd.: New Delhi (2009).
4. Mahan, B.H. University Chemistry, 3rd Ed. Narosa (1998).
5. Petrucci, R.H. General Chemistry, 5th Ed., Macmillan Publishing Co.: New York (1985).
6. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
7. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
8. Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
9. Nelson, D. L. & Cox, M. M. Lehninger's Principles of Biochemistry 7th Ed., W. H. Freeman.
10. Berg, J.M., Tymoczko, J.L. & Stryer, L. Biochemistry, W.H. Freeman, 2002.

LAB COURSE
CHEM 201PR
SOLUTIONS, PHASE EQUILIBRIUM, CONDUCTANCE, ELECTROCHEMISTRY & ORGANIC CHEMISTRY LAB

IME ALLOWED: 03 HOURS

Max Marks: 20   Credits – 2

I.   Distribution Law

Determination of distribution coefficient of
- i)   iodine between CCl_4 and Water
- ii)   benzoic acid between benzene and water

II.   Conductance

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

III.   Organic Chemistry

1. Preparations of organic compounds – Iodoform and Glucosazone
2. Any Two of the following:
    - i)   Separation of amino acids by paper chromatography
    - ii)   Determination of the concentration of glycine solution by formylation method.
    - iii)   Titration curve of glycine
    - iv)   Action of salivary amylase on starch
    - v)   Effect of temperature on the action of salivary amylase on starch.
    - vi)   Differentiation between a reducing and a non reducing sugar.

Reference Books:
1. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.

2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.
3. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
4. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry, Universities Press.

CHEM 202TH
CHEMISTRY OF MAIN GROUP ELEMENTS , CHEMICAL ENERGETICS AND EQUILIBRIA
Max. Marks: 50   **Time Allowed: 3 Hours**
Credits: 4

Note for Examiners and Students:
  1. *The question paper will consist of five sections A, B, C, D and E. Section E will be compulsory. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of **10** marks each and may contain more than one part. Section E will be of **10** marks and consists of objective type questions (MCQ/true and false / fill in the blanks etc.) of **one** mark each covering the entire paper.*

  2. *The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.*

SECTION - A
Hydrogen
Unique position of Hydrogen in the periodic table, isotopes, ortho and para hydrogen, Industrial production, Hydrides and their chemistry, Heavy water, Hydrogen bonding, Hydrates.
S-Block Elements
Periodicity of elements with respect to electronic configuration, atomic and ionic size, ionization enthalpy, electron gain enthalpy, electronegativity(Pauling Scale). General characteristics of s-block elements like density, melting points, flame colouration and reducing character, solvation and complexation tendencies and solutions of metals in liquid ammonia.   **(16 Hours)**

SECTION – B
P- Block Elements
Comparative studies including diagonal relationship of group 13 and 14 elements. Borohydrides, Hydrides, oxide and oxy-acids and halides of boron, borax, Borazine ,allotropic forms of carbon, fullerenes, carbides of calcium and silicon. Hydrides, oxides, oxoacids and halides of nitrogen. Allotropic forms of phosphorous. Hydrides, halides, oxides and oxyacids of phosphorous. Basic properties of halogens and inter halogen compounds, pseudohalogens and poly halides.
Noble Gases
Occurrence of noble gases, History of discovery of noble gases and isolation of noble gases form air. Preparation properties and structure of important compounds of noble gases-flourides, oxides, oxyflorides of xenon (valence bond structure only). Krypton difloride and clathrate compounds of noble gases.   (16 Hours)

SECTION - C
Chemical Energetics:
Review of thermodynamics and the Laws of Thermodynamics. Important principles and definitions of thermochemistry. 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.   (12 Hours)

SECTION - D
Chemical Equilibrium:
Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔG^o, Le Chatelier's principle. Relationships between K_p, K_c and K_x for reactions involving ideal gases.   (6 Hours)
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. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.

(10 Hours)

Reference Books:
1. Cotton, F.A. & Wilkinson, G. Basic Inorganic Chemistry, Wiley.
2. Shriver, D.F. & Atkins, P.W. Inorganic Chemistry, Oxford University Press.
3. Wulfsberg, G. Inorganic Chemistry, Viva Books Pvt. Ltd.
4. Rodgers, G.E. Inorganic & Solid State Chemistry, Cengage Learning India Ltd., 2008.
5. Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
6. Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).
7. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry Cengage Learning India Pvt. Ltd., New Delhi (2009).
8. Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
9. Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985).

Lab Course
CHEM 202PR
CHEMISTRY OF MAIN GROUP ELEMENTS , CHEMICAL ENERGETICS AND EQUILIBRIA LAB

TIME ALLOWED: 03 HOURS
Max Marks: 20   Credits – 2

1. **Inorganic Mixture Analysis** - Semi-micro qualitative analysis of inorganic mixture using H_2S of mixtures - not more than four ionic species (two anions and two cations and excluding insoluble salts) out of the following: Cations : NH^{4+}, Pb^{2+}, Ag^+, Bi^{3+}, Cu^{2+}, Cd^{2+}, Sn^{2+}, Fe^{3+}, Al^{3+}, Co^{2+}, Cr^{3+}, Ni^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, K^+ Anions : CO_3^{2-}, S^{2-}, SO_3^{2-}, $S_2O_3^{2-}$, NO_2^-, CH_3COO^-, Cl^-, Br^-, I^-, NO_3^-, SO_4^{2-}, PO_4^{3-}, BO_3^{3-}, $C_2O_4^{2-}$
(Spot tests should be carried out wherever feasible)

2. **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 integral enthalpy of solution of salts (KNO_3, NH_4Cl).
    4. Determination of enthalpy of hydration of copper sulphate.

3. **Ionic Equilibria: pH measurements**
    a) Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter.
    b) Preparation of buffer solutions: (i) Sodium acetate-acetic acid (ii) Ammonium chloride-ammonium hydroxide Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

Reference Books:
1. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
2. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
3. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).

COURSE CONTENT FOR

Skill Enhancement Courses (CHEMISTRY)
(4 Courses)
(Credit: 04 each)

CHEM 203
BASIC ANALYTICAL CHEMISTRY

Max. Marks: 70   **Time allowed: 03 Hours**

Credits: 4

Note for Examiners and Students:

1. *The question paper will consist of five sections A, B, C, D and E. Section E will be compulsory. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of **15** marks each and may contain more than one part. Section E will be of **10** marks and consists of 10 objective type questions (in MCQ/true and false / fill in the blanks) of **one** mark each covering the entire syllabus of the paper.*

2. *The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.*

SECTION – A

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.   (15 Hours)

SECTION – B

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.

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.   (18 Hours)

SECTION – C

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).   (12 Hours)

SECTION – D

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. **Suggested Applications (Any one):**

a. To study the use of phenolphthalein in trap cases. b. To analyze arson accelerants. c. To carry out analysis of gasoline.   (15 Hours)

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

Reference Books:

1. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. Instrumental Methods of Analysis. 7th Ed. Wadsworth Publishing Co. Ltd., Belmont, California, USA, 1988.
2. Skoog, D.A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed.
3. Skoog, D.A.; West, D.M. & Holler, F.J. Fundamentals of Analytical Chemistry 6th Ed., Saunders College Publishing, Fort Worth (1992).
4. Harris, D. C. Quantitative Chemical Analysis, W. H. Freeman.
5. Dean, J. A. Analytical Chemistry Notebook, McGraw Hill.
6. Day, R. A. & Underwood, A. L. Quantitative Analysis, Prentice Hall of India.
7. Freifelder, D. Physical Biochemistry 2nd Ed., W.H. Freeman and Co., N.Y. USA (1982).
8. Cooper, T.G. The Tools of Biochemistry, John Wiley and Sons, N.Y. USA. 16 (1977).
9. Vogel, A. I. Vogel's Qualitative Inorganic Analysis 7th Ed., Prentice Hall.

10. Vogel, A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Prentice Hall.
11. Robinson, J.W. Undergraduate Instrumental Analysis 5th Ed., Marcel Dekker, Inc., New York (1995).

CHEM 204 TH
FUEL CHEMISTRY
&
CHEMISTRY OF COSMETICS & PERFUMES

Max. Marks: 70   **Time allowed: 03 Hours**
Credits: 4

Note for Examiners and Students:

1. *The question paper will consist of five sections A, B, C, D and E. Section E will be compulsory. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of **15** marks each and may contain more than one part. Section E will be of **10** marks and consists of 10 objective type questions (in MCQ/true and false / fill in the blanks) of **one** mark each covering the entire paper.*
2. *The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.*

SECTION-A

Review of energy sources (renewable and non-renewable). Classification of fuels and their calorific value.
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.

Petroleum and Petrochemical Industry: Composition of crude petroleum, Refining and different types of petroleum products and their applications.   (18 Hours)

SECTION-B

Fractional Distillation (Principle and process), Cracking (Thermal and catalytic cracking), 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.

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.   (18 Hours)

SECTION-C

A general study including preparation and uses of the following: Hair dye, hair spray, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours.   (12 Hours)

SECTION-D

Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmone, Civetone, Muscone.   (12 Hours)

Reference Books:

1. E. Stocchi: Industrial Chemistry, Vol -I, Ellis Horwood Ltd. UK.
2. P.C. Jain, M. Jain: Engineering Chemistry, Dhanpat Rai & Sons, Delhi.
3. Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut (1996).
4. Stocchi, E. Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK (1990). 2.
5. Jain, P.C. & Jain, M. Engineering Chemistry Dhanpat Rai & Sons, Delhi.
6. Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut (1996).

Discipline Specific Electives (DSE) Courses (CHEMISTRY)

(Two papers from Each Discipline

(Credits: Theory-04/Practical-02)

THIRD YEAR
CHEM 301TH
POLYNUCLEAR HYDROCARBONS, DYES, HETEROCYCLIC COMPOUNDS AND SPECTROSCOPY (UV, IR, NMR)

Max. Marks: 50   **Time Allowed: 3 Hours**
Credits: 4
Note for Examiners and Students:

1. *The question paper will consist of five sections A, B, C, D and E. Section E will be compulsory. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of **10** marks each and may contain more than one part. Section E will be of **10** marks and consists of objective type questions (MCQ/true and false / fill in the blanks etc.) of **one** mark each covering the entire paper.*

2. *The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.*

SECTION – A

Polynuclear Hydrocarbons:
Synthesis & reactions of Naphthalene, Anthracene & Phenanthrene. Relative reactivity of these compounds at various positions.
Synthetic dyes:
Colour and constitution [electronic concept], classification of dyes. Chemistry and synthesis of methyl orange, congo red, malachite green, crystal violet, phenolphthalein, fluorescein, alizarin and indigo.

(12 Hours)

SECTION - B

Heterocyclic compounds:
Introduction: Classification and nomenclature, Molecular orbital picture & aromatic characteristics of pyrrole, furan, thiophene & pyridine. Methods of synthesis, chemical reactions with emphasis on mechanism of electrophilic substitution. Mechanism of nucleophilic substitution reactions in pyridine. comparison of basicity of pyridine, piperidine and pyrrole.

Introduction to condensed five & six-membered heterocyclic compounds, preparation & reactions of indole quinoline & isoquinoline with special reference to Fisher indole synthesis Skraup synthesis & Bischler – Napieralski synthesis. Mechanism of electrophilic substitution reactions of indole, quinoline, & isoquinoline .   (16 Hours)

SECTION - C

Application of UV and IR Spectroscopy to Simple Organic Molecules
Application of visible, ultraviolet and Infrared spectroscopy in organic molecules. Electromagnetic radiations, electronic transitions, λmax. & $\mathcal{E}$max. chromophore, auxochrome, bathochromic and hypsochromic shifts. Application of electronic spectroscopy and Woodward rules for calculating λmax. 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).   (16 Hours)

Section D

Nuclear Magnetic Resonance Spectroscopy:
Principle of nuclear magnetic resonance, number of signals, peak areas equivalent & non-equivalent protons, positions of signals, chemical shift. Shielding & deshielding of protons, proton counting, splitting of signals & coupling constants, magnetic equivalence of protons. Discussion of PMR spectra of molecules : ethyl bromide, n – propyl bromide, isopropyl bromide 1,1-dibromoethane 1,1,2- tribromo ethane, ethanol, toluene, acetaldehyde, acetophenone. Simple problems on PMR spectroscopy for structure determination of organic compounds.

(16 Hours)

Reference Books:

1. James E. Huheey, Ellen Keiter & Richard Keiter: Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Publication.
2. G.L. Miessler & Donald A. Tarr: Inorganic Chemistry, Pearson Publication.
3. J.D. Lee: A New Concise Inorganic Chemistry, E.L.B.S.
4. F.A. Cotton & G. Wilkinson: Basic Inorganic Chemistry, John Wiley & Sons.
5. I.L. Finar: Organic Chemistry (Vol. I & II), E.L.B.S.
6. John R. Dyer: Applications of Absorption Spectroscopy of Organic Compounds, Prentice Hall.
7. R.M. Silverstein, G.C. Bassler & T.C. Morrill: Spectroscopic Identification of Organic Compounds, John Wiley & Sons.
8. R.T. Morrison & R.N. Boyd: Organic Chemistry, Prentice Hall.
9. Peter Sykes: A Guide Book to Mechanism in Organic Chemistry, Orient Longman.
10. Arun Bahl and B. S. Bahl: Advanced Organic Chemistry, S. Chand.

LAB COURSE
CHEM 301PR
POLYNUCLEAR HYDROCARBONS, DYES, HETEROCYCLIC COMPOUNDS AND SPECTROSCOPY (UV, IR, NMR) LAB

TIME ALLOWED: 03 HOURS

Max Marks: 20   **Credits – 2**

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+}, Al^{3+} and Cr^{3+} or 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
   (iii) potassium trioxalatoferrate (III) trihydrate

3. **Colorimetry**

Draw calibration curve (absorbance at λmax vs. concentration) for various concentrations of a given coloured compound ($KMnO_4$/ $CuSO_4$) and estimate the concentration of the same in a given solution.

Reference Books:

1. A.I. Vogel: Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.
2. A.I. Vogel: Quantitative Chemical Analysis, Prentice Hall, 6th Edn.
3. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.
4. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.

CHEM 302TH
INDUSTRIAL CHEMISTRY AND ENVIRONMENT

Max. Marks: 50   **Time Allowed: 3 Hours**
Credits: 4

Note for Examiners and Students:

*1. The question paper will consist of five sections A, B, C, D and E. Section E will be compulsory. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of **10** marks each and may contain more than one part. Section E will be of **10** marks and consists of objective type questions (MCQ/true and false / fill in the blanks etc.) of **one** mark each covering the entire paper.*

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

SECTION – A

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.

(14 Hours)

SECTION - B

Industrial Metallurgy

General Principles of Metallurgy - Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon as reducing agent.

Hydrometallurgy, Methods of purification of metals (Al, Pb, Ti, Fe, Cu, Ni, Zn): electrolytic, oxidative refining, Kroll process, Parting process, van Arkel-de Boer process and Mond's process. 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.

(16 Hours)

SECTION - C

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.   (16 Hours)

SECTION - D

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.   (14 Hours)

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 Publishers, New Delhi.
3. J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
4. S. S. Dara: A Textbook of Engineering Chemistry, S. Chand & Company Ltd. New Delhi.
5. K. De, Environmental Chemistry: New Age Inter0national Pvt., Ltd, New Delhi.
6. S. M. Khopkar, Environmental Pollution Analysis: Wiley Eastern Ltd, New Delhi.
7. S.E. Manahan, Environmental Chemistry, CRC Press (2005).
8. G.T. Miller, Environmental Science 11th edition. Brooks/ Cole (2006).
9. A. Mishra, Environmental Studies. Selective and Scientific Books, New Delhi (2005).

LAB COURSE
CHEM 302PR
INDUSTRIAL CHEMISTRY AND ENVIRONMENT LAB

TIME ALLOWED: 03 HOURS

Max Marks: 20   **Credits – 2**

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 ($AgNO_3$ and potassium chromate).
6. Estimation of total alkalinity of water samples (CO_3^{2-}, HCO_3^-) 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.

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 Publishers, New Delhi.
3. J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
4. S. S. Dara: A Textbook of Engineering Chemistry, S. Chand & Company Ltd. New Delhi.
5. K. De, Environmental Chemistry: New Age International Pvt. Ltd, New Delhi.
6. S. M. Khopkar, Environmental Pollution Analysis: Wiley Eastern Ltd, New Delhi.

CHEM 303TH
QUANTUM CHEMISTRY, MOLECULAR SPECTROSCOPY & PHOTOCHEMISTRY
Max. Marks: 50   **Time Allowed: 3 Hours**
Credits: 4
Note for Examiners and Students:
1. *The question paper will consist of five sections A, B, C, D and E. Section E will be compulsory. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of **10** marks each and may contain more than one part. Section E will be of **10** marks and consists of objective type questions (MCQ/true and false / fill in the blanks etc.) of **one** mark each covering the entire paper.*

2. *The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.*

SECTION – A
Quantum Chemistry
Postulates of quantum mechanics, quantum mechanical operators, Schrödinger equation and its application to free particle and "particle-in-a-box" (rigorous treatment), quantization of energy levels, zero-point energy and Heisenberg Uncertainty principle; wave functions, probability distribution functions, nodal properties, Extension to two and three dimensional boxes, separation of variables, degeneracy. Qualitative treatment of simple harmonic oscillator model of vibrational motion: Setting up of Schrödinger equation and discussion of solution and wave functions. Vibrational energy of diatomic molecules and zero-point energy.
Angular momentum: Commutation rules, quantization of square of total angular momentum and z-component.
Rigid rotator model of rotation of diatomic molecule. Schrödinger equation, transformation to spherical polar coordinates. Separation of variables. Spherical harmonics. Discussion of solution.   (16 Hours)

SECTION – B
Molecular Spectroscopy
Interaction of electromagnetic radiation with molecules and various types of spectra; Born Oppenheimer approximation. Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution. Vibrational spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies. Vibration-rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches.   (16 Hours)

SECTION - C
Raman spectroscopy
Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion.
Electronic spectroscopy
Franck-Condon principle, electronic transitions, singlet and triplet states, fluorescence and phosphorescence, dissociation and pre issociation, calculation of electronic transitions of polyenes using free electron model.
Nuclear Magnetic Resonance (NMR) spectroscopy: Principles of NMR spectroscopy, Larmor precession, chemical shift and low resolution spectra, different scales, spin-spin coupling and high resolution spectra, interpretation of PMR spectra of organic molecules. Electron Spin Resonance (ESR) spectroscopy: It's principle and hyperfine structure, ESR of simple radicals.   (16 Hours)

SECTION - D
Photochemistry
Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws, of photochemistry, quantum yield, examples of low and high quantum yields,

photochemical equilibrium and the differential rate of photochemical reactions, photosensitised reactions, quenching. Role of photochemical reactions in biochemical processes, photostationary states, chemiluminescence.

(12 Hours)

Reference Books:
1. Banwell, C. N. & McCash, E. M. Fundamentals of Molecular Spectroscopy 4th Ed. Tata McGraw-Hill: New Delhi (2006).
2. Chandra, A. K. Introductory Quantum Chemistry Tata McGraw-Hill (2001).
3. House, J. E. Fundamentals of Quantum Chemistry 2nd Ed. Elsevier: USA (2004).
4. Lowe, J. P. & Peterson, K. Quantum Chemistry, Academic Press (2005).
5. Kakkar, R. Atomic & Molecular Spectroscopy: Concepts & Applications, Cambridge University Press (2015).

LAB COURSE
CHEM 303PR
QUANTUM CHEMISTRY, MOLECULARB SPECTROSCOPY & PHOTOCHEMISTRY LAB

TIME ALLOWED: 03 HOURS
Max Marks: 20   **Credits - 2**

I. Verify Lambert-Beer's law and determine the concentration of $CuSO_4$/ $KMnO_4$/ $K_2Cr_2O_7$ in a solution of unknown concentration
II. Determine the concentrations of $KMnO_4$ and $K_2Cr_2O_7$ in a mixture.
III. Study the kinetics of iodination of propanone in acidic medium.
IV. Determine the amount of iron present in a sample using 1,10-phenathroline.
V. Determine the dissociation constant of an indicator (phenolphthalein).
VI. Study the kinetics of interaction of crystal violet/ phenolphthalein with sodium hydroxide.
VII. Analyse the given vibration-rotation spectrum of HCl(g)

Reference Books
1. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
2. Khosla, B. D.; Garg, V. C. & Gulati, A., Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
3. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York (2003).
4. Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co.: New York (2003).

CHEM 304TH
CHEMISTRY OF TRANSITION AND INNER TRANSITION ELEMENTS , COORDINATION CHEMISTRY, ORGANOMETTALICS, ACIDS and BASES
Max. Marks: 50   **Time Allowed: 3 Hours**
Credits: 4

Note for Examiners and Students:
1. *The question paper will consist of five sections A, B, C, D and E. Section E will be compulsory. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of **10** marks each and may contain more than one part. Section E will be of **10** marks and consists of objective type questions (MCQ/true and false / fill in the blanks etc.) of **one** mark each covering the entire paper.*

2. *The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.*

SECTION - A

Transition Elements (3d series) - Chemistry of elements 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, $K_2Cr_2O_7$, $KMnO_4$, $K_4[Fe(CN)_6]$, sodium nitroprusside, $[Co(NH_3)_6]Cl_3$, $Na_3[Co(NO_2)_6]$.

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.

Lanthanides and actinides: Electronic configurations, oxidation states, colour, magnetic properties, lanthanide contraction, separation of lanthanides and actinides (ion exchange method only). (16 Hours)

SECTION – B
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 nomenclature of coordination compounds.

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). (16 Hours)

SECTION - C
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 CF splitting. Spectrochemical series. Comparison of CF Splitting for Octahedral and tetrahedral complexes, Tetragonal distortion of octahedral geometry. Jahn-Teller distortion, Square planar coordination. (14 Hours)

SECTION – D

Acids and Bases
Arrhenius, Bronsted and Lowry, Lewis, Lux flood and solvent system concepts of acids and bases. Classification of acids and bases as hard and soft. Pearson's HSAB concept, application of HSAB principle. Relative strength of acids and bases and effect of substituents and solvent on their strength. **(14 Hours)**

Books Recommended:
1. Concise inorganic Chemistry 4th Edn. By J. D.Lee.
2. Inorganic Chemistry by T. Moeller.
3. Advanced Inorganic Chemistry by Cotton And Wilkinson.
4. Inorganic Chemistry by J.E.Huheey.
5. Theoretical Inorganic Chemistry by Day & Selbin.
6. Canham, G.R. & Overton, T. Descriptive inorganic chemistry. Freeman & Co. 2006.
7.Purecell, K.F. & Kotz J.C. Inorganig Chemistry. W.B. Saunders & Co. 1977.
8.Basolo, F. & Pearson, R.C. Mechanisms of Inorganic chemistry. John Wiley 7 Sons, NY,1967.
9.Chemistry of Elements by Greenwood, N.N. & Earnshaw. Butterworth – Heinemann 1997.

LAB COURSE
CHEM 304PR
CHEMISTRY OF TRANSITION AND INNER TRANSITION ELEMENTS , COORDINATION CHEMISTRY,ORGANOMETTALICS, ACIDS and BASES LAB
TIME ALLOWED: 03 HOURS
Max Marks: 20 **Credits – 2**

1. Iodometric estimation of potassium dichromate and copper estimate.
2. Iodimetric estimation of antimony in tartaremetic.
3. Estimation of amount of available chlorine in bleaching powder and household bleachers .
4. Estimation of iodine in iodized salts
5. Iodimetric estimation of ascorbic acid in fruit juices .
6. Gravimetric estimation of sulphate in barium sulphate.
7. Gravimetric estimation of aluminum in oximato complex.

8. Inorganic preparation of
    i) Potash alum
    ii) Chrome alum
    iii) tetraamminecopper(II) sulphate
    iv) potassium trioxalatoferrate(III)
    v) hexaammine nickel(II) chloride
9. **Complexometric titrations**
    a) Estimation of (i) Mg^{2+} or (ii) Zn^{2+} by complexometric titrations using EDTA.
    b) Estimation of total hardness of a given sample of water by complexometric titration

CHEM 305TH
POLYMER CHEMISTRY

Max. Marks: 50   **Time Allowed: 3 Hours**
Credits: 4
Note for Examiners and Students:
   *1. The question paper will consist of five sections A, B, C, D and E. Section E will be compulsory. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of **10** marks each and may contain more than one part. Section E will be of **10** marks and consists of objective type questions (MCQ/true and false / fill in the blanks etc.) of **one** mark each covering the entire paper.*

   2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

SECTION - A
Introduction and history of polymeric materials:
Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers. Functionality and its importance: Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization. Bifunctional systems, Poly-functional systems.   (15 Hours)
SECTION - B
Kinetics of Polymerization:
Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques.
 Crystallization and crystallinity:
Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point. Nature and structure of polymers-Structure Property relationships.   (15 Hours)
SECTION - C
Determination of molecular weight of polymers (Mn, Mw, etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index. Glass transition temperature (Tg) and determination of Tg, Free volume theory, WLF equation, Factors affecting glass transition temperature (Tg).
Polymer Solution – Criteria for polymer solubility, Solubility parameter, Thermodynamics of polymer solutions, entropy, enthalpy, and free energy change of mixing of polymers solutions, Flory- Huggins theory, Lower and Upper critical solution temperatures.   (16 Hours)
SECTION - D
Properties of Polymers (Physical, thermal, Flow & Mechanical Properties).
Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly(vinyl chloride) and related polymers, poly(vinyl acetate) and related polymers, acrylic polymers, fluoro polymers, polyamides and related polymers. Phenol formaldehyde resins (Bakelite, Novalac), polyurethanes, silicone polymers, polydienes, Polycarbonates, Conducting Polymers, [polyacetylene, polyaniline, poly(p-phenylene sulphide polypyrrole, polythiophene)].   (14 Hours)
Reference Books:
   1. Seymour, R.B. & Carraher, C.E. Polymer Chemistry: An Introduction, Marcel Dekker, Inc. New York, 1981.
   2. Odian, G. Principles of Polymerization, 4th Ed. Wiley, 2004.
   3. Billmeyer, F.W. Textbook of Polymer Science, 2nd Ed. Wiley Interscience, 1971.

4. Ghosh, P. Polymer Science & Technology, Tata McGraw-Hill Education, 1991.
5. Lenz, R.W. Organic Chemistry of Synthetic High Polymers. Interscience Publishers, New York, 1967.

LAB COURSE
CHEM 305PR
POLYMER CHEMISTRY LAB

TIME ALLOWED: 03 HOURS

Max Marks: 20   **Credits - 2**

I. Polymer synthesis

1. Free radical solution polymerization of styrene (St) / Methyl Methacrylate (MMA) / Methyl Acrylate (MA) / Acrylic acid (AA).
    a. Purification of monomer
    b. Polymerization using benzoyl peroxide (BPO) / 2,2'-azo-bis-isobutylonitrile (AIBN)
2. Redox polymerization of acrylamide
3. Precipitation polymerization of acrylonitrile
4. Preparation of urea-formaldehyde resin
5. Preparations of novalac resin/resold resin.
6. Microscale Emulsion Polymerization of Poly(methylacrylate).

II. Polymer characterization

1. Determination of molecular weight by viscometry:
    (a) Polyacrylamide-aq.$NaNO_2$ solution
    (b) (Poly vinyl proplylidine (PVP) in water
2. Determination of the viscosity-average molecular weight of poly(vinyl alcohol) (PVOH) and the fraction of "head-to-head" monomer linkages in the polymer.
3. Determination of molecular weight by end group analysis: Polyethylene glycol (PEG) (OH group). 4. Testing of mechanical properties of polymers. 5. Determination of hydroxyl number of a polymer using colorimetric method.

 *At least 6 experiments to be carried out.

Reference Books:

1. M.P. Stevens, Polymer Chemistry: An Introduction, 3rd Ed., Oxford University Press, 1999.
2. H.R. Allcock, F.W. Lampe & J.E. Mark, Contemporary Polymer Chemistry, 3rd ed. Prentice-Hall (2003)
3. F.W. Billmeyer, Textbook of Polymer Science, 3rd ed. Wiley-Interscience (1984)
4. J.R. Fried, Polymer Science and Technology, 2nd ed. Prentice-Hall (2003)
5. P. Munk & T.M. Aminabhavi, Introduction to Macromolecular Science, 2nd ed. John Wiley & Sons (2002)
6. L. H. Sperling, Introduction to Physical Polymer Science, 4th ed. John Wiley & Sons (2005)
7. M.P. Stevens, Polymer Chemistry: An Introduction 3rd ed. Oxford University Press (2005).
8. Seymour/ Carraher's Polymer Chemistry, 9th ed. by Charles E. Carraher, Jr. (2013).

CHEM 306TH
MOLECULES OF LIFE

Max. Marks: 50   **Time Allowed: 3 Hours**
Credits: 4
Note for Examiners and Students:

1. *The question paper will consist of five sections A, B, C, D and E. Section E will be compulsory. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of* **10** *marks each and may contain more than one part. Section E will be of* **10** *marks and consists of objective type questions (MCQ/true and false / fill in the blanks etc.) of* **one** *mark each covering the entire paper.*

2. *The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.*

SECTION – A

Bioinorganic Chemistry:

Essential and trace elements in biological process, metalloporphyrrinn with special reference to haemoglobin and myoglobin. Biological role of alkali and alkaline earth metals ion with reference to Ca^{2+} and nitrogen fixation.

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).   (16 Hours)

SECTION – B

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 (tbutyloxycarbonyl and phthaloyl) & C-activating groups and Merrifield solid phase synthesis.   (16 Hours)

SECTION - C

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,
(13 Hours)

SECTION - D

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.

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.

(15 Hours)

Recommended Texts:
1. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Nelson, D. L. & Cox, M. M. Lehninger's Principles of Biochemistry 7th Ed., W. H. Freeman.

5.   Berg, J.M., Tymoczko, J.L. & Stryer, L. Biochemistry, W.H. Freeman, 2002.

LAB COURSE
CHEM 306 PR
MOLECULES OF LIFE LAB

TIME ALLOWED: 03 HOURS
Max Marks: 20   **Credits – 2**

 1. Separation of amino acids by paper chromatography
 2. To determine the concentration of glycine solution by formylation method.
 3. Study of titration curve of glycine
 4. Action of salivary amylase on starch
 5. Effect of temperature on the action of salivary amylase on starch.
 6. To determine the saponification value of an oil/fat.
7. To determine the iodine value of an oil/fat
8. Extraction of DNA from onion/cauliflower

Recommended Texts:
1.   Furniss, B.S.; Hannaford, A.J.; Rogers, V.; Smith, P.W.G.; Tatchell, A.R. Vogel's Textbook of Practical Organic Chemistry, ELBS.
2.   Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry, Universities Press.

CHEM 307
CHEMICAL TECHNOLOGY & SOCIETY   and   BUSINESS SKILLS FOR CHEMISTRY

Max. Marks: 70   **Time allowed: 03 Hours**
Credits: 4

Note for Examiners and Students:
1.   *The question paper will consist of five sections A, B, C, D and E. Section E will be compulsory. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of **15** marks each and may contain more than one part. Section E will be of **10** marks and consists of 10 objective type questions (in MCQ/true and false / fill in the blanks) of **one** mark each covering the entire syllabus of the paper.*
2.   *The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.*

SECTION-A
Chemical Technology
Basic principles of distillation, solvent extraction, solid-liquid leaching and liquid-liquid extraction, separation by absorption and adsorption. An introduction into the scope of different types of equipment needed in chemical technology, including reactors, distillation columns, extruders, pumps, mills, emulgators. Scaling up operations in chemical industry. Introduction to clean technology.   (18 Hours)

SECTION-B
Society
Exploration of societal and technological issues from a chemical perspective. Chemical and scientific literacy as a means to better understand topics like air and water (and the trace materials found in them that are referred to as pollutants); energy from natural sources (i.e. solar and renewable forms), from fossil fuels and from nuclear fission; materials like plastics and polymers and their natural analogues, proteins and nucleic acids, and molecular reactivity and interconversions from simple examples like combustion to complex instances like genetic engineering and the manufacture of drugs.   (18 Hours)

Section - C
Business Basics
Key business concepts: Business plans, market need, project management and routes to market.
Chemistry in Industry
Current challenges and opportunities for the chemistry-using industries, role of chemistry in India and global economies.   (12 Hours)

Section - D
Making money
Financial aspects of business with case studies
Intellectual property
Concept of intellectual property, patents.   (12 Hours)

Reference Books:
1.   www.rsc.org
2.   John W. Hill, Terry W. McCreary & Doris K. Kolb, Chemistry for changing times 13th Ed.

CHEM 308
PESTICIDE CHEMISTRY & PHARMACEUTICAL CHEMISTRY

Max. Marks: 70   **Time allowed: 03 Hours**
Credits: 4

Note for Examiners and Students:
1.   *The question paper will consist of five sections A, B, C, D and E. Section E will be compulsory. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of **15** marks each and may contain more than one part. Section E will be of **10** marks and consists of 10 objective type questions (in MCQ/true and false / fill in the blanks) of **one** mark each covering the entire syllabus of the paper.*

2. *The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.*

SECTION-A

General introduction to pesticides (natural and synthetic), benefits and adverse effects, changing concepts of pesticides, structure activity relationship. (12 Hours)

SECTION-B

Synthesis and technical manufacture and uses of representative pesticides in the following classes: Organochlorines (DDT, Gammexene,); Organophosphates (Malathion, Parathion); Carbamates (Carbofuran and carbaryl); Quinones (Chloranil), Anilides (Alachlor and Butachlor). (15 Hours)

SECTION - C

Drugs & Pharmaceuticals Drug discovery, design and development; Basic Retrosynthetic approach. Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, antiinflammatory agents (Aspirin, paracetamol, lbuprofen); antibiotics (Chloramphenicol); 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). (18 Hours)

SECTION -D

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. (15 Hours)

Reference Books:
1. G.L. Patrick: Introduction to Medicinal Chemistry, Oxford University Press, UK
2. Hakishan, V.K. Kapoor: Medicinal and Pharmaceutical Chemistry, Vallabh Prakashan, Pitampura, New Delhi.
3. William O. Foye, Thomas L., Lemke , David A. William: Principles of Medicinal Chemistry, B.I. Waverly Pvt. Ltd. New Delhi.
5. Cremlyn, R. Pesticides. Preparation and Modes of Action, John Wiley & Sons, New York, 1978.