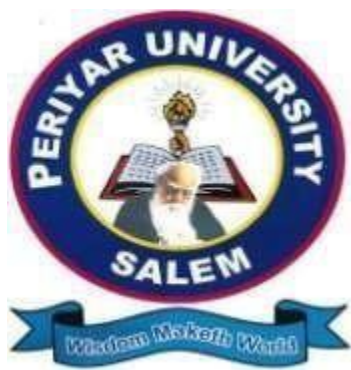


**PERIYAR UNIVERSITY
PERIYAR PALKALAI NAGAR
SALEM – 636 011**



DEGREE OF BACHELOR OF SCIENCE

CHOICE BASED CREDIT SYSTEM

SYLLABUS FOR BRANCH IV- B.Sc. CHEMISTRY

FOR THE STUDENTS ADMITTED FROM THE ACADEMIC YEAR 2021-2022 ONWARDS

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REGULATIONS

1. Preamble and objectives of the Course:

Chemistry is central to the current revolutions in Science. No educated person today can understand the modern world without a basic knowledge of Chemistry. The existence of a large number of chemical factories, mines and related industries in the catchment of the University necessitates Chemistry education.

The programme educational objectives (PEOs) of B.Sc. Chemistry course are

1. To impart knowledge in fundamental aspects of all branches of Chemistry.
2. To acquire basic knowledge in the specialized areas like Polymer Chemistry, Environmental Chemistry, Dye Chemistry, Pharmaceutical Chemistry, Industrial Chemistry etc.
3. To create manpower in Chemical industries and help their growth.
4. To prepare candidates for a career in Chemical industries.

Programme Specific Outcomes (PSOs)

After completion of this programme the candidate will

- have enormous job opportunities at all levels of chemical, pharmaceutical and food product industries.
- get specific placements in R & D and synthetic division of polymer industries & Allied divisions.
- appear in competitive exams conducted by service commission.
- gain complete knowledge about all fundamental aspects of chemistry
- learn about the emerging field of green chemistry, nanochemistry and polymer chemistry
- carry out experiments in the area of organic analysis, estimation, inorganic semi-micro analysis, conductometric & potentiometric equipment.

Programme Outcomes (POs)

On successful completion of this programme, students will have the ability to

- think critically and analyze chemical problems.
- present scientific and technical information resulting from laboratory experimentation in both written and oral formats.
- work effectively and safely in a laboratory environment.
- use technologies and instrumentation together to explore new areas of research.
- work as a member of interdisciplinary problem solving team.
- apply their scientific skill to innovative studies.

2. Condition for Admission

A candidate who has passed the Higher Secondary Examination of TamilNadu Higher Secondary Board or an examination of some other board accepted by the syndicate as equivalent there

to with Chemistry and Physics and any one of the following subjects namely Maths, Botany, Zoology or Biology shall be eligible for admission into B.Sc., course in Chemistry.

3. Duration of the Course:

The course for the degree of Bachelor of Science shall consist of three academic years divided into six semesters.

4. Course of study:

The course of study for the B.Sc. Degree in the Branch IV-Chemistry shall comprise of the following subjects according to the syllabus and books prescribed from time to time. The Syllabus for various subjects shall be demarcated into five units in each subject

Part-I – Tamil / Other languages

Part-II – English

Part-III – Coresubjects

Allied subjects

Project / Elective with three courses

Part-IV

1. Non Major elective comprising of two courses.

2. Skill based subjects (Elective)

3. Environmental Studies

4. Value Education

5. Professional English

Part-V – Extension Activities

NSS / NCC / Sports / YRC and other co and extracurricular activities offered under part V of the programmes.

The two allied subjects may be chosen by the respective colleges and the same must be communicated to the University.

Non major elective course subjects may be chosen by the respective colleges and the same must be communicated to the University.

The college may also choose the allied subject of their choice in the first and second year.

I-SEMESTER:

1. Language - Paper I
2. English - Paper I
3. Major Core - Paper I
4. Allied I - Paper I
5. Value Education
6. Professional English- I [Add – On Course]

II-SEMESTER

7. Language – Paper II
8. English - Paper II
9. Major Core - Paper II
10. Allied I - Paper II
11. Major- practical – I
12. Allied – I Practical

13. Environmental studies
14. Skill based Elective Course I
15. Professional English- II [Add – On Course]

III- SEMESTER

16. Language – Paper III
17. English- Paper III
18. Major Core – Paper III
19. Allied II – Paper I
20. Skill Based Elective course II
21. Non Major Elective course I

IV SEMESTER

22. Language – Paper IV
23. English – Paper IV
24. Major Core – Paper IV
25. Allied II- Paper II
26. Major- Practical III
27. Allied II- Practical
28. Skill Based Elective course II
29. Non Major Elective course II

V SEMESTER

30. Major Core Paper – V
31. Major Core Paper – VI
32. Major Core paper – VII
33. Elective Paper – I
34. Skill Based Elective course III
35. Skill Based Elective course IV

VI- SEMESTER

36. Major Core Paper- VIII
37. Major core paper – IX
38. Major core paper – X
39. Elective Paper – II
40. Skill Based Elective course V
41. Elective Paper - III
42. Major Practicals – III
43. Major Practicals – IV

5. Examinations

There shall be six examinations- two in the first year, two in the second year and two in the third year. Candidates failing in any subject / subjects will be permitted to appear for such failed subject / subjects at subsequent examinations.

The Syllabus has been divided into six semesters. Examinations for I, III and V semesters will be held in November/ December and for II, IV and VI semesters will be held in April / May.

The practical examination I will be held at the end of I year. II will be held at the end of II year. III and IV will be held at the end of III year.

Requirement to appear for the examination

A candidate shall be permitted to appear for the university examinations for any semester (practical/theory) if He / She secures not less than 75% of attendance in the number of working days during the semester.

6. Passing Minimum

A candidate who secures not less than 40% in the university (external) Examination and 40% marks in the external examination and continuous internal assessment put together in any course of Part I, II, III & IV shall be declared to have passed the examination in the subject (theory or Practical). For practical, the minimum for a pass includes the record notebook marks also. There is no passing minimum for the record notebook. However submission of a record notebook is amust.

7. Classification of Successful Candidates

Candidates who secure not less than 60% of the aggregate marks in the whole examination shall be declared to have passed the examination in First Class.

All other successful candidates shall be declared to have passed in the Second Class.

Candidates who obtain 75% of the marks in the aggregate shall be declared to have passed the examination in First Class with Distinction provided they pass all the examinations prescribed for the course at the first appearance.

Grading:

Conversion of marks to Grade points and letter grade (Performance in a course/paper)

Range of marks	Grade Points	Letter Grade	Description
90-100	9.0-10.0	O	Outstanding
80-89	8.0-8.9	D+	Excellent
75-79	7.5-7.9	D	Distinction
70-74	7.0-7.4	A+	Very Good
60-69	6.0-6.9	A	Good
50-59	5.0-5.9	B	Average
40-49	4.0-4.9	C	Satisfactory
00-39	0.0	U	Re-appear
ABSENT	0.0	AAA	ABSENT

C_i = Credits earned for course I in any semester

G_i = Grade point obtained for course I in any semester

n = refers to the semester in which such course were credited

Grade point average (for a Semester):

Calculation of grade point average semester-wise and part-wise is as follows:

$$\text{GRADE POINT AVERAGE [GPA]} = \frac{\sum_i C_i G_i}{\sum_i C_i}$$

Sum of the multiplication of grade points by the credits of the courses offered under each part GPA =

Sum of the credits of the courses under each part in a semester

Calculation of grade point average (CGPA) (for the entire programme):

A candidate who has passed all the examinations under different parts (Part-I to V) is eligible for the following partwise computed final grades based on the range of CGPA.

$$\text{CUMULATIVE GRADE POINT AVERAGE [CGPA]} = \frac{\sum_n \sum_i C_{ni} G_{ni}}{\sum_n \sum_i C_{ni}}$$

Sum of the multiplication of grade points by the credits of the entire programme under each part CGPA =

Sum of the credits of the courses of the entire programme under each part

Classification of Successful candidates

A candidate who passes all the examinations in Part I to Part V securing following CGPA and Grades shall be declared as follows for Part I or Part II or Part III:

CGPA	GRADE	Classification of Final Result
9.5-10.0	O+	First Class – Exemplary
9.0 and above but below 9.5	O	
8.5 and above but below 9.0	D++	First Class with Distinction
8.0 and above but below 8.5	D+	
7.5 and above but below 8.0	D	
7.0 and above but below 7.5	A++	First Class
6.5 and above but below 7.0	A+	
6.0 and above but below 6.5	A	
5.5 and above but below 6.0	B+	Second Class
5.0 and above but below 5.5	B	
4.5 and above but below 5.0	C+	Third Class
4.0 and above but below 4.5	C	

8. Ranking

Candidates who pass all the examinations prescribed for the course in the first instance and within a period of three academic years from the year of admission to the course only are eligible for University Ranking.

9. Maximum Duration for the completion of the UG Programme:

The maximum duration for completion of the UG Programme shall not exceed twelve semesters.

10. Commencement of this Regulation:

These regulations shall take effect from the academic year 2021-2022, i.e. for students who are to be admitted to the first year of the course during the academic year 2021-2022 and thereafter.

11. Marks Distribution and Question Paper Pattern for B.Sc., (For Both Major & Allied)

Theory–Marks Distribution

Maximum Marks: 100 Marks

External : 75 Marks

Internal : 25 Marks

(a).Theory-External Marks Distribution

Time :3Hours

Maximum: 75Marks

Part A : 15 x 1 =15 (Answer all questions)

Choose the correct answer

(Three questions from each unit)

Part B : 2 x 5 = 10 (Answer any two questions)

(One question from each unit with internal choice)

Part C : 5 x 10 = 50 (Answer All questions)

(One question from each unit with internal choice)

(b).Theory-Internal Marks Distribution

(TotalMarks:25)

Attendance : 5 Marks

Assignment : 5 Marks

Test : 15 Marks

(c) Practical Marks - Distribution

MaximumMarks :100 Marks

External :60 Marks

Internal :40Marks

INTERNSHIP (2 weeks)

The students have the option to select any organization – Government / private like industry, R & D organizations, scientific companies, etc., in consultation with the staff coordinator & Head of the Department. The students have to undergo training for a period of two weeks at the end of semester IV during vacation. The students must maintain a work diary and prepare report of the training undergone and submit the same.

Part	Course	No.ofHours /week	Exam Hours	Credit	Marks		
					Internal	External	Total
I – SEMESTER							
I	Tamil or other language -I	6	3	3	25	75	100
II	Communicative English Paper -I	6	3	3	25	75	100
III	Core Chemistry Paper -I	5	3	5	25	75	100
III	Core Chemistry Practical-I	3	-	-	-	-	-
III	Allied– I (Maths or Botany or Zoology) (Theory)	4	3	5	25	75	100
III	Allied– I (Maths or Botany or Zoology) (Practical)	3	-	-	-	-	-
IV	Value Education	2	3	2	25	75	100
IV	Professional English- I [Add – On Course]	6	3	4	25	75	100
IV	Environmental Science	1	--	-	-	-	-
		36		22			600
II -SEMESTER							
I	Tamil or other language Paper-II	6	3	3	25	75	100
II	Communicative English Paper- II	4	3	3	25	75	100
II	Naan Muthalvan course Effective English (Cambridge) Language Proficiency for Employability	2	3	2	25	75	100
III	Core Chemistry Paper -II	5	3	5	25	75	100
III	Core Chemistry Practical-I	3	3	4	40	60	100
III	Allied– II (Maths or Botany or Zoology) (Theory)	4	3	5	25	75	100
III	Allied Practical-I (Maths or Botany or Zoology)	3	3	4	40	60	100
IV	Environmental studies	1	3		25	75	100
IV	Skill based elective course I (SBEC I)- Food and Nutrition	2	3	3	25	75	100
IV	Professional English- II [Add – On Course]	6	3	4	25	75	100
		36		27			900

Part	Course	No. of Hours perweek	Exam Hours	Credit	Marks		
					Internal	External	Total
III - SEMESTER							
I	Tamil or other language-III	6	3	3	25	75	100
II	English -III	6	3	3	25	75	100
III	Core Chemistry Paper-III	5	3	5	25	75	100
III	Core Chemistry Practical-II	3	-	-	-	-	-
III	Allied III Physics Theory- I	4	3	3	25	75	100
III	Allied Practical-II Physics Practical-I	3	-	-	-	-	-
IV	SBEC II- Polymer Chemistry	1	-	-	-	-	-
IV	Digital Skills for Employability- Microsoft office Essentials	2	2	2	25	75	100
		30		16			500
IV - SEMESTER							
I	Tamil or other language-IV	6	3	3	25	75	100
II	English - IV	4	3	3	25	75	100
III	Core Chemistry Paper-IV	5	3	5	25	75	100
III	Core Chemistry Practical-II	3	3	4	40	60	100
III	Allied IV – Physics Theory-II	4	3	3	25	75	100
III	Allied Practical-II Physics Practical-I	3	3	4	40	60	100
IV	SBEC –NMSDC – Office Fundamentals (Digital Skills foremployability)	2	3	2	25	75	100
IV	SBEC II- Polymer Chemistry	1	3	3	25	75	100
IV	Non Major Elective course -II	2	3	2	25	75	100
	Internship 2 weeks report should be submitted						
		30		27			800

Part	Course	No. of Hours per week	Exam Hours	Credit	Marks		
					Internal	External	Total
V - SEMESTER							
III	Core Chemistry Paper -V (inorganic chemistry)	5	3	5	25	75	100
III	Core Chemistry Paper-VI (organic chemistry)	5	3	5	25	75	100
III	Core Chemistry Paper-VII(Physical Chemistry)	5	3	5	25	75	100
III	Elective Paper – I Analytical Chemistry –I	4	3	4	25	75	100
III	Core Chemistry Practical– III (Physical)	3	-	-	-	-	-
III	Core Chemistry Practical-IV(Organic & Gravimetric)	4	-	-	-	-	-
IV	SBEC – III Agricultural Chemistry	2	3	3	25	75	100
IV	Advanced Technology for Employability in Life Science-PCR Technology	2	3	2	25	75	100
		30		24			600
VI - SEMESTER							
III	Core Chemistry Paper -VIII (inorganic chemistry)	4	3	4	25	75	100
III	Core Chemistry Paper-IX (organic chemistry)	4	3	4	25	75	100
III	Core Chemistry Paper-X (Physical Chemistry)	4	3	4	25	75	100
III	Elective Paper II Nano & green chemistry	4	3	4	25	75	100
III	Elective Paper -III Industrial Chemistry	4	3	4	25	75	100
III	Core Chemistry Practical – III (physical)	3	3	4	40	60	100
III	Core Chemistry Practical – IV(Organic & Gravimetric)	5	6	6	40	60	100
IV	SBEC V – Pharmaceutical Chemistry	2	3	3	25	75	100
Add on course	Naan Muthalvan – Employability readiness (Addon Course)	-	-	-	-	-	-
V	Extension activities			1			
		30		34			800

For students admitted from 2021-2022 onwards

Total Credit for I & II Semester = 49 credits

For students admitted from 2021-2022 onwards

Total Credit for III & IV Semester = 43 credits

Total Credit for VI Semester = 34 credits

Total Credits for 3 years = 150 Credits

B.Sc. CHEMISTRY
SEMESTER – I
GENERAL CHEMISTRY I (75 hours)
CODE -21UCH01

Internal Assessment Marks:25

External Marks:75

UNIT-I s,p-Block elements and Volumetric Analysis

1.1 s-block elements – Characteristic properties of group I and II elements, Diagonal relationship between Li and Mg, Be and Al.

1.2 p-block elements – Boron family: Synthesis and structure of diborane and higher boranes (B_4H_{10} and B_5H_9). Boron nitrogen compound ($B_3N_3H_6$) and Lewis acid nature of BX_3 . Carbon family: Carbides – Classifications (ionic, covalent and interstitial). Chemistry of carborundum and boron carbide.

1.3 Volumetric analysis – Principle, Preparation of standard solutions, types of titration. Theory of acid– base titration, redox titrations: Fe^{+2} vs $K_2Cr_2O_7$ using internal and external indicators. Precipitation titration: $AgNO_3$ Vs KCl – Complexometric titration: $EDTA$ Vs Mg^{+2} .

UNIT – II Chemical Bonding

2.1 Ionic bond-Mode of formation – properties of ionic compounds-inert pair effect-Born Haber cycle- polarization of ions- factors affecting polarization-importance of polarization of ions- Fajan's rules and applications.

2.2 Covalent Bond-Mode of formation-properties of covalent compounds- Valence Bond theory- Postulates of Pauling-Slater's theory-Different types of overlapping. Molecular orbital theory Postulates-Bonding and anti-bonding molecular orbitals-Tabulation of various M.Os formed from atomic orbitals- Bond order- MO diagrams for Homo and Hetero nuclear diatomic molecules: H_2 , He, N_2 , O_2 , CO, NO and HF. Comparisons between VBT and MOT.

UNIT – III Basic Concepts in Organic Chemistry

3.1 Hybridisation and geometry of molecules: methane, ethylene, acetylene – Electron displacement effect: Inductive effect – electromeric effect – mesomeric effects – Hyper conjugative effect – Illustration and their effects.

3.2 Homolytic and heterolytic fission: Electrophiles, nucleophiles and free radicals. Reaction intermediates: Carbocations, Carbanions and Free radicals – stability. Difference between intermediate and transition state.

UNIT – IV Cycloalkanes, Alkenes and Alkynes

4.1 Cycloalkanes: IUPAC Nomenclature, preparation using Dieckmann's ring closure and reduction of aromatic hydrocarbons, Substitution reactions with Cl_2 and Br_2 and ring opening reactions of cyclopropane with H_2 , Br_2 and HBr , Bayer's strain theory.

4.2 Alkenes: IUPAC nomenclature, mechanisms of addition reactions with hydrogen halogenhydrogen halide (Markovnikoff's rule), HBr (peroxide effects), Hydration, Hydroboration, ozonolysis; hydroxylation using KMnO_4 and OsO_4 and allylic substitution by NBS.

4.3 Alkynes – General methods of preparation, properties and uses.

UNIT – V Gaseous State

5.1 Behaviour of ideal gases - kinetic molecular theory of gases-the kinetic gas equation. Gas Laws: Boyle's law, Charles law, Avagadro's law, Graham's law of gaseous diffusion and Dalton's law of partial pressure-Ideal gas equation. Derivation of the gas laws-kinetic theory and temperature-Boltzmann constant-Maxwell's distribution of molecular velocities-types of molecular velocities- Root mean square, average and most probable velocity. Collision diameter-collision frequency-mean free path.

5.2 Behaviour of Real gases - Deviations from ideal behaviour- -Explanation of deviations – derivation of vander Waal's equation for real gases. PV isotherms of real gases. The virial equation of state-derivation of the principle of corresponding states.

TEXT BOOKS AND REFERENCES:

1. B.R. Puri, L.R. Sharma, K.C. Kalia, principles of inorganic chemistry
2. Soni.P.L, Text Book of Inorganic Chemistry, Sultan Chand & Sons.
3. Puri and Sharma, Text book of Inorganic Chemistry-Vishal publishingco.
4. Bhal. B.S, and Arun Bhal, A Text book of Organic Chemistry.
5. Morrison and Boyd, Organic Chemistry, Allyn and Bacon Inc.
6. Puri, Sharma and Pathanaia, Principles of Physical Chemistry

B.Sc. CHEMISTRY
SEMESTER – II
GENERAL CHEMISTRY II (75 hours)
CODE -21UCH02

Internal Assessment Marks: 25

External Marks: 75

UNIT-I p-Block Elements:

1.1 Nitrogen family: Nitrides – Classifications (ionic, covalent and interstitial). Reactivity – hydrolysis. Preparation and reactions of hydrazine, hydroxyl amine and phosphines.

1.2 Oxygen family: Oxides – Types of oxides (acidic, basic amphoteric and neutral), oxides and oxy acid of halogens (structure only). Ozone and hydrogen peroxide – Preparation, properties, structure and uses.

UNIT-II Aromatic Compounds and Electrophilic Substitution:

2.1 Aromaticity: Resonance in Benzene – Huckel's ($4n+2$) rule and its simple applications.

2.2 Electrophilic substitution- Nitration, Halogenation, Sulphonation, Fried Crafts alkylation, acylation and arylation –Mechanism Orientation and reactivity in monosubstituted benzene.

2.3 Polynuclear hydrocarbons- Naphthalene, Anthracene isolation, synthesis, properties and uses.

UNIT-III Aliphatic Nucleophilic Substitution & Elimination:

3.1 Reaction intermediates: carbocation, carbanion, free radicals- formation and stability.

3.2 Aliphatic Nucleophilic substitution: Mechanism and stereochemistry of SN_1 , SN_2 and SN_i reactions-Effect of substrate structure, nucleophile, solvent and leaving group.

3.3 Elimination reaction- mechanism of E_1 and E_2 reactions- Hofmann and Saytzeff's rule– comparison between substitution and elimination.

3.4 Dienes -Isolated and Conjugated dienes, 1,2 and 1,4 addition.

UNIT-IV The Liquid State, Liquid Crystals & Colloids

4.1 The Liquid state: structure of liquids- Vapour-pressure-Trouton's rule-surface tension- surface energy-some effects of surface tension-viscosity- effect of temperature on viscosity (Experimental determination of surface tension and viscosity not necessary)-Refractive index-specific refraction-molar refraction. Physical properties and chemical constitution-Molar volume and chemical constitution- Parachor and chemical constitution. Viscosity and chemical constitution- molar refraction and chemical constitution.

4.2 Liquid crystals (The mesomorphic state) Thermography-classification of Thermotropic liquid crystals-Smectic liquid crystals- Nematic liquid crystals- Cholesteric liquid crystals- Applications of liquid crystals

4.3 Colloids: Types of sols-characteristic of lyophilic and lyophobic sols- optical, kinetic and electrical properties of sols- Applications of colloids.

UNIT-V Solid State

5.1 The solid state- differences between crystalline and amorphous solids- isotropy and anisotropy – interfacial angle-symmetry in crystal systems- Elements of symmetry, space lattice & unit cell- Bravis lattices- Law of rationality of indices- Millerindices.

5.2 X ray diffraction- Braggs- equation Experimental methods, Structure of NaCl, CsCl, ZnS.

5.3 Band theory and defects insolids.

TEXT BOOKS AND REFERENCES:

1. Soni.P.L, Text Book of Inorganic Chemistry, Sultan Chand & Sons.
2. Madhan R D, Inorganic Chemistry
3. Puri and Sharma, Text book of Inorganic Chemistry-Vishal publishingco.
4. Bhal. B.S, and Arun Bhal, A Text book of Organic Chemistry.
5. Morrison and Boyd, Organic Chemistry, Allyn and Bacon Inc.
6. Puri, Sharma and Pathanaia, Principles of Physical Chemistry

B.Sc. CHEMISTRY SEMESTER – II
SKILL BASED ELECTIVE COURSE –I
FOOD AND NUTRITION (30 hours)
CODE -21UCHS01

Internal Assessment Marks: 25

External Marks:75

UNIT -I Food Sources

1.1 Sources of foods, types, constituents of foods-carbohydrate, protein, fats, oils and their functions.

1.2 Food colours, flavours and natural toxicants.

UNIT -II Nutrition

2.1 Definition of nutrition, nutrients, functions. Nutritional status – Definition, signs of good and poor nutritional status.

2.2 Mal nutrition- Definition, forms, causes and remedy.

2.3 Health –Definition, guidelines for good health, Balanced diet, Food pyramid.

2.4 BMI (Body Mass Index), Obesity: causes complications, treatment and prevention.

UNIT-III Food Poisoning, Adulteration And Food Preservation

3.1 Food poisoning- Sources, causes and remedy. Causes and remedies for acidity, gastritis, indigestion and constipation

3.2 Food adulteration- Types of adulterants- intentional and incidental, Adulterants in different foods- Milk and milk products- vegetable oils and fats-spices-cereals-pulses, detection and prevention.

3.3 Food spoilage, causes of food spoilage, types of Food spoilage

3.4 Food preservation-preservation and processing by heating - sterilization, pasteurization. Food preservation by low temperature method, fermentation.

UNIT-IV Vitamins And Minerals

4.1 Sources, requirement and deficiency diseases of fat soluble vitamins - A, D, E, and K, water soluble vitamins- B₁, B₂ and B₆

4.2 Mineral elements in food-source, function, deficiency diseases and daily requirements of Na, K, Mg, Fe, S and P.

UNIT-V Foods In Relation To Disease

5.1 Food borne illness, bacterial and viral food borne disorder, animal parasites, mycotoxins.

5.2 Deficiency diseases - nutritional anaemia, PEM, IDD, VAD - chemical finding, prevention and treatment.

TEXT BOOKS AND REFERENCES:

1. Seema Yadav : —Food Chemistry , Anmol publishing (P) Ltd, NewDelhi
2. Car H. Synder : — The Extraordinary Chemistry for ordinarything,
John Wiley & sons inc., New York,1992.
3. B.Sivasankar - — Food Processing and Preservation – PHI Learning (P) Ltd, New Delhi–
11001.
4. B.Srilakshmi- Nutrition science. Third edition, New age International (P) Ltd. New Delhi,Chennai.

B.Sc. CHEMISTRY SEMESTER – III
GENERAL CHEMISTRY –III (75 hours)
CODE -21UCH03

Internal Assessment Marks:25

External Marks:75

Unit-I

Inorganic Qualitative Analysis and Nuclear Chemistry

1.1 Principles of Qualitative analysis: Principles involved in Na_2CO_3 extract preparation- Common ion effect and its application- Solubility product principle & applications in qualitative analysis-complexation reactions in qualitative analysis-separation of cation into groups.

1.2 Nuclear chemistry: Nuclear Stability n/p ratio- nuclear forces- Natural radioactivity- modes of decay- Geiger- Nuttal rule- Kinetics of radioactivity disintegration.

1.3 Mass defect and binding energy- Artificial transmutation and artificial radioactivity.

1.4 Nuclear reactors-types- common features like fuels- moderators, coolant control materials.

Unit-II

Halogen Family and Chemistry of Rare Gases

2.1 Position of halogens in periodic table- Oxides and Oxyacids of halogens. Inter halogen compounds. Basic properties of halogens.

2.2 Rare gases: Position of rare gases in the periodic table - General properties- compounds of Xenon – oxides, halides and oxy-halides.

Unit-III

Carbonyl Compounds

3.1 General methods of preparation of aldehydes and ketone - Addition reaction of carbonyl group. addition of HCN , NH_2OH , NH_2NH_2 , phenyl hydrazines, semicarbazide, and grignard reagent.

3.2 Mechanism of reduction of carbonyl group by NaBH_4 , LiAlH_4 , Wolf Kishner, Clemmenson and Meerwin-ponndorf verley (MPV) reduction.

3.3 Carbonyl polarization-Reactivity of carbonyl group- Acidity of carbonyl group- Haloform reaction – Mechanism.

3.4 Aldol condensation and Cannizzaro reaction - mechanism.

Unit-IV

Thermodynamics and Thermochemistry

4.1 Terminology of Thermodynamics- thermodynamic equilibrium-Nature of work and heat- Law of conservation of energy- first Law of thermodynamics- internal energy- Enthalpy of a system- Heat capacity of a system

4.2 Expansion of an ideal gas- work done in reversible isothermal expansion-work done in reversible isothermal compression-work done in reversible adiabatic expansion-.

4.3 Joule- Thomson effect, Joule- Thomson coefficient-Inversion temperature- Zeroth Law of thermodynamics- Absolute temperature scale - Kirchoff's equation.

Unit-V

Second Law of Thermodynamics - I

5.1 Limitations of the first Law- need for second law- Spontaneous process- cyclic process Carnot cycle -Efficiency-Carnot theorem- thermodynamic scale of temperature.

5.2 Concept of entropy- Entropy- a state function- Entropy change in isothermal expansion of an ideal gas- Entropy change in reversible and irreversible processes- Clausius inequality- Entropy change accompanying change of phase- Entropy of mixture of ideal gases-entropy of mixing- physical significance of entropy.

TEXT BOOKS AND REFERENCES:

1. Soni.P.L, Text Book of Inorganic Chemistry, Sultan Chand & Sons.
2. Madhan R D, Inorganic Chemistry
3. Puri and Sharma, Text book of Inorganic Chemistry-Vishal publishingco.
4. Bhal. B.S, and Arun Bhal, A Text book of Organic Chemistry.
5. Morrison and Boyd, Organic Chemistry, Allyn and Bacon Inc.
6. Puri, Sharma and Pathanaia, Principles of Physical Chemistry

B.Sc. CHEMISTRY SEMESTERS – III and IV
SKILL BASED ELECTIVE COURSE – II (30 hours)
POLYMER CHEMISTRY
CODE -21UCHS02

Internal Assessment Marks: 25

External Marks:75

UNIT-I

1.1 Basic concepts: Monomer, polymerization, degree of polymerization, repeat units. Classification of Polymers-addition and condensation polymers, natural and synthetic, inorganic and organic, thermoplastic and thermosetting resin.

1.2 General methods of preparation of polymers. Polymerization through functional groups, multiple bonds and ring opening and Coordination polymerization.

UNIT-II

2.1 Structure of polymers- linear, branched and cross linked. Homo & hetro copolymers. Block copolymers &graft copolymers. Stereochemistry of polymers-Isotactic, Syndiotactic and Atactic

2.2 Properties of polymers: The crystalline melting point. The glassy state and glass transition temperature. Determination of glass transition temperature.

UNIT-III

3.1 Molecular weight of polymers Number average molecular weight and weight average molecular weight. Determination of molecular weight by viscosity and osmometry methods.

3.2 Polymer processing- calendaring, Die casting, blow moulding, injection moulding, extrusion moulding and wet spinning.

UNIT-IV

4.1 Preparation, properties and uses of Poly olefins-polythene, PTFE, Freons, PVC, polypropylene and polystyrene.

4.2 Natural and synthetic rubbers-Constitution of natural rubber. Butyl, Buna-N, Buna-S, Neoprene, Thiocol, Polyurethane and silicone rubbers.

UNIT-V

5.1 Plastics and Resins Definitions. Thermoplastic and thermo setting resins. Constituents of plastic-fillers, dyes, pigments, plasticizers, Lubricants and catalysts. Uses of thermoplastic resins and thermo setting resins.

REFERENCES:

1. V. R. Gowrikar, N.V.Viswanathan : Polymer Science- Wiley Eastern Limited,New Delhi.1986.
2. R.B.Seymour, Introduction to Polymer Chemistry, MC Craw Hill, New York1971.
3. S.S.Dara, A Text Book in Engineering Chemistry, S.Chand & Company Ltd, New Delhi. Third Edition,1992.

B.Sc. CHEMISTRY SEMESTER-IV
GENERAL CHEMISTRY-IV (75 hours)
CODE -21UCH04

Internal Assessment Marks:25

External Marks :75

UNIT-I

d-Block elements & Principles of Metallurgy

1.1 Transition elements - position in the periodic table - general characteristics - objective study of the properties expected. Occurrence, extraction, properties and uses of Titanium, Zirconium, Molybdenum. Chemistry of Titanium dioxide, Titanium tetrachlorate, Vanadium pentoxide, Ammonium vanadate, Zirconium dioxide, Zirconium halide, Ammonium molybdate & Molybdenum blue.

1.2 Principles of Metallurgy: Minerals, ores. Different metallurgical operations employed in extracting metals from ores. Methods of concentration, Reduction of mineral to metal and Refining of metals.

UNIT – II

Gravimetric Analysis

2.1 Principle - Theories of precipitation - conditions of precipitation - co precipitation & post precipitation - Reduction of errors, precipitation from homogeneous solution - Washing & Drying of precipitate. Choice of precipitant - Specific & Selective precipitants - Anthranilic acid, Cupferon, Dimethylglyoxime ethylene diamide, 8-hydroxy quinoline - use of masking agent.

2.2 Crucible - Types, care & uses. Calculation in gravimetric analysis. Use of Gravimetric factor.

UNIT – III

Carboxylic Acids

3.1 Unsaturated acids - preparation and properties of acrylic, crotonic, oleic and cinnamic acids.

3.2 Hydroxy acids - classification preparation and reactions of glycolic acid, malic acid and citric acid - Action of heat on α , β and γ acids.

3.3 Dicarboxylic acids - preparation and properties of oxalic, malonic, succinic, glutaric and adipic acids.

3.4 Mechanism of conversion of acids into acid derivatives - esterification including trans esterification. Hydrolysis of esters.

UNIT-IV

Reaction Mechanism

4.1 Reaction and Mechanism of Kolbe's reaction - Reimer - Tiemann reaction, Gattermann, Lederer manasse and Houben Hoesch reactions.

4.2 Reaction and Mechanism of Mannich, Stobbe, Darzen, Wittig and Reformatsky reactions.

UNIT-V

Second law of thermodynamics - II

5.1 Work and free energy functions - Maxwell's relationships for reversible and irreversible process - Gibbs Helmholtz equation – Partial molar free energy-chemical potential-Gibb's Duhem Equation, Clapeyron - Clausius equation - Applications of Clapeyron - Clausius equation.

5.2 Third law of thermodynamics Nernst heat theorem - statement of III law Evaluation of absolute entropy from heat capacity measurements - Test for the validity of the law.

TEXT BOOKS AND REFERENCES:

- 1 Soni.P.L, Text Book of Inorganic Chemistry, Sultan Chand & Sons.
- 2 Madhan R D, Inorganic Chemistry
- 3 Puri and Sharma, Text book of Inorganic Chemistry-Vishal publishingco.
- 4 Kalsi P S, Organic Reactions and their Mechanism
- 5 Morrison and Boyd, Organic Chemistry, Allyn and Bacon Inc.
- 6 Puri, Sharma and Pathanaia, Principles of Physical Chemistry
7. Rajaram and Kuriacose, Thermodynamics for Students Of Chemistry

B.Sc. CHEMISTRY SEMESTER V
INORGANIC CHEMISTRY (75 hours)
CODE -21UCH05

Internal Assessment Marks:25

External Marks:75

Unit I

Coordination Chemistry

1.1 Definition of the terms-Classification of ligands- Nomenclature of mononuclear and polynuclear complexes-chelating ligands and chelates- Examples-chelate effect-explanation.

1.2 Werner's theory-conductivity and precipitation studies – Sidgwick's theory- Effective Atomic Number concept.

1.3 Isomerism in complexes-Structural Isomerism—types. Stereoisomerism- Geometrical isomerism in 4 and 6 coordinated complexes. Optical isomerism in 4-and 6-coordinated complexes.

Unit II

Theories of Coordination Compounds

2.1 Theories of bonding in complexes-Valence Bond Theory- Postulates – Hybridisation and geometries of complexes-Outer orbital and inner orbital octahedral complexes. Square planar and tetrahedral complexes-V.B. Theory and magnetic properties of complexes-limitations of V.B. Theory.

2.2 Crystal Field Theory (CFT)-postulates-d-orbital splitting in octahedral, tetrahedral and square planar complexes-strong and weak ligands- Spectrochemical series- High spin and low spin complexes-C.F. Theory and magnetic properties of complexes-Crystal Field Stabilisation Energy (CFSE) and its uses-Calculation of CFSE values of d^1 to d^{10} Octahedral and Tetrahedral complexes-CFT and colour of complexes-limitations of CFT -comparison between VBT and CFT.

Unit III

Reactions Mechanisms and Applications of Complexes

3.1 Substitution reactions in square planar complexes-Trans Effect-Trans effect series-uses of Trans effect-Theories of Trans effect- polarisation theory and π - bonding theory.

3.2 Application of coordination compounds in Qualitative and Quantitative analysis-separation of Copper and Cadmium ions, Cobalt and Nickel ions- Identification of Cu, Fe, and Ni.

3.3 EDTA and its applications - estimation of metals, hardness of water and sequestration.

Unit IV

Chemistry of f-block elements

4.1 Position in the Periodic Table-General characteristics of Lanthanides and Actinides Lanthanide contraction and its consequences.

4.2 Isolation of Lanthanides from Monazite including the Ion exchange resin method.

4.3 Actinides-occurrence and preparation.

4.4 Chemistry of Thorium and Uranium-Important compounds - preparation, properties and uses of Uranyl nitrate, Uranium hexafluoride, Thoriumdioxide.

Unit V

Concepts of acids, bases and non aqueous solvents

5.1 Acids and Bases: Arrhenius, Bronsted-Lowry, the Lewis concepts of acids and bases. Relative strength of acids and bases.

5.2 Hard and Soft Acids and Bases-classification of acids and bases as hard and soft- examples Pearson's HSAB concept, acid-base strength and hardness and softness, Theoretical basis of hardness and softness, Applications of HSAB principle.

5.3 Non-aqueous solvents- physical properties of a solvent, types of solvents and their general characteristics. Reactions in non- aqueous solvents with reference to liquid NH_3 and liquid SO_2 - Comparison.

TEXT BOOKS AND REFERENCES:

- 1 Madhan R D, InorganicChemistry
- 2 Puri and Sharma, Text book of Inorganic Chemistry-Vishal publishingco.
- 3 Madhan R D, Tuli G D and Wahid U Malik, Selected topic in InorganicChemistry
- 4 Sharpe A G, Inorganic Chemistry
- 5 Gurdeep Chatwaal and M.S. Yadav Coordination Chemistry.
- 6 Gurdeep Advanced InorganicChemistry
7. Madhan R D and Sathya Prakash Modern Inorganic Chemistry

B.Sc. CHEMISTRY SEMESTER V
ORGANIC CHEMISTRY (60 hours)
CODE -21UCH06

Internal Assessment Marks:25

External Marks:75

UNIT – I

1.1 Stereoisomerism: Definition – classification into optical and geometrical isomers. Optical isomerism – optical activity – specific rotations – condition for optical activity of stereogenic centre – chirality.

1.2 Elements of symmetry – Enantiomers, diastereomers and mesomers and their physical and chemical properties. Racemization – resolution – Asymmetric synthesis – Walden inversion. Projection formulae: Fisher and Sawhorse, erythro and threo representations. Configuration – D, L and R, S notations for optical isomers with one and two asymmetric carbon. Optical activity of biphenyls, allenes and spiranes.

UNIT – II

2.1 Geometrical isomerism – Alkenes – cis – trans and E-Z notations. Geometrical isomerism in maleic, fumaric acids and in unsymmetrical oximes – methods of distinguishing geometrical isomers (dipole moment, dehydration, cyclization and m.p). cis – trans isomerism in cyclopropane.

2.2 Conformational analysis – Introduction of terms (conformation, conformer, configuration, dihedral angle, torsional strain, conformational analysis). Conformational analysis of ethane, n- butane and cyclohexane - axial, equatorial bonds and cis – trans – isomers in cyclohexane (chair form only) stability of cis and trans decalins - Elementary treatment.

UNIT – III

3.1 Phenols – Acidity of Phenol, explanation on the basis of the resonance stabilization.

3.2 Preparation of phenol: Reaction of monohydric phenol with mechanism – alkylation, acylation. Mechanism of Kolbe, Reimer – Tiemann, Gattermann, Houben-Hoesch reactions.

3.3 Di and trihydric phenols – preparation and properties of catechol, resorcinol, alpha and beta naphthols – Preparation and properties.

UNIT- IV

Molecular rearrangements:

4.1 Mechanism of pinacol – pinacolone (migratory aptitude), Beckmann, Hoffmann, Curtius, Schmidt, Benzilic acid, Claisen, Cope and Fries rearrangements. Difference between inter and intramolecular nature.

UNIT – V

Chemistry of natural products

5.1 Alkaloids-classification-isolation-general methods of determination of structure of alkaloids.

Structural elucidation and synthesis (any one method) of the following alkaloids, nicotine, papaverine Atropine.

5.2 Terpenes-classification-isolation-isoprene rule-synthesis and structural elucidation of citral, geraniol, alpha pinene.

TEXT BOOKS AND REFERENCES:

1. Kalsi P S, Stereochemistry, Conformation and Mechanism
2. Bhal. B.S, and Arun Bhal, A Text book of Organic Chemistry.
3. Morrison and Boyd, Organic Chemistry, Allyn and Bacon Inc.
4. Tewari K S and Vishoni N K, Organic Chemistry
5. Finar I L, , Organic Chemistry Vol I & II
6. P L Soni Text book of Organic Chemistry
7. Nasipuri D Stereo Chemistry of Organic compounds
8. N R Krishnaswamy Chemistry of Natural products.
9. O P Agarwal Reactions and Reagents in Organic Chemistry

B.Sc. CHEMISTRY
SEMESTER V
PHYSICAL CHEMISTRY(75 hours)
CODE -21UCH07

Internal Assessment Marks:25

External Marks:75

UNIT-I Chemical Equilibrium

1.1 Thermodynamic derivation of equilibrium constants- K_p , and K_c - Relations between K_p , and K_c - Standard free energy change-Derivation of van't Hoff reaction isotherm DeDonder's treatment of chemical equilibria-concept of chemical affinity (no derivation)-Temperature dependence of equilibrium constant-van't Hoff isochore-Pressure dependence of equilibrium constant.

1.2 Adsorption- Physical and chemical adsorption-Types of adsorption isotherms-Freundlich adsorption isotherm-Derivation of Langmuir adsorption isotherm (BET isotherm (postulates only) BET equation (statement).

UNIT-II Chemical Kinetics-I

2.1 Derivation of rate constant of a second order reaction-when the reactants are taken at different initial concentrations-when the reactants are taken at the same initial concentrations Determination of the rate constant of a II order reaction-Derivation of rate constant of a third order reaction-when the reactants are taken at the same initial concentrations. Derivation of half-life periods for second and third order reactions having equal initial concentration of reactants.

2.2 Methods of determining the order of reaction-Experimental methods in the study of kinetics-volumetry, manometry, polarimetry and colorimetry.

2.3 Effect of temperature on reaction rates-Derivation of Arrhenius equation-concept of activation energy-determination of Arrhenius frequency factor and energy of activation.

UNIT-III Chemical Kinetics-II

3.1 Collision theory (CT) of reaction rates-Derivation of rate constant of a bimolecular reaction from collision theory-Failures of collision theory.

3.2 Lindemann theory of Unimolecular reactions.

3.3 Theory of Absolute Reaction Rates (ARRT) -Thermodynamic derivation of rate constant for a bimolecular reaction based on ARRT- comparison between ARRT and CT. Significance of free energy of activation and entropy of activation.

UNIT-IV Electrochemistry – I

4.1 Metallic and electrolytic conductance –Definitions of specific, equivalent and molar conductance – Relations between them – measurement of conductance and cell constant.

4.2 Variation of conductance with dilution – Qualitative explanation – Strong and weak electrolytes-Migrations of ions – transport number – determination by Hittorf and moving boundary methods – Kohlrausch's law – applications – calculation of equivalent conductance for weak electrolytes and

determination of transport number.

4.3 Ionic mobilities and Ionic conductance. Diffusion and ionic mobility- molar ionic conductance and viscosity- Waldenrule.

4.4 Applications of conductance measurements – Degree of dissociation of weak electrolytes – Determination of ionic product of water – Determination of solubility of sparingly soluble salts – conductometric titrations.

UNIT – V Theory of strong electrolytes

5.1 Debye – Huckel – Onsager theory – verification of Onsager equation – Wein and Debye – Falkenhagen effect.

5.2 Activity and activity co-efficients of strong electrolytes – ionic strength. Ostwald's dilution law – determination of dissociation constants – Ionic product of water – pH value.

5.3 Buffer solution – Henderson equations – uses of Buffers including living systems– common ion effect – solubility product principle – relation to solubility– Applications in qualitative and quantitative analysis.

5.4 Hydrolysis of salts – expression for hydrolysis constant – Degree of hydrolysis and pH of salt solutions for different types of salts – Determination of Degree of hydrolysis– conductance and distribution methods.

TEXT BOOKS AND REFERENCES:

1. Puri, Sharma and Pathanaia, Principles of Physical Chemistry
2. Glasstone S, An Introduction to Electrochemistry
3. Kundu and Jain, Physical Chemistry
4. Yadhav M S, Electrochemistry
5. Gurdeep Raj Advanced Physical Chemistry
6. J Rajaram and Kuriacose Kinetics and mechanisms of Chemical Transformation
7. Laidler K J Chemical Kinetics.

B.Sc. CHEMISTRY SEMESTER V
Elective Paper- I
CODE -21UCHE01
ANALYTICAL CHEMISTRY (60 hours)

Internal Assessment Marks:25

External Marks:75

UNIT – I Chromatography

1.1 Column Chromatography- principle, types of adsorbents, preparation of the column, elution, recovery of substances and applications.

1.2 TLC- principle, choice of adsorbent and solvent, preparation of chromatoplates, R_f -values, factors affecting the R_f -values- Significance of R_f -values.

1.3 Paper Chromatography- principle, solvents used, development of chromatogram, ascending, descending and radial paper chromatography.

UNIT – II Thermoanalytical method

2.1 Principle - Thermogravimetric analysis and differential thermal analysis-discussion of various components with block diagram- TGA & DTA curves of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, $\text{MgC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ and $\text{Ca}(\text{OOCCH}_3)_2 \cdot \text{H}_2\text{O}$ -Simultaneous DTA-TGA curves of SrCO_3 in air and $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ in air and in CO_2 - factors affecting TGA & DTA curves.

2.2 Thermometric titrations-principle- apparatus- applications.

UNIT – III Electroanalytical method

3.1 Polarography- Principle, dropping mercury electrode (DME)-advantages and disadvantages- Migration, residual, limiting and diffusion currents- Use of supporting electrolytes-Ilkovic equation (derivation not required) and significance- experimental assembly- Current voltage curve- oxygen wave. Half wave potential ($E_{1/2}$)- Polarography as an analytical tool in quantitative and qualitative analysis.

3.2 Amperometric titrations: Basic principle – types of titrations- advantages, disadvantages – applications.

UNIT-IV UV-Visible & IR spectroscopy

4.1 UV-Visible Spectroscopy-Types of Electronic transition-Beer-Lambert's law Instrumentation- Applications of UV.

4.2 I.R. Spectroscopy-Principles-modes of vibration of diatomic, triatomic linear (CO_2) and nonlinear triatomic molecules(H_2O)-Stretching and bending vibrations-selection rules.Expression for vibrational frequency (derivation not needed)-Instrumentation-Applications.

UNIT-V NMR & Mass spectroscopy

5.1 NMR Spectroscopy- principle of nuclear magnetic resonance, instrumentation-chemical shift-shielding and deshielding-spin-spin coupling and coupling constants- Interpretation of Anisole, Benzaldehyde, Ethyl acetate, Ethylamine and Ethyl Bromide.

5.2 Mass spectroscopy- Basic principles- instrumentation- molecular ion peak, base peak, metastable peak, isotopic peak-Interpretation of Anisole, Benzaldehyde, Ethyl acetate, Ethylamine and Ethyl Bromide.

TEXT BOOKS AND REFERENCES:

1. Gopalan R, Subramaniam P S, Rengarajan K, Elements of Analytical Chemistry
2. Gurdeep R Chatwal, Instrumental methods of Chemical analysis
3. Sharma Y R, Elementary Organic Chemistry
4. Sharma B K, Analytical Chemistry
5. Bassett, Denney, R C Jeffery and J Vogel's Hand book of quantitative Inorganic Analysis
6. Douglas A Skoog and Donald M West Fundamentals of Analytical Chemistry.

B.Sc. CHEMISTRY SEMESTER V
Skill Based Elective Course –III
CODE -21UCHS03
AGRICULTURAL CHEMISTRY (30 hours)

Internal Assessment Marks:25

External Marks:75

UNIT – IFertilizers

1.1 Fertilizers - Primary, Secondary and micronutrients on plant growth and development.

Commercial method of Nitrogenous fertilizers - preparation and uses of urea, ammonium nitrate and ammonium sulphate.

1.2 Phosphate Fertilizers- Preparation and uses of mono and diammonium phosphate, super phosphate and triple superphosphate.

1.3 Potassium Fertilizers – Preparation and uses of potassium nitrate, potassium chloride and potassium sulphate. Complex fertilizers and mixed fertilizers – their manufacture and composition.

UNIT – IManures

2.1 Manures : Organic manures - Bulky organic manures – Farm yard manure – Difference between fertilizers and manures–

2.2 Handling and storage practices- fresh manure, fermentation and liquid treatment – Aerobic and Anaerobic- Enriched organic manures -oil cakes, blood meal and fish manures.

UNIT – III Pesticides And Insectides

3.1 Pesticides : classification of Insecticides, fungicides, herbicides as organic and inorganic –general methods of application and toxicity. Safety measures when usingpesticides.

3.2 Insecticides : Plant products – Nicotine, pyrethrin – Inorganic pesticides – borates. Organic pesticides – D.D.T. and BHC.

UNIT – IV Fungicides And Herbicides

4.1 Fungicide : Sulphur compounds, Copper compounds, Bordeaux mixture.

4.2 Herbicides : Acaricides – Rodenticides. Attractants – Repellants. Preservation of seeds.

UNIT – V Soils

5.1 Soils-Composition of soil- organic and inorganic constituents-Classification- Properties of soils- physical and chemical-Important functions of water in plant growth-Biological system of the soil- Role of soil organisms.

5.2 Soil analysis – pH, Electrical conductivity, Estimation of macronutrients and micronutrients.

References

1. Plant Ecology and Soil Science, R.S. Shukla and P.S.Chandel.
2. Shreve's Chemical Process Industries, G.T. Austin
3. Agricultural Chemistry, B.A.Yagodin.

B.Sc. CHEMISTRY SEMESTER VI
Core Chemistry Major Paper –VIII
CODE -21UCH08
INORGANIC CHEMISTRY (60 hours)

Internal Assessment Marks:25

External Marks :75

UNIT I - Organometallic compounds –I

1.1 Definition- Nomenclature of organometallic compounds - classification-ionic, σ - bonded and Π -bonded organometallic compounds- examples- nature of carbon-metal bond.

1.2 Organometallic compounds of Lithium & Boron- preparation, properties, structure and uses.

1.3 Olefin complexes –Zeise’s salt –synthesis and structure

1.4 Cyclopentadienyl complexes -Ferrocene- preparation, properties, structure and uses.

UNIT II - Organometallic compounds – II

2.1 Metal carbonyls - EAN rule, 18 electron rule. Structure & bonding in 3d transition metal carbonyls; polynuclear carbonyls, bridging & terminal carbonyls.

2.2 Uses of IR absorption spectra for the determination of structure of metallic carbonyls.

2.3 Homogeneous catalysis-Wilkinson’s catalyst and alkene hydrogenation,hydroformylation, Monsanto acetic acid process, Wacker process, Zeigler-Natta catalyst and polymerization of olefins.

UNIT III - Bioinorganic Chemistry

3.1 Essential and trace elements in Biological processes – Role of Na^+ , K^+ , Mg^{2+} & Ca^{2+} ions in biological process-Sodium and Potassium pump.

3.2 Toxic effects of some metals(Cu, Pb, As, Hg, Cd), Fixation of atmospheric nitrogen.

Structure & Biological functions of Haemoglobin, Myoglobin, Chlorophyll and Vitamin B_{12} .

UNIT IV - Some Special compounds

4.1 Silicones – types, preparation, properties & uses.

4.2 Silicates-classification and structure–examples. Composition, properties and uses of asbestos and zeolite.

4.3 Boron nitrides - Borazole- metal borides

4.4 Phosphonitrilic compounds- Phosphazenes, Polysulphur nitrogen compounds

UNIT V - Magnetic properties of molecules:

5.1 Origin - Magnetic susceptibility. Types of magnetic behaviour- diamagnetism and paramagnetism, Temperature and magnetic behaviour, Ferromagnetism and antiferromagnetism- Temperature independent paramagnetism-determination of magnetic moment using Guoy Balance- Applications of magnetic measurements.

5.2 Magnetic properties of transition metal complexes-Spin orbit coupling and its effect - Magnetic behavior of some complexes of metals of 3d transition series

TEXT BOOKS AND REFERENCES:

- 1 Puri and Sharma, Kalia Principles of Inorganic Chemistry.
- 2 Madhan R D, Tuli G D and Wahid U Malik, Selected topic in Inorganic Chemistry
- 3 Sharpe A G, Inorganic Chemistry
- 4 Gurdeep Raj, Advanced Inorganic Chemistry
- 5 Cotton and Wilkinson, Advanced Inorganic Chemistry
- 6 G.R. Chatwal, Ajay Kumar Bhagi, M. Arora, Bio- Inorganic Chemistry.

B.Sc. CHEMISTRY SEMESTER VI
ORGANIC CHEMISTRY (60 hours)
CODE -21UCH09

Internal Assessment Marks:25

External Marks:75

UNIT – I Carbohydrates

1.1 Classification, constitution of glucose and fructose. Reactions of glucose and fructose, Osazone formation, mutarotation and its mechanism. Cyclic structure – Pyranose and furanose forms. Determination of ring size – Haworth projection formula. Configuration of monosaccharides – Epimerisation, interconversions – D.Arabinase to D – glucose and vice versa. D – glucose to D – fructose and vice versa. Epimerisation D – glucose to D – mannose.

1.2 Disaccharides – chemistry and structure of Sucrose and lactose.

1.3 Polysaccharides – starch and cellulose – derivatives – cellulose nitrate, cellulose acetate, Ethyl cellulose.

UNIT – II

Amino acids and proteins

2.1 Amino acids-classification-essential and non essential amino acids-preparation of alpha amino acids- glycine, alanine and tryptophan-General properties of amino acids-Zwitter ions, isoelectric point.

2.2 Peptides and proteins-synthesis of peptide- Bergmann method. Proteins-classification based on physical and chemical properties and on physiological functions-primary and secondary structure of proteins-helical and sheet structures (elementary treatment only) – Denaturation of proteins.

UNIT – III

Organic photochemistry

3.1 Principles of photochemistry. Electronic excitations – excited states – modes of dissipation of energy– Jablonsky diagram. Energy transfer – quantum efficiency.

3.2 Photochemistry of carbonyl compounds. Photo reduction. Norrish type reaction. Photochemical reaction of cyclic ketones. The paterno – Buchi reaction. Barton reaction. Photochemistry of α , β -Unsaturated ketones and olefines.

UNIT – IV

Steroids, Hormones and Vitamins

4.1 Steroids- definition–Cholesteron and Erhosterol (structure only). Steroidal Harmones- Androsterones, Testosterone, Prohestone and Oestrone (Structureonly).

4.2 Vitamin-Classification- deficiency of vitamins- Synthesis of Retinol and Ascorbic acid.

UNIT – V

Heterocyclic compounds

5.1 Aromaticity – preparation, properties and uses of furan, Pyrrole, thiophene and pyridine.

Comparative study of basicity of pyrrole and pyridine with amines.

5.2 Synthesis and reactions of quinoline, isoquinoline and indole with special reference to Skraup's, Bischler and Napieralski and Fischer Indole synthesis.

TEXT BOOKS AND REFERENCES:

1. Bhal BS and Arun Bhal, A text book of Organic Chemistry
2. Finar I L, Organic Chemistry Vol-I &II
3. Agarwal O P, Reactions and Reagents
4. K. K. Rohatgi-Mukherjee, Fundamentals of Photochemistry
5. P L Soni and H M Chawla Text book of Organic Chemistry
6. O P Agarwal Organic Chemistry
7. R. Gurdeep Chatwal Organic Chemistry of Natural Products.

B.Sc. CHEMISTRY SEMESTER VI
CODE -21UCH10
PHYSICAL CHEMISTRY (60 hours)

Internal Assessment Marks:25

External Marks:75

Unit-I Solutions

1.1 Solutions of gases in liquids – Henry’s law- solutions of liquids in liquids-Raoult’s law Binary liquid mixture- ideal solution- deviation from ideal behaviour-Thermodynamics of ideal solutions- V-P- temperature curves, Azeotropic distillation.

1.2 Nernst Distribution law-Thermodynamic derivations- applications, Solvent extraction.

1.3 Thermodynamic derivation of elevation of boiling point and depression of freezing point vantHoff factor- Abnormal molecular mass-Degree of dissociation and association.

UNIT – II Phase Rule

2.1 Definition of terms-Derivation of phase rule -One component systems-H₂O system, Sulphur system– explanation using Clausius - Clapeyron equation-supercooling and sublimation.

2.2 Two component systems-solid liquid equilibria-reduced phase rule – simple eutectic systems-Ag-Pb only-Compound formation with congruent melting point-Mg-Zn system only. KI-H₂O system efflorescence-deliquescence.

2.3 C.S.T-phenol water system only. Effect of impurities on CST.

UNIT – III Electro chemistry – II

3.1 Galvanic cells – Reversible and Irreversible cells – EMF and its measurement – Weston Standardcell– types of reversible single electrodes – standard Hydrogen electrode – calomel electrode

3.2 Derivation of Nernst equation both for emf of cells and single electrode potentials – Nernst theory for single electrode potential – standard reduction potentials – electro chemical series – significance.

3.3 Application of emf measurements – Application of Gibbs – Helmholtz equation to galvanic cells – calculation of thermodynamic quantities – pH using hydrogen, quinhydrone and glass electrodes – potentiometric titrations.

UNIT – IV Cells and Batteries

4.1 Concentration cells with and without transference – LJP expression – applications of concentration cells– valency of ions – transport number – solubility product – activity coefficient.

4.2 Storage cells – Lead storage battery – mechanism of charging and discharging fuel cells – hydrogen - oxygen cell – polarization – over voltage- decomposition voltage.

UNIT – V Photochemistry

5.1 Consequences of light absorption-The Jablonski diagram- non radiative transitions-radiative transitions-Grotthus-Draper law- The Stark Einstein law of photochemical equivalence-Quantum efficiency (quantum

yield).

5.2 Energy transfer in photochemical reactions- photosensitisation-Photosynthesis in plants
Chemiluminescence - fluorescence and phosphorescence-lasers- uses of lasers.

5.3 Photochemical reactions-Kinetics of hydrogen-bromine reaction-decomposition of HI

TEXT BOOKS AND REFERENCES:

1. Glasstone.S, Text Book of Physical Chemistry, MacMillan.
2. Maron and Lando, Fundamentals of Physical Chemistry, Collier, MacMillan.
3. Gurudeep R. Chatwal, Physical Chemistry.
4. Puri, Sharma and Pathanaia, Principles of Physical Chemistry
5. Atkins Physical Chemistry
6. Samuel Glasstone An Introduction to Electro Chemistry

B.Sc. CHEMISTRY SEMESTER VI
ELECTIVE PAPER-II
CODE-21UCHE02
NANO AND GREEN CHEMISTRY (60 hours)

Internal Assessment Marks:25

External Marks :75

UNIT I Introduction To Nanoscience And Nanotechnology

1.1 Introduction to nanoscale materials – Nano scale, atomic & molecular size. Bonding in solids - Ionic bond - Covalent bond - Metallic bond – Intermolecular Bonds - Dispersion bonds - dipole bonds - hydrogen bonds.

1.2 A historical perspective of nanoparticles - Classification of nanostructures - zero, one, two and three dimensional nanostructures. Size dependency in nanostructures.

1.3 Definition and description of nanomaterials such as carbon nanomaterials, Inorganic nanoparticle, nanocrystal, quantum dots, nano composites, nano hybrid nanomaterials.

UNIT II Nanomaterial Synthesis And Characterisation Techniques

2.1 Process of nanomaterial synthesis: top down and bottom up approach.

2.2 Method of nanomaterials preparation : Nucleation and growth of nanosystems; self- assembly, mechanical milling, sputtering, microwave plasma, hydrothermal, micelles, sol- gel processes, Chemical vapour deposition and Microwave.

2.3 Principle and applications of UV-VIS-NIR Spectroscopy, Scanning electron microscopy, Atomic force microscopy, X –ray diffraction and Cyclic voltammeter.

UNIT III Properties And Applications Of Nanostructures

3.1 New properties of nanomaterials: Role of Physical and chemical properties,

3.2 Discussion on properties and applications of nanomaterials: Surface, mechanical optical electrical electronic and chemical properties.

3.3 A short discussion on commercial utilization of nanomaterials in drug delivery and medications, cosmetics, electronics, energy harvesting, and environment remediation

3.4 Toxicity of nanomaterials

UNIT IV Principles Of Green Chemistry

4.1 Green Chemistry- Definition, need of green chemistry, Twelve basic principles of green chemistry, selection of starting materials, reagents, catalysts and solvents.

4.2 Synthesis involving basic principles of green chemistry – synthesis of methyl methacrylate and paracetamol. Water as green solvent- reactions in ionic-liquid.

UNIT V Designing A Green Chemical Synthesis

5.1 Planning a green synthesis in a chemical laboratory- Solvent-less reactions- Solid support organic synthesis, Phase transfer catalyst (PTC).

5.2 Microwave activation and heating - Use of microwaves in chemical reactions- microwave assisted reactions in water – oxidation of toluene to benzoic acid, microwave assisted reactions in organic solvent – Diels alder reaction,

5.3 Ultrasound assisted reactions: Esterification, saponification, substitution reactions, Cannizaroreaction.

Reference:

1. Charles P. Poole, Jr., Frank J. Owens, Introduction to Nanotechnology, Wiley Interscience, 2003.
2. T. Pradeep, —Nanothe Essential Nanoscience and Nanotechnology, Tata McGraw Hill, 2007
3. V. Rajendran, Material Science, Tata McGraw Hill, New Delhi, 2011.
4. Rashmi Sanghi, M. M. Srivastava, Green Chemistry, Environment friendly Alternatives, Narosa Publishing house, 2007
5. V. Kumar, An introduction to Green Chemistry, Vishal Publishing co. Jalandhar, 2007

B.Sc. CHEMISTRY- SIXTH SEMESTER
Skill Based Elective Course -V
Paper Code: 21UCHS05

PHARMACEUTICAL CHEMISTRY (30Hours)

Internal assessment Marks:25

External Marks :75

UNIT-I

1.1 Definition of the terms-drug, pharmacophore, pharmacodynamics, pharmacopoea, pharmacology, bacteria, virus, fungus, actinomycetes, metabolites, antimetabolites, LD₅₀, ED₅₀. Therapeutic index and its significance.

UNIT-II

2.1 Sulphonamides-mechanism and action of sulpha drugs- preparation and uses of sulphadiazine, sulphapyridine.

2.2 Antibiotics-Definition-classification as broad and narrow spectrum, Antibiotics-penicillin, ampicillin, structure, mode of action only (no structural elucidation) and uses.

UNIT-III

3.1 Analgesics-definition and actions-narcotic and non narcotic-morphine, Heroin.

3.2 Antipyretic analgesics-salicylic acid derivatives-methyl salicylate, aspirin. Anti-inflammatory agents.

UNIT –IV

4.1 Anaesthetics-definition-classification-local and general- volatile, nitrous oxide, ether, chloroform, uses and disadvantages – nonvolatile – intravenous - thiopental sodium, -local anaesthetics – cocaine and benzocaine.

4.2 Antianaemic drugs-iron, vitamin B₁₂ and folic acid-mode of action.

UNIT-V

5.1 Diabetics-Hypoglycemic agents-sulphonyl urea, biguanides.

5.2 AIDS-causes, prevention and control.

5.3 Cardio Vascular Drugs – Cardiac glycosides- Antiarrhythmic Drugs-preparation, dosage and therapeutic uses.

5.4 Indian medicinal plants and uses-tulasi, kilanelli, mango, semparuthi, adadodai and thoothuvalai.

Reference Books

1. A text book of pharmaceutical chemistry, Jayashree Ghosh
2. Pharmaceutical Chemistry, S.Lakshmi
3. Organic Pharmaceutical Chemistry, Harkishan Singh and V.K.Kapoor.

B.Sc. CHEMISTRY- SIXTH SEMESTER
Elective Paper –III Industrial Chemistry
Paper Code: 21UCHE03
INDUSTRIAL CHEMISTRY (60 hours)

Internal assessment Marks:25

External Marks:75

UNIT-1: Industrial fuels

- 1.1** Classification of fuels: solid, liquid and gas. Calorific value of fuels and its determination.
- 1.2** Solid fuels – Coal- types – properties and uses – lignite, sub-bituminous coal, bituminous coal and anthracite. Coking and non-coking coal.
- 1.3** Liquid fuels: Refining of crude petroleum and uses of fractions. Hydrodesulphurisation. Cracking: thermal and catalytic (fixed bed and fluidised bed catalysis).
- 1.4** Gaseous fuels Natural gas and gobar gas: production, composition and uses, Gobar electric cell.

UNIT-2: Water treatment

- 2.1** Introduction Sources of water. Hardness of water-temporary or carbonate hardness, permanent hardness or non-carbonate hardness. Disadvantages of hard water in domestic, industry and steam generation (boilers). Estimation of hardness – EDTA method, Estimation of total hardness.
- 2.2** Water softening methods Industrial purpose, Lime – soda process, Zeolite process, Ion-exchange, Demineralisation - deionisation process. Removal of suspended impurities.
- 2.3** Removal of microorganism – Chlorination, Reverse osmosis, Desalination.

UNIT-3: Industries:

- 3.1** Sugar Industry: Manufacture of sugar from molasses and beetroot – sugar industries in India. Fermentation: Manufacture of spirits and wines. Distillation: Manufacture of vinegar and ethyl alcohol.
- 3.2** Match industries: Manufacture – chemistry of lighting and pyrotechnics.
- 3.3** Explosives: Definition – Classification – Characteristics of explosives – Nitro cellulose, T.N.T. Picric acid, Gun Powder, Cordite and Dynamite.

UNIT-4: Energy resources

- 4.1** Renewable and non renewable sources of energy, conventional and non conventional sources of energy, solar energy, solar technology, solar photovoltaic cell – application.
- 4.2** Wind energy: Nature of the wind – power in the wind – factors influencing wind, applications. Wind energy potential in India.

UNIT-5 Industrial Wastes treatment:

- 5.1** Industrial Wastes and Treatment Processes, characteristics of industrial wastes, types of industrial wastes, solid industrial wastes, principles of industrial waste treatment, waste reduction process.
- 5.2** Treatment and disposal of industrial wastes-mention of the general methods adopted for the treatment of industrial wastes, sanitary chemical analysis of industrial effluents and sewage.

References

1. B.K.Sharma, Krishnaprakasam (2014), Industrial Chemistry Including Chemical Engineering, Media, Meerut
2. B.K.Sharma—Industrial Chemistry, 1st Ed., (1983), Goel Publication, Meerut.
3. B.N.Charabarthi – -Industrial Chemistry, 1st Ed., Oxford and IBh Publishing, New Delhi.
4. D. A. Spera, Wind Turbine Technology: Fundamental concepts of Wind Turbine Engineering, ASME Press.
5. Norris shreve, r. And joseph a. Brink, jr. Chemical process industries, 4th ed.; Mc graw – hill Kogakusha, ltd:1977.

Note: Industrial Visit for two days is recommended under the guidance of teachers

B.SC CHEMISTRY BRANCH – IV

CORE PRACTICAL – I
VOLUMETRIC ESTIMATIONS AND ORGANIC PREPARATIONS
CODE -21UCHP01

Internal Assessment Marks:40

External Marks :60

I. 1. ACIDIMETRY-ALKALIMETRY

- a) Estimation of Sodium Hydroxide – Standard Sodium Carbonate
- b) Estimation of oxalic acid – Standard Oxalic acid

2. Permanganometry:

- a) Estimation of ferrous iron. Standard Oxalic acid
- b) Estimation of Oxalic acid. Standard Oxalic acid

3. Dichrometry:

Estimation of ferrous iron using diphenylamine internal indicator. Standard FeSO_4

4. Iodometry and iodimetry

- a) Estimation of potassium dichromate standard $\text{K}_2\text{Cr}_2\text{O}_7$
- b) Estimation of Copper standard $\text{K}_2\text{Cr}_2\text{O}_7$

5. Complexometric Titrations

- a) Estimation of Zn / Mg using EDTA
- b) Estimation of hardness of water

II. ORGANIC PREPARATIONS.

1. Preparations involving the following:
 - a) Oxidation of benzaldehyde.
 - b) Hydrolysis of Methyl salicylate or ethylbenzoate.
 - c) Nitration – p – nitroacetanilide and m – dinitrobenzene
 - d) Bromination- p – bromoacetanilide and tribromophenol
 - e) Benzoylation – naphthylbenzoate

TEXT BOOKS AND REFERENCE BOOKS:

1. V. Venkateswaran, R. Veerasamy and A. R. Kulandaivelu, Basic Principles of Practical Chemistry, Sultan Chand & Sons, ISBN: 9788180547768, 8180547760, Edition: 2012
2. A. O. Thomas, Practical Chemistry
3. Raj K Bansal, Laboratory Manual Of Organic Chemistry

BRANCH – IV

CORE PRACTICAL – I

VOLUMETRIC ESTIMATIONS AND ORGANIC PREPARATIONS

Time :3 hours

MaximumMarks :60

VolumetricEstimations:35

Organic Preparation :15

Record 10

1. Estimate Volumetrically the amount of _____ present in the whole of the given solution. You are provided with _____ and a suitable link solution. Get the titre values attested by the examiners.
2. Prepare maximum quantity of _____ from the given sample. Submit the dried sample for evaluation.

BRANCH – IV

CORE PRACTICAL – II

CODE -21UCHP02

INORGANIC QUALITATIVE ANALYSIS AND INORGANIC PREPARATIONS

Internal Assessment Marks:40

External Marks :60

I. INORGANIC QUALITATIVE ANALYSIS

1. Analysis of a mixture containing two cations and two anions of which one will be an interfering ion. Semimicro methods using the conventional scheme with hydrogen sulphide may be adopted.
2. Anions to be studied : Carbonate, sulphate, nitrate, fluoride, chloride, bromide, borate, oxalate, phosphate. Cations to be studied : lead, bismuth, copper, cadmium, iron, manganese, aluminium, cobalt, nickel, zinc barium, strontium, calcium, magnesium and ammonium.

II. INORGANIC PREPARATIONS:

- a) Ferrous ammonium sulphate
- b) Tetraammine copper (II) Sulphate
- c) Microcosmic salt
- d) Bis (acetyl acetonato) Nickel (II) or Copper(II)
- e) Tris (Thiourea) copper (II) sulphate dihydrate
- f) Potassium tri (oxalato) ferrate –III

TEXT BOOKS AND REFERENCE BOOKS

1. V. Venkateswaran, R. Veerasamy and A. R. Kulandaivelu, Basic Principles of Practical Chemistry, Sultan Chand & Sons, ISBN: 9788180547768, 8180547760, Edition: 2012
2. A. O. Thomas, Practical Chemistry
3. V.V. Ramanujam, Inorganic Semimicro Qualitative Analysis

BRANCH – IV
CORE PRACTICAL – II

INORGANIC QUALITATIVE ANALYSIS AND INORGANIC PREPARATIONS

Maximum Marks:60

Qualitative Analysis :35

Inorganic Preparations :15

Record :10

1. Analyse systematically the given Inorganic mixture containing two acid radicals and two basic radicals, one acid radical being interfering one, Record your observations and inferences then and there Exhibit confirmative tests for each radical for evaluation.
2. Prepare maximum quantity of _____ from the given simple salts. Submit the dried sample for evaluation.

BRANCH – IV
CORE PRACTICAL – III
CODE -21UCHP03

PHYSICAL CHEMISTRY PRACTICALS

Internal Assessment Marks:40

External Marks :60

- 1. Kinetics**
 - a) Determination of rate constant – Acid catalysed hydrolysis of an ester (methyl acetate or ethyl acetate)
- 2. Molecular weight determination – Rast method**
- 3. Heterogeneous Equilibrium**
 - a) Effect of impurity on CST of phenol – water system and determination of concentration of Sodium Chloride
 - b) Determination of transition temperature of hydrated salts :sodium thiosulfate, Sodium acetate, Strontium Chloride.
- 4. Phase rule : Simple Eutectic system – Naphthalene –Biphenyl**
- 5. Electrochemistry:**
Conductivity Experiment
 - i) Determination of cell constant
 - ii) Equivalent conductance of strong electrolyte
 - iii) Conductometric titration- acid base titration
- 6. Potentiometry – Potentiometric titration – acid - base titration**

TEXT BOOKS AND REFERENCE BOOKS

1. V. Venkateswaran, R. Veerasamy and A. R. Kulandaivelu, Basic Principles of Practical Chemistry, Sultan Chand & Sons, ISBN: 9788180547768, 8180547760, Edition: 2012
2. J.P. Yadav, Advanced Practical Physical Chemistry.
3. S. Oolvi, Practical Physical Chemistry.

BRANCH – IV
CORE PRACTICAL – III
PHYSICAL CHEMISTRY PRACTICALS

Maximum Marks : 60

Choose any one of the questions given below by lot

1. Determine the rate constant of the acid catalyzed hydrolysis of the given ester at room temperature.
2. Determine the molecular weight of the given solute. You are provided with a suitable solvent, whose K_f value is _____
3. Determine the transition temperature of the hydrated salt by thermometric method.
4. Find out the concentration of the given sodium chloride solution. You are provided with pure phenol and 1 % solution of Sodium Chloride.
5. Determine the molar depression constant K_f of the given solvent. You are provided with a solute of known molecular weight.
6. Determine the strength of the given Hydrochloric acid solution conductometrically using a standard Sodium Hydroxide solution.
7. Find out the cell constant of the given conductivity cell using 0.1 N and 0.01 N potassium chloride solutions, whose specific conductivities are given. Determine the equivalent conductance of the two solutions of known concentration.

TEXT BOOKS AND REFERENCE BOOKS

1. V. Venkateswaran, R. Veerasamy and A. R. Kulandaivelu, Basic Principles of Practical Chemistry, Sultan Chand & Sons, ISBN: 9788180547768, 8180547760, Edition: 2012
2. J.P. Yadav, Advanced Practical Physical Chemistry.
3. S. Oolvi, Practical Physical Chemistry.

BRANCH – IV
CORE PRACTICAL – IV
CODE -21UCHP04

GRAVIMETRIC ESTIMATIONS AND ORGANIC PRACTICALS

Internal Assessment Marks:40

External Marks : 60

I. GRAVIMETRIC ESTIMATIONS

1. Estimations of Barium as Barium sulphate
2. Estimation of Barium as Barium chromate
3. Estimation of Lead as Lead chromate
4. Estimation of Calcium as Calcium oxalate monohydrate
5. Estimation of Sulphate as Barium sulphate
6. Estimation of Nickel as Nickel DMG

II. ORGANIC QUALITATIVE ANALYSIS

Analysis of organic compounds. Characterisation of organic compounds by their functional groups and confirmation by preparation of derivative. The following functional groups may be studied.

Aldehydes, Ketones, Carboxylic acids, Aromatic primary amines, Phenol, Aromatic ester, Amide, Diamide, Anilide, Nitro compounds and monosaccharids.

TEXT BOOKS AND REFERENCE BOOKS

1. V. Venkateswaran, R. Veerasamy and A. R. Kulandaivelu, Basic Principles of Practical Chemistry, Sultan Chand & Sons, ISBN: 9788180547768, 8180547760, Edition: 2012
2. Dr. N. S. Gnanapragasam, Organic Chemistry, Laboratory Manual
3. Raj K Bansal, Laboratory Manual of Organic Chemistry.

BRANCH – IV
CORE PRACTICAL – IV
GRAVIMETRIC ESTIMATIONS AND ORGANIC PRACTICALS

Time :6 Hour

Maximum Marks :60

Gravimetry:20 marks

Organic practicals :30 marks

Record : 10

1. Estimate Gravimetrically the amount of _____ present in the whole of the given _____ solution by converting it into _____.

Get the weighings attested by the Examiners.

2. Analyse the given organic compound and report on the following

- a) Whether Aliphatic or Aromatic
- b) Saturated or Unsaturated
- c) Special elements present (or) absent
- d) Functional group present Submit a colour reaction or derivative in support of functional group present

ALLIED CHEMISTRY
Paper Code : 21UCHA01
FIRST/ THIRD SEMESTER PAPER-I
INORGANIC, ORGANIC AND PHYSICAL CHEMISTRY-I (60 HOURS)

Internal Assessment Marks:25

External Marks-75

UNIT-I Chemical Bonding

- 1.1** Types of Bonding- Ionic Bond, covalent Bond and coordinate bond Molecular Orbital Theory-bonding, antibonding and nonbonding orbitals. M.O. diagrams of Hydrogen, Helium, Nitrogen, discussion of bond order and magnetic properties.
- 1.2.** Hydrides-classification and characteristics - preparation, properties and uses of Borazole, NaBH_4 and LiAlH_4 .

UNIT-II Nuclear Chemistry

- 2.1** Natural radioactivity-radioactive series including Neptunium series-Group displacement law.
- 2.2** Nuclear Binding energy, mass defect-Calculations.
- 2.3** Nuclear Fission and Nuclear Fusion-differences – Stellar energy.
- 2.4** Nuclear reactors, Applications of radioisotopes-C-14 dating, rock dating.

UNIT-III Basic Concepts of Organic Chemistry

- 3.1** Covalent Bond-Orbital Overlap-Hybridisation – Geometry of Organic molecules-Methane,
- 3.2** Ethylene and Acetylene Electron displacement Effects: Inductive, Resonance, Hyper conjugative & steric effects. Their effect on the properties of compounds.
- 3.3** Stereoisomerism: Symmetry-elements of symmetry- cause of optical activity, Tartaric acid. Racemisation. Resolution. Geometrical isomerism of Maleic and Fumaric acids.

UNIT-IV Aromatic compounds

- 4.1** Aromatic compounds-Aromaticity-Huckel's rule
- 4.2** Electrophilic substitution in Benzene-Mechanism of Nitration, Halogenation-Alkylation, Acylation.
- 4.3** Isolation, preparation, properties and structure of Naphthalene Haworth's synthesis.
- 4.4** Heterocyclic compounds:- Preparation, properties and uses of Furan, Thiophene, Pyrrole.

UNIT-V

Polymer Chemistry

- 5.1** Basic concepts: Monomer, polymerization, degree of polymerization, repeat units. Classification of Polymers-addition and condensation polymers, natural and synthetic, based on structure, inorganic and organic, thermoplastic and thermosetting resin.
- 5.2.** Preparation, properties and uses of Poly olefins-polythene, PTFE, Freons, PVC,

polypropylene and polystyrene.

5.3 Natural and synthetic rubbers-Constitution of natural rubber, Buna-N ,Buna -S, Neoprene, Polyurethane and silicone rubbers

. Reference books :

1. Soni.P.L, Text Book of Inorganic Chemistry,Sultan Chand&Sons.
2. Bhal.B.S. and Arun Bhal ,A Text Book of OrganicChemistry
3. PuriB.R , L.R. Sharma and Pathania,PhysicalChemistry
4. V.R Gowrikar,N.V.Viswanathan :PolymerScience

ALLIED CHEMISTRY
Paper Code : 21UCHA02
SECOND/ FOURTH SEMESTER PAPER –II
INORGANIC, ORGANIC AND PHYSICAL CHEMISTRY-II (60HOURS)

Internal Assessment Marks:25

External Marks-75

UNIT-I

Co-ordination chemistry

1.1 Definition of terms- classification of ligands-Nomenclature-Chelation- Examples. Chelate effect- explanation.Werner's theory-conductivity and precipitation studies. Sidgwick's theory-Effective Atomic Number concept.

1.2 Pauling's theory-postulates-Application to octahedral, square planar and tetrahedral complexes. Pauling's theory and magnetic properties of complexes. Merits and demerits of Pauling's theory

1.3 Biological role of Haemoglobin and Chlorophyll (Elementary idea of structure and functions).

UNIT-II

Carbohydrates & Aminoacids

2.1 Carbohydrates: Classification, preparation and properties of Glucose and Fructose- Properties of Starch, Cellulose and derivatives of Cellulose. Inter conversion of Glucose to Fructose and vice versa.

2.2 Amino Acids-classification, preparation and properties of Glycine and Alanine.

UNIT-III

Pharmaceutical chemistry

3.1 Chemotherapy: Preparation, uses and mode of action of sulpha drugs-prontosil, sulphadiazine and sulphafurazole. Uses of penicillin, chloramphenicol and streptomycin, Definition and one example each for-analgesics, antipyretics, tranquilizers, sedatives, hypnotics, local anaesthetics and general anaesthetics . Cause and treatment of diabetes, cancer andAIDS.

UNIT-IV

4.1 Photochemistry: Grotthus-Draper law and Stark-Einstien's law of photochemical equivalence. Quantum yield. Example for photochemical reactions- Hydrogen-Chlorine reaction (elementary idea only) Photosynthesis. Phosphorescence and Fluorescence.

4.2 Phase Rule: Phase rule and the definition of terms in it. Application of phase rule to water system. Reduced phase rule and its application to a simple eutetic system (Pb-Ag) Freezing mixtures.

UNIT-V

5.1 Electro Chemistry- Kohlrausch law -measurement of conductance, pH determination. Conductometric titrations. Galvanic cells-EMF-standard electrode potentials, reference electrodes.

5.2 Corrosion: Methods of prevention.

Reference books :

1. Soni.P.L, Text Book of Inorganic Chemistry, Sultan Chand & Sons.
2. Puri and Sharma, Text book of Inorganic Chemistry-Vishalpublishing
3. Soni.P.L. Text Book of Organic Chemistry, Sultan Chand andSons.
4. Jain.M.K, Principles of Organic Chemistry-Vishal publishing Co.
5. Kundu and Jain, Physical Chemistry, S. Chand.
6. Puri, Sharma and Pathania, Text-book of Physical Chemistry, Vishal Publishingco

**ALLIED CHEMISTRY PRACTICAL
SECOND/ FOURTH SEMESTER PAPER
VOLUMETRY and ORGANIC ANALYSIS
CODE -21UCHAP01**

Internal Assessment Marks:40

External Marks:60

I. TITRIMETRY

- a) Estimation of Sodium hydroxide - Standard sodium carbonate.
- b) Estimation of Hydrochloric acid-Standard Oxalic acid.
- c) Estimation of Ferrous sulphate –Standard Mohr’s Salt.
- d) Estimation of Oxalic Acid – Standard Ferrous Sulphate.
- e) Estimation of Ferrous iron using diphenylamine as internal indicator.

II. Organic Analysis:

- a) Detection of elements- nitrogen, sulphur and halogens.
- b) Detection of aliphatic or aromatic.
- c) Detection of whether saturated or unsaturated compounds.
Preliminary tests and detection of functional groups, phenols, aromatic amines, aromatic acids, Urea , benzamide & carbohydrate.

TEXT BOOKS AND REFERENCE BOOKS

1. V. Venkateswaran, R. Veerasamy and A. R. Kulandaivelu, Basic Principles of Practical Chemistry, Sultan Chand & Sons, ISBN: 9788180547768, 8180547760, Edition: 2012
2. A O. Thomas, Practical Chemistry
3. Raj K Bansal, Laboratory Manual Of Organic Chemistry

**DEPARTMENT OF CHEMISTRY
NON MAJOR ELECTIVE COURSES
(THIRD and FOURTH SEMESTERS)**

1.	TextileChemistry	-21UCHN02
2.	IndustrialChemistry	-21UCHN03
3.	BiologicalChemistry	-21UCHN04
4.	MedicinalChemistry	-21UCHN05
5.	FoodChemistry	-21UCHN06
6.	Agro Chemistry	-21UCHN07
7.	Polymer&Plastics	-21UCHN08

NOTE:

Any two papers from the above eight papers may be chosen for all B.A/B.Sc.students except B.Sc.Chemistry major students for NMEC in semester III and IV and the same must be communicated to the University for Examinationpurpose.

DEPARTMENT OF CHEMISTRY
NON MAJOR ELECTIVE COURSE II
PAPER CODE -21UCHN02
TEXTILE CHEMISTRY (30 Hours)

Internal Assessment Marks:25 External Marks:75

Unit 1. Fibre Science

Definition of textile fibres; Essential and desirable properties of textile fibres; Textile fibre classifications. Natural fibres: Cotton, Wool, Silk, Flax (Linen), Jute; Physical & chemical properties, fine structure, Chemical structure and applications. Brief idea of Regenerated cellulosic fibres: Viscose, Lyocell, Cuprammonium rayon. Introduction to Manmade fibres: Raw materials, manufacturing process, physical and chemical properties and applications of polyester, polyamides, Acrylic & Polyolefins.

Unit 2. Chemical preparatory process:

Fabric preparatory processes: Grey inspection, Shearing, Cropping, Singeing & its types, Introduction to desizing, technology of acid and enzymatic desizing methods.

Chemistry and technology of hypochlorite, peroxide and chlorite bleaching, Wool scouring, bleaching; silk degumming and bleaching. Introduction to Mercerisation, its chemistry and technology;

Textile auxiliaries for scouring and bleaching.

Unit 3. Dyes & Coloration of textiles

Introduction to dyeing: Theory of Colour, chromophore, auxochrome, chromogen. Primary and Secondary colour.

Classification of dyes based on method of application, Properties & Application of different dyes on textiles like Direct, Reactive, Vat, Azoic, Sulphur, Acid, Basic dyes, disperse dyes.

Printing Basics: Introduction to printing; Different methods & styles of Printing; Printing paste ingredients & types of thickeners; Concepts of Ageing, Steaming & Curing. Dyeing and printing auxiliaries.

Unit 4. Finishing of Textiles

Introduction to Finishing: Importance of textile finishing, classification of finishing, Concept about different type of softeners-anionic, cationic, non-ionic, amphoteric, reactive softeners, silicone softeners.

Functional finishes: Its properties and agents in water repellent and water proof finishes, anti-creasing agents, Soil release finish, Antistatic finish, UV protection finish, antimicrobial finish, flame retardants, anti-odour finish.

Concept of enzymatic finishing in cotton (Bio polishing).

Unit 5. Technical Textiles and Textile Effluent:

Basic introduction about technical textiles. Fibres that are used for technical textiles. Production of high performance fibres like Kevlar and aramid. Different types of Technical textiles; Filtration, Automotive, Home, Packaging & Medical.

Textile Effluent: Characteristics and determination of BOD, COD, TDS, pH and Toxicity
Modern Textile Effluent Treatment process -Primary, Secondary, Tertiary & Membrane technology. Concept of Zero Discharge and its importance.

References:

Indian Author

1. Shenai, V.A., 1983. Chemistry of dyes and principles of dyeing.
2. Prayag RS. Textile finishing. 1994.
3. Shenai VA. Toxicity of dyes and intermediates. 1995;
4. Mishra SP. A text book of fibre science and technology. New Age International; 2000
5. R.S. Bhagwat, Handbook of Textile Processing Machinery, Color Publication, 1999
6. Textile Effluents by Padma Varkar, NCUTE Publications, IIT, Delhi.
7. Environmental Chemistry and pollution Control, S.S. Dhara, S. Chand & Co., Delhi.
8. N. Manivasakam, Treatment of Textile Processing Effluents, Sakhi Publications, 1995.

Foreign Author

1. Horrocks AR, Anand SC, editors. Handbook of Technical Textiles: Technical Textile Processes. Woodhead Publishing; 2015 Dec 1.
2. Sadov, F.I., Korchagin, M.V. and Matetskii, A.I., 1978. Chemical technology of fibrous materials. MIR Publishers, Moscow.
3. Trotman ER. Dyeing and chemical technology of textile fibres. Wiley; 1984.
4. J. Shore, Cellulosics dyeing, First ed., Society of Dyers and Colourists, West Yorkshire, 1995
5. Peters RH. 1975 Textile Chemistry: Vol. III. The physical chemistry of dyeing. Elsevier, New York
6. Gohl, Erhard Paul Gottlieb, and Leo David Vilensky. Textile science. 1983.
7. Renfrew AH. Reactive dyes for textile fibres. Society of Dyers and Colourists. 1999
8. Schindler WD, Hauser PJ. Chemical finishing of textiles. Elsevier; 2004 Aug 10.

Website:

<https://www.cottoninc.com/>

DEPARTMENT OF CHEMISTRY
NON MAJOR ELECTIVE COURSE- III
INDUSTRIAL CHEMISTRY
CODE -21UCHN03

Internal Assessment Marks:25

External Marks:75

UNIT I Fuels

Definition, calorific value, requirement of a good fuel, types of fuel, coal gas, producer gas, water gas– composition, preparation, uses; LPG, Gobar gas – production, composition, calorific value.

UNIT II Soaps and detergents

Definition, classification of soaps, manufacture of soaps – kettle process, hydrolyser process; cleansing action of soap, synthetic detergents, classification- anionic, cationic and non-ionic; additives used in detergents, differences between hard and soft detergents, differences between soaps and detergents.

UNIT III Chemistry of sugar and fermentation

Manufacture of sucrose from cane sugar-extraction of juice, purification, concentration, crystallization, separation and refining of crystals, recovery of sucrose from molasses, estimation of sucrose and inversion sugar by polarimetry. Manufacture of alcohol from molasses and starch by fermentation process.

UNIT-IV Glass & Cement Industry

Glass- Types of glass, composition, manufacture and uses.

Cement- Manufacture wet and dry processes, composition of portland cement, setting of cement, Concrete and RCC.

UNIT V Leather & Paper Industry

Leather industry - Curing, preservation and tanning of hides and skins, process of dehairing and dyeing. Treatment of tannery effluents.

Paper industry - Manufacture of paper production of sulphite pulp and conversion to paper (bleaching, filling, sizing and calendaring).

References

1. B.K.Sharma, Krishnaprakasam (2014), Industrial Chemistry Including Chemical Engineering, Media, Meerut
2. B.K.Sharma—Industrial Chemistry, 1st Ed., (1983), Goel Publication, Meerut.
3. B.N.Charabarthi – Industrial Chemistry, 1st Ed., Oxford and IBh Publishing. New Delhi.

DEPARTMENT OF CHEMISTRY
NON MAJOR ELECTIVE COURSE IV
PAPER CODE -21UCHN04
BIOLOGICAL CHEMISTRY (30 HOURS)

Internal Assessment Marks:25

External Marks :75

UNIT I Amino acids and Nucleic acids

Amino acids- classification, essential and nonessential aminoacids and functions. Nucleic acids-DNA,RNA-constituents, structure and functions.

UNIT II Carbohydrates and lipids

Carbohydrates-classification and functions.

Lipids-classification, biological functions and difference between fats and oils.

UNIT III Vitamins

Classification, sources, biological function and deficiency diseases of Vitamins A,C,K,E₁ and B₆.

UNIT IV Minerals

Sources, biological functions and deficiency disease of macro minerals-Sodium, Potassium, Calcium, Phosphorous and Magnesium. Micro minerals: Selenium, copper, Iron, Zinc and Manganese.

UNIT V Enzymes and Hormones

Enzymes : Classification and functions.

Hormones: Classification and biochemical functions of Adrenalin, Thyroxine, Oxytocin, Insulin and Sex hormones.

Reference :

1. S.Jayashree Ghosh, Fundamental concepts of applied chemistry. S.Chand & company 1st Edition 2006.
2. U.Satyanarayana and U.Chakrapani Biochemistry Elsevier India Pvt.Ltd. 4th Edition.
3. P.Palanivelu, Laboratory manual for analytical biochemistry and separation techniques, School of Biotechnology, Madurai Kamaraj University Press, Madurai.
4. Gurdeep Chatwaal,Natural products, Goel Publishing House,NewDelhi.

DEPARTMENT OF CHEMISTRY
NON MAJOR ELECTIVE COURSE-V
MEDICINAL CHEMISTRY (30Hours)
PAPER CODE -21UCHN05

Internal Assessment Marks:25 External Marks:75

UNIT I- Introduction

Common diseases – infective diseases – insect – borne, air – borne and water-borne – hereditary diseases – Terminology – drug, pharmacology, antimetabolites, absorption of drugs – factors affecting absorption –therapeutic index (Basic concepts only)

UNIT II- Drugs

Various sources of drugs, pharmacologically active constituents in plants, Indian medicinal plants – tulsi, neem, keezhanelli – their importance – Classification of drugs– biological chemical

(Structure not required) Drug receptors and biological responses– factors affecting metabolism of drugs. (Basic concepts only)

UNIT III- Chemotherapy

Chemotherapy Drugs based on physiological action, definition and two examples each of anesthetics-General and local – analgesics – narcotic and synthetic – Antipyretics and anti inflammatory agents – antibiotics – Penicillin, Streptomycin, Antivirals, AIDS – symptoms, prevention, treatment – Cancer (Structure not required)

UNIT IV- Common body ailments

Diabetes – Causes, hyper and hypoglycemic drugs – Blood pressure – Systolic & Diastolic Hypertensive drugs – Cardiovascular drugs – depressants and stimulants –Lipid profile – HDL, LDL cholesterol lipid lowering drugs. (Structure not required)

UNIT V Health promoting drugs

Vitamins A, B, C, D, E and K micronutrients – Na, K, Ca, Cu, Zn and I, Medicinally important inorganic compounds of Al, P, As, Hg and Fe, Examples and applications, Agents for kidney function (Aminohippuric acid). Agents for liver function (Sulfo bromophthalein), antioxidants, treatment of ulcer and skin diseases. (Structure not required)

RECOMMENDED REFERENCE BOOKS

1. Ashutosh Kar, —Medicinal Chemistry, Wiley Eastern Ltd., New Delhi, 1993.
2. David William and Thomas Lemke, Foyes Principles of Medicinal Chemistry, BI Publishers.
3. Romas Nogrady, Medicinal Chemistry, Oxford Univ. Press

DEPARTMENT OF CHEMISTRY
NON- MAJOR ELECTIVE COURSE-VI
FOOD CHEMISTRY (30 HOURS)
PAPER CODE -21UCHN06

Internal Assessment Marks:25

External Marks :75

UNIT - I Food source & Constituents offoods

Food: Source, functions of foods. Food groups: Basic five foodgroups.
Constituents of food : Carbohydrates, Classification – Storage of Carbohydrates and its function. Proteins – Classification sources and functions. Fats and oils, Dietary sources, Uses of fat sand oils and their role in biological systems.

UNIT - II Food Adulteration

Adulterants in different foods - Milk, and milk products, Vegetable oils and fats spices, cereals, pulses. Contamination with toxic chemicals - Pesticides and Insecticides Detection and prevention of food Adulteration.

UNIT - III Food Spoilage and food preservation

Causes of Food spoilage-Food preservation - Principle and methods of preservation - By using high temperature - sterilization, pasteurization and Blanching.Low temperature food perservation methods.

UNIT - IV Vitamins

Classification, sources, functions and deficiencies of fat soluble vitamins – A,D,E, and K, water soluble vitamins – B₁,B₂, and B₆.

UNIT - V Minerals

Mineral elements in foods, Principal mineral elements – sources, functions and deficiencies of Na, K, Mg, Fe, S and P.

Reference books:

1. Food & Nutrition - Dr. M. Swaminathan
2. Food Science -Srilakshmi
3. Food processing & preservation –Sivasankar
4. Text book on food chemistry - Dr. M.Swaminathan

DEPARTMENT OF CHEMISTRY
NON MAJOR ELECTIVE
COURSE-VII-AGRO CHEMISTRY (30 hours)
PAPER CODE -21UCHN07

Internal Assessment Marks:25

External Marks:75

UNIT I Chemistry of soil

1.1 Definition of soils, Classification, Properties of soils-physical properties - structure and texture, soil water, soil air and soil temperature.

1.2 Chemical properties- soil mineral matter-soil colloids, ion-exchange reactions. Soil fertility and its evaluation.

UNIT II Soil analysis

2.1 Soil organic matter and their influence on soil properties –N ratio effects.

2.2 Soil reactions. Soil pH, acidity, alkalinity, buffering of soils and its effects on the availability of N, P, K, Ca, Mg, I, Al, Mn & sulphuric acid- soils salinity, acid & alkaline soils- their formation and reclamation.

UNIT III Fertilizers

3.1 Primary, secondary and micro nutrients on plant growth and development. Nitrogenous fertilizers, manufacture of ammonium nitrate, ammonium sulphate and urea.

3.2 Phosphate fertilizers - preparation and uses of mono and diammonium phosphates, superphosphate.

3.3 Potassium fertilizers-potassium nitrate, potassium chloride, potassium sulphate and mixed fertilizers

UNIT IV Pesticides

4.1 Classification-Insecticides, fungicides and herbicides, application and toxicity. Insect attractants and repellents-fluorine compounds, boron compounds, arsenic compounds, organomercuric compounds.

4.2 General methods of preparation of DDT, BHC. Structure and uses of Herbicides: 2,4-D and 2,4,5-T. Structure and uses of Fungicides: Preparation of Bordeaux mixture, lime-sulphur.

UNIT V Water Treatment & Water Analysis

5.1 Water Treatment- Hard and soft water, water softening methods - lime soda process, phosphate conditioning and ion-exchange processes.

5.2 Water analysis - determination of hardness of water, acidity, alkalinity, pH value, amount of free CO₂, fluoride content, chloride content. Biological oxygen demand (BOD), chemical oxygen demand (COD), recycling of water.

References

1. Plant Ecology and Soil Science, R.S. Shukla and P.S.Chandel.
2. Shreve's Chemical Process Industries, G.T.Austin
3. Agricultural Chemistry, B.A.Yagodin.

DEPARTMENT OF CHEMISTRY
NON MAJOR ELECTIVE COURSE -VIII
PAPER CODE -21UCHN 08

Internal Assessment Marks:25

External Marks :75

POLYMER & PLASTICS (30Hours)

UNIT-I

1.1 Basic concepts : Monomer, polymerization, degree of polymerization, repeat units. Classification of Polymers-addition and condensation polymers, natural and synthetic, based on structure, inorganic and organic, thermoplastic and thermosetting resin.

1.2 General methods of preparation of polymers. Polymerization through functional groups, multiple bonds and ring opening and Coordination polymerization.

UNIT-II

2.1 Structure of polymers- linear, branched and cross linked. Homo & hetro copolymers. Block copolymers &graft copolymers. Stereochemistry of polymers-Isotactic ,Syndiotactic and Atactic

2.2 Properties of polymers : The crystalline melting point. The glassy state and glass transition temperature

UNIT-III

3.1. Molecular weight of polymers

3.2 Number average molecular weight and weight average molecular weight. Determination of molecular weight by Viscosity and Osmometry methods.

3.3. Polymer processing- calendaring, Die casting, blow moulding, and Wetspinning.

UNIT-IV

4.1 Poly olefins-polythene , PTFE , Freons ,PVC ,polypropylene and polystyrene.

4.2 Natural and synthetic rubbers.-Constitution of natural rubber. Butyl, Buna-N, Neoprene, Thiocol, Polyurethane and silicone rubbers.

UNIT-V

5.1. Plastics and Resins Definitions. Thermoplastic and thermo setting resins. Constituents of plastic-fillers, dyes, pigments, plasticizers, Lubricants and catalysts.Uses of thermoplastic resins and thermo setting resins.

REFERENCES:

1.V. R. Gowrikar ,N.V.Viswanathan : Polymer Science- Wiley Eastern Limited ,New Delhi. 1986

2.R.B.Seymour, Introduction to Polymer Chemistry, MC Craw Hill, New York 1971.

3.S.S.Dara , A Text Book in Engineering Chemistry, S.Chand & Company Ltd, New Delhi. Third Edition ,1992.