

BHARATHIAR UNIVERSITY

M.Sc. CHEMISTRY

SCHEME OF EXAMINATION (CBCS PATTERN)

For the students admitted during the academic year 2014-2015 Batch onwards

Study Components	Course Title	Ins. hrs / week	Exam				Credit
			Dur. Hrs.	CIA	Uni. exam	Total	
Semester I							
Paper – I	Organic Chemistry – I (Organic reaction mechanisms)	4	3	25	75	100	4
Paper – II	Inorganic Chemistry – I (Nuclear chemistry etc)	4	3	25	75	100	4
Paper – III	Spectroscopy, Group theory and computer in Chemistry	4	3	25	75	100	4
Practical – I	Organic Chemistry – I	5	--	--	--	--	--
Practical – II	Inorganic Chemistry – I	5	--	--	--	--	--
Practical – III	Physical Chemistry – I	5	--	--	--	--	--
Elective I		3	3	25	75	100	4
Semester II							
Paper - IV	Organic Chemistry – II (Organic reaction mechanisms)	4	3	25	75	100	4
Paper – V	Physical Chemistry-I (Quantum chemistry and Spectroscopy)	4	3	25	75	100	4
Paper – VI	Physical Methods in Chemistry	4	3	25	75	100	4
Practical - I	Organic Chemistry – I	5	6	40	60	100	4
Practical – II	Inorganic Chemistry – I	5	6	40	60	100	4
Practical – III	Physical Chemistry – I	5	6	40	60	100	4
Elective II		3	3	25	75	100	4
Semester III							
Paper - VII	Organic Chemistry – III (Chemistry of natural products)	4	3	25	75	100	4
Paper - VIII	Physical Chemistry – II (Thermodynamics)	4	3	25	75	100	4
Paper – IX	Kinetics of polymerization	4	3	25	75	100	4
Practical - IV	Organic Chemistry – II	5	--	--	--	--	--
Practical – V	Inorganic Chemistry – II	5	--	--	--	--	--
Practical - VI	Physical Chemistry – II	5	--	--	--	--	--
Elective III		3	3	25	75	100	4

Semester IV							
Paper - X	Inorganic Chemistry – II (Coordination chemistry)	4	3	25	75	100	4
Paper - XI	Physical Chemistry – III (Reaction kinetics and electro chemistry)	4	3	25	75	100	4
Paper - XII	Polymer technology	4	3	25	75	100	4
Practical - IV	Organic Chemistry - II	5	6	40	60	100	4
Practical – V	Inorganic Chemistry – II	5	6	40	60	100	4
Practical - VI	Physical Chemistry – II	5	6	40	60	100	4
Elective IV (Option given either to choose Project Work or Elective paper)		3	3	-	-	100**	4
Practical Viva		--	--	50	-	50	2
Total						2250	90

Electives : List of Group Elective papers (Colleges can choose any one of the Group papers as electives)

	GROUP A	GROUP B	GROUP C
Paper I/Sem I	Dye chemistry	Dye chemistry	Organic Synthesis and structure
Paper II/Sem II	Water pollution and Industrial effluent treatment	Water pollution and Industrial effluent treatment	Pharmaceutical Chemistry
Paper III/Sem III	Industrial Chemistry	Applied Electrochemistry	Applied Electrochemistry
Paper IV/Sem IV Theory paper (or) Project Work	Nano Chemistry and Corrosion Chemistry	Advanced Polymeric Materials	Advanced Polymeric Materials

* Includes 25/40% continuous internal assessment marks for theory and practical papers respectively.

** For Project report - 80%; Viva-voce - 20%

Note :

The revised syllabus for the **PAPER I ORGANIC CHEMISTRY – I, PAPER IV ORGANIC CHEMISTRY – II and PAPER VII ORGANIC CHEMISTRY – III** is furnished below. There is no change in remaining papers.

Subject Title : PAPER I ORGANIC CHEMISTRY - I
(Organic Reaction Mechanisms)

No.of hours: 75 hrs

Subject Description :

This contents of this paper present the basic principles of understanding mechanism of organic reactions. In addition to the general physical methods of approaching the course of reactions, specific examples like aromatic electrophilic substitution, aliphatic nucleophilic substitution, elimination and free radical reactions have been dealt with in detail.

Goals :

To motivate and enable the students to comprehend the possible chemical route by which a reaction may proceed.

Objectives :

On successful completion of the course the students should have:

Understood aromaticity, antiaromaticity and nonaromaticity in organic compounds,
Learnt possible reaction pathways in aromatic electrophilic, aliphatic nucleophilic, elimination and free radical reactions.

Contents

UNIT-I

1. Aromaticity : Introduction - Aromaticity of benzenoids and heterocyclic compounds. Non-benzenoid aromatics - annulenes. Azulenes and ferrocenes(synthesis not necessary). Antiaromatic and non aromatic compounds – Homoaromaticity.
2. Kinetic and nonkinetic methods of study of reaction mechanisms - Kinetic methods primary and secondary kinetic isotopic effects, non-kinetic methods - study of reaction mechanism — study of intermediates, isotopic labeling, stereochemical studies and cross over experiments. Hammond's postulate. Kinetic and thermodynamic control.
3. Linear free energy relationship — Hammett equation (Taft equation not necessary).

UNIT—II

Aromatic electrophilic substitution. reactions – Introduction - Mechanism of electrophilic substitution. reactions such as halogenation, nitration, sulphonation and Friedel – Crafts alkylation and acylation reactions. Orientation and reactivity. Electrophilic substitution on monosubstituted and disubstituted benzenes. Typical reactions such as Gattermann reaction Gattermann Koch reaction. Rimer -Tiemann reaction. Kolbe reaction. Hofmann-Martius and Jacobson's reactions.

UNIT-III

Aliphatic nucleophilic substitution reactions and mechanisms:

S_N1, S_N2, S_Ni mechanisms. Factors affecting nucleophilic substitution reaction – nature of the substrate, solvent, nucleophile and leaving group. Neighbouring group participation. Ambident nucleophiles and ambident substrates. Stereochemistry of nucleophilic substitution reactions.

Substitution at vinyl carbon allylic carbon and bridge head carbon. Typical substitution reactions such as Von Braun reaction, Claisen condensation and hydrolysis of esters. S_NAr and Benzyne mechanisms (Zigler alkylation and Chichibabin reaction).

UNIT- IV

1. Elimination reactions: $E1$, $E2$, Ei , $E1CB$ mechanisms, Stereochemistry of elimination reactions. Elimination Vs substitution. Typical elimination reactions such as Chugaev reaction. Hofmann degradation. Cope elimination.
2. Carbenes and nitrenes — structure, generation and reactions.

UNIT-V

Free radical reactions: Introduction -structure, stability and geometry of free radicals. Generations of long lived and short lived free radicals. Characteristics of free radical reactions - substitutions - additions and eliminations, rearrangements. of free radicals. Typical reactions such as Sandmeyer, Gamberg, Pechmann, Ullman, Pschorr and Hunsdiecker reactions.

REFERENCES

1. Jerry March — Advanced organic chemistry
2. I.I. Finar — Organic chemistry. Vol. 1 & II
3. R.T. Morrison and R.N. Boyd — Organic chemistry
4. E.S. Gould — Mechanism and structure in organic chemistry
5. E. R. Alexander — Principles of ionic organic reactions
6. Fieser and Fieser — Advanced organic chemistry
7. J.B. Hendrickson, D.J.Gram and G.S.Hammond — Organic chemistry
8. P.J. Garrat — Aromaticity
9. Badger — Aromaticity and aromatic character
10. D.V. Banthorpe — Eliminations

Subject Title : PAPER IV ORGANIC CHEMISTRY - II
(Organic reaction mechanisms)

No.of hours: 75 hrs

Subject Description :

This paper gives a concise idea of organic reaction mechanisms in molecular rearrangement and concerted reactions. In addition, mechanism in organic photochemical, oxidation- reduction reactions, addition reactions and stereoisomerism have been presented.

Goals :

To enable the students to learn different rearrangement reactions, pericyclic and name reactions in organic chemistry. A comprehensive knowledge on conformational analysis is also aimed.

Objectives :

On successful completion of the course the students should have:

Mastered rearrangement reactions, Woodward-Hofmann rules, organic photochemistry, synthetically important name reactions in organic chemistry and stereoisomerism in organic compounds.

Contents

UNIT-I

Molecular rearrangements: Introduction - Wagner - Meerwein rearrangements, Neber rearrangement, Baeyer —Villiger rearrangement. Rearrangements to electron deficient nitrogen and oxygen — Dienone phenol, Favorski, Fries, Wolt Benzidine and Stevens rearrangements. Curtius, Chapman and Wallac rearrangements.

UNIT—II

Concerted reactions: Pericyclic reactions — the perturbation theory of pericyclic reactions, the electrocyclic reactions & sigmatropic reactions. Woodward — Hofmann rules, orbital correlation diagrams, the frontier orbital theory. Cycloadditions - Diel's Alder reaction. Cope, Claisen and Di-pi - methane rearrangements.

UNIT-III

1. Organic photochemistry: Introductory theory of light absorption, photophysical processes – Jablonski diagram , energy transfer photochemical reaction of ketones - Norrish type I and type II reactions. Paterno – Buchi reaction and cis and trans isomerisation.

2. Oxidation and reductions: Mechanisms — oxidation of olefins, alcohols, glycols, ozonolysis and aromatization reaction and Sommelet reaction. Reduction reactions and selectivity in reduction. Reduction reactions involving metal hydrides(LiAlH_4 and NaBH_4). Reduction of nitro compounds, carbonyl compounds and aromatic compounds. Typical reactions such as Birch reduction, Clemmensen, Wolff – Kishner and MPV reduction.

UNIT-IV

1. Addition reactions : Electrophilic and nucleophilic. Addition to double and triple bonds — Hydration. hydroxylation. Michael addition. hydroboration and epoxidation.

2. Addition to carbonyl compounds : Mannich reaction, Dieckmann, Stobbe, Knoevenagel, Darzen, Wittig, Thorpe and Benzoin reactions.

UNIT - V

Stereoisomerism – Configurational & conformational isomerism:

1. Introduction, definition & classification. Molecular representation (Fischer projection, Newmann projection formula). Basic requirements of optical isomerism. Optical isomerism exhibited by a few nitrogen and sulphur compounds – the role of nitrogen inversion.

2. Configurational nomenclature: D & L, R & S and E & Z(olefins) nomenclatures.

3. Conformations of acyclic and cyclic molecules:

Conformations of ethane and 1, 2 disubstituted ethanes. Configurations and conformations of cyclohexane, mono and disubstituted cyclohexanes(conformational equilibrium – delta G). Configurations and conformations of fused polycyclic systems – decalin, perhydrophenanthrene, perhydroanthracene. Stereoselective and stereospecific reactions.

REFERENCES

1. Jerry March : Advanced organic chemistry
2. Jaffee and Drchin : Orbital symmetry
3. Entwistle : Orbital symmetry correlations in organic chemistry
4. Lehr and Marchand : Orbital symmetry
5. Pant De Mayo : Molecular rearrangements vol. 1 & II
6. N.J. Turro : Molecular photochemistry
7. C.H. Depuy and O.S. Chapman : Molecular reactions and photochemistry
8. J.M. Coxon and B.Halton : Organic chemistry
9. W.A. Pnyer : Introduction to free radical chemistry
10. S.M.Munergee and S.P.Singh : Reaction mechanisms in organic chemistry
11. L.N.Ferguson — The modern structural theory of organic chemistry
12. C.A.Buntcn -- Nucleophilic substitution at the saturated carbon atom
13. J .Miller — Atomic nucleophilic substitution
14. C.K. Ingold — Structure and mechanism in organic chemistry
15. K.Milson — Introduction to stereochemistry
16. LL.Lliel — Stereochemistry of carbon compounds
17. Whitaker David — Stereochemistry
18. Eliel and Ailsinger — Stereochemistry

Subject Title : **PAPER VII ORGANIC CHEMISTRY - III**
(Natural Products Chemistry)

No.of hours: 75 hrs

Subject Description :

This paper deals with chemistry of natural products – terpenoids, steroids, alkaloids, proteins and heterocyclic compounds.

Goals :

To enable the students to know the chemical compositions of natural substances around them and to motivate them devise synthetic routes to prepare natural products in the laboratory.

Objectives :

On successful completion of the course the students should have:

Understood the composition of the important natural materials around them.

Learnt scientific methods to synthesise organic natural products.

Contents :

UNIT-I

Terpenoids: Isolation and classification of terpenoids — structural elucidation and synthesis of zingiberene, eudesmol, juvenile hormone, abietic acid and caryophyllene.

UNIT-II

Steroids: Introduction — structural elucidation of cholesterol (synthesis not required), ergosterol, equilenin, estrone, testosterone and progesterone.

UNIT-III

Alkaloids: Introduction – isolation of alkaloids, structural elucidation and synthesis of morphine, reserpine. Quinine, atropine and glaucine.

UNIT-IV

1. Proteins and nucleic acids: Classification and characteristics(structure) of proteins — synthesis of polypeptides and oxytocin, enzymes and coenzymes. Structure of RNA and DNA and their biological importance.

2. Heterocyclic compounds: Structure, synthesis and reactions of flavones, isoflavones, purines (adenine and guanine) and anthocyanins (cyanin and pelargonin).

UNIT – V

Reactions and reagents: Reactions in organic synthesis: Oppanauer oxidation, Barbier – Wieland degradation, Barton reaction, Jones oxidation and Vilsmeier reaction.

Reagents in organic synthesis : Preparations and synthetic applications of DDQ(2,3-dichloro-5,6-dicyano-1,4-benzoquinone), DBU(1,5-diazabicyclo[5.4.0]undecene-5), DCC(dicyclohexylcarbodiimide) NBS, PCC, PDC and crown ethers.

REFERENCES :

1. J.L. Finar : Organic chemistry Vol. I & II
2. O.P. Agarwal : Natural product chemistry
- P.S. Kalsi : Chemistry of natural products
- R.K. Mackie and D.M. Sijnti : Guide book to organic synthesis
- J.N. Guntu and R. Kapoor : Organic reactions and reagents
- Acheson : Introduction to heterocyclic compounds
- Katritsky : Principles of heterocyclic chemistry
- S. W. PejJeLjez. : Alkaloids