S. K. E. Society's

Govindram Seksaria Science College (Autonomous)

Belagavi

P. G. DEPARTMENT OF CHEMISTRY

Regulations
Scheme of Examination & Syllabus
for
M.Sc. Degree in Chemistry
as per
Choice Based Credit System
(Effective from the Academic Year 2024-25)

MEMBERS OF BoS

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5	**Shri. Niranjan Dadkar** Dadson Industries, Udyambag, Belagavi. **Mob:9243222100**	Industry Representative	
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Regulations
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for
M.Sc. Degree in Chemistry
as per
Choice Based Credit System
(Effective from the Academic Year 2024-25

1.0 Title of the Course: The course shall be called **M.Sc. in CHEMISTRY (Organic)**

1.1 Duration of the course: The M.Sc. degree course is of two years duration, spread over four semesters each of four months duration.

1.2 Eligibility for Admission: The Bachelor's degree in science or equivalent degree with Chemistry as one of the subject. The candidate should have obtained at least 40% of marks in optional subjects as well as in aggregate. Relaxation in respect of SC/ST/Cat -I etc. will be followed as per prevailing rules of the university.

1.3 Admission & Seat Matrix: The rules for admission and seat matrix as per management G. S. Sc. autonomous college notification from time to time

1.4. Admission to other semesters: students are allowed to take admissions to successive semesters under carry over benefit (COB) facility.

2.0 Attendance: Every student must have at least 75% attendance in each paper (Theory & Practical) in each semester. Shortage of attendance will be dealt with as per the G. S. Sc. autonomous college rules from time to time.

3.0 Medium of instruction: The medium of instruction shall be English.

4.0 Course Structure:

There shall be *three* categories of papers namely, core subject (Theory & Practical's), soft core (50 marks paper), project dissertation and open elective (Theory) papers for M.Sc. in Chemistry.

In the 1st semester, there shall be 4 core theory papers of 4 credits in each paper and 4 core subject practical papers of 2 credits each.

In 2nd semester, there shall be 3 core theory papers of 4 credits in each paper and 3 core subject practical's of each 2 credits, 1 soft core paper of 2 credits and one open elective paper with 4 credits.

In 3rdsemester, there shall be 3 core theory papers of 4 credits in each paper and 3 core subject practical's each of 2 credits, 1 soft core paper of 2 credits and one open elective paper with 4 credits.

In the 4th semester, there shall be 3 core theory papers of 4 credits in each paper and 3 core subjects of practical's each of 2 credits, 1 soft core paper of 2 credits & one project with 4 credits.
Syllabus for each paper of 4 credits shall have four units of 16 h each & each paper of 2 credits shall have two units of 16 h each.
Project work of 4th semester shall be allocated during the 1st semester itself so that it can be planned well in advance for effective execution under the supervision of guide.

5.0 Scheme of Evaluation:

5.1 There shall be an examination at the end of each Semester.

5.2 The duration of examination of theory paper carrying 80 marks is 3h & duration of examination of theory paper carrying 40 marks is 2h.
Duration of Exam for practical's (Lab) is 4h and number of students per batch should not exceed 15.
The IA marks of theory papers are based on best of two out of three per paper per semester as well as attendance, seminar and assignments (if any). The weightage of marks for these components may be distributed accordingly.
The IA marks of practical paper are based on one IA Tests per paper per semester.

5.3 The theory and practical examinations of all the semesters shall be evaluated through single / double valuation by an internal / external examiner as per the guidelines of G. S. Sc. Autonomous, College.

5.4 Project: The project report shall be evaluated for 80 marks by one internal and one external examiner based on the *dissertation* & oral presentation.
IA marks of 20 allocated for project work must be earned from ***Industrial visit / Technical / Study tour*** of minimum 2 days to be undertaken during the 2nd year M.Sc. course. Such a visit/ tour (within India) must be endorsed by the Chairman, Dept. of Chemistry (Principal of affiliated college).
In case the student cannot undertake ***Industrial visit / Technical / Study tour*** due to health issues or unavoidable circumstances, IA marks shall be based on the presentation of the work in a seminar. However, students should produce the medical certificate approved by coordinator.

6.0 Pattern of question paper: 80 (Exam) + 20 (IA)

Question paper contains five questions. Question 1 is compulsory. It shall contain 10 questions carrying 2 marks each, drawn from all the four units. Questions 2, 3, 4 and 5 should be drawn from each unit for 15 marks each (sub questions a, b and c or d carry 5, 5 and 5 marks).
20+60, Total marks = 80 (20+60)

7.0 Maximum period for the completion of M.Sc. Degree in Chemistry: There shall be fully carry over system from first to fourth semesters. Maximum number of years for a student to complete the degree is as specified by the university from time to time.

8.0 The general regulations governing post graduate programs under CBCS and regulation governing post graduate programs in the school of basic sciences under CBCS of G. S. Sc. Autonomous College, Belagavi are applicable to this course for all the matters not covered under this.

Course structure of M.Sc. degree in Chemistry @ GSS College, Belagavi

Subjects	Paper	Instruction hrs / week	Duration of exam, hr	Marks			Credits
				IA	Exam	Total	
a) 1st semester of the PG Programme							
Core Subject	4 T	4 X 4 = 16	4 X 3	4 X 20	4 X 80	4 X 100	4 X 4 = 16
	4 P	4 X 4 = 16	4 X 4	4 X 10	4 X 40	4 X 50	4 X 2 = 8
						Per semester total of credits	24
b) 2nd and 3rd semester							
Core Subject	3 T	3 X 4 = 12	3 X 3	3 X 20	3 X 80	3 X 100	3 X 4 = 12
	3 P	3 X 4 = 12	3 X 4	3 X 10	3 X 40	3 X 50	3 X 2 = 6
Soft core	1T	1 X 2 = 2	1 X 2	1X 10	1 X 40	1 X 50	1 X 2 = 2
OEC	1T	1 X 4 = 4	1 X 3	1X 20	1 X 80	1 X 100	1 X 4 = 4
						Semester total of credits	24X2= 48
c) 4th semester							
Core Subject	3 T	3 X 4 = 12	3 X 3	3 X 20	3 X 80	3 X 100	3 X 4 = 12
	3 P	3 X 4 = 12	3 X 4	3 X 10	3 X 40	3 X 50	3 X 2 = 6
Soft core	1T	1 X 2 = 2	1 X 2	1X 10	1 X 40	1 X 50	1 X 2 = 2
Project	1Pr	1 X 4 = 4	Report Evaluation	1X 20	1 X 80	1 X 100	1 X 4 = 4
						Semester total of credits	24
						Programme grand total of credits	96

T - Theory, P- Practical, Pr-Project, OEC-Open Elective

***** For earning IA marks of Project work, please refer to Section 5.4 in the regulation.

Course structure of M. Sc. degree in Chemistry @ GSS College, Belagavi

Paper Details		Teaching h / week	Duration of exam, h	Marks			Credits
				Exam	IA	Total	
1st Semester							
Core Sub	CHIT 1.1 : Inorganic Chemistry – I	4	3	80	20	100	4
	CHOT 1.2 : Organic Chemistry - I	4	3	80	20	100	4
	CHPT 1.3 : Physical Chemistry - I	4	3	80	20	100	4
	CHAC 1.4: Analytical Chemistry	4	3	80	20	100	4
	CHIPr 1.5: Inorganic Chemistry Practical – I	4	4	40	10	50	2
	CHOPr 1.6:Organic Chemistry Practical – I	4	4	40	10	50	2
	CHPPr 1.7 : Physical Chemistry Practical – I	4	4	40	10	50	2
	CHACPr 1.8: Analytical Chemistry Practical - I	4	4	40	10	50	2
Total		32	28	480	120	600	24
2nd Semester							
Core Sub	CHIT 2.1 : Inorganic Chemistry – II	4	3	80	20	100	4
	CHOT 2.2 : Organic Chemistry - II	4	3	80	20	100	4
	CHPT 2.3 : Physical Chemistry - II	4	3	80	20	100	4
	CHIPr 2.5: Inorganic Chemistry Practical – II	4	4	40	10	50	2
	CHOPr 2.6:Organic Chemistry Practical – II	4	4	40	10	50	2
	CHPPr 2.7 : Physical Chemistry Practical – II	4	4	40	10	50	2

Soft core	CHORT 2.2.1: Spectroscopy-I	2	2	40	10	50	2
OEC	CHEG – 2.4: Open Elective	4	3	80	20	100	4
	Total	30	26	480	120	600	24

Course structure of M. Sc. degree in Chemistry (ORGANIC CHMISTRY) @ GSS College, Belagavi

Paper Details		Teaching h / week	Duration of exam, h	Marks			Credits
				Exam	IA	Total	
3rd Semester							
Core Sub	CHORT - 3.1 : Organic Chemistry – III A	4	3	80	20	100	4
	CHORT - 3.2 : Organic Chemistry – III B	4	3	80	20	100	4
	CHORT - 3.3 : Organic Chemistry – III C	4	3	80	20	100	4
	CHORPr 3.6: Organic Chemistry Practical - IIIA	4	4	40	10	50	2
	CHORPr 3.7 Organic Chemistry Practical - IIIB	4	4	40	10	50	2
	CHORPr 3.8: Organic Chemistry Practical - IIIC	4	4	40	10	50	2
Soft core	CHORT 3.4: Spectroscopy - II	2	2	40	10	50	2
OEC	CHEG – 3.5: Open Elective	4	3	80	20	100	4
	Total	30	26	480	120	600	24
4th Semester							
Core	CHORT - 4.1 : Organic Chemistry – IV A	4	3	80	20	100	4

Sub	CHORT - 4.2 : Organic Chemistry – IV B	4	3	80	20	100	4
	CHORT - 4.3 : Organic Chemistry – IV C	4	3	80	20	100	4
	CHORPr 4.5: Organic Chemistry Practical - IVA	4	4	40	10	50	2
	CHORPr 4.6 Organic Chemistry Practical – IVB	4	4	40	10	50	2
	CHORPr 4.7: Organic Chemistry Practical - IVC	4	4	40	10	50	2
Soft core	CHORT 4.4: Advanced Techniques of Organic Chemistry	2	2	40	10	50	2
Project	CHOP – 4.8: Project / Dissertation	4	-	80	20	100	4
Total		30	23	480	120	600	24
Grand Total		122	103	1920	480	2400	96

S.K.E. Society's
G.S.S. COLLEGE BELAGAVI
P.G DEPARTMENT OF CHEMISTRY
Syllabus for Autonomous Status
Syllabus of M.Sc. degree in CHEMISTRY

FIRST SEMESTER

CHIT-1.1. INORGANIC CHEMISTRY-I

Teaching: 4 h/ week & Total: 64 h **Credit: 4**

UNIT–I 16hr

CHEMICAL BONDING

Ionic Bonding: Formation, conditions for the formation and properties of ionic compounds, lattice energy, Born-Lande's equation, calculation of lattice energy from Born-Lande's equation (problems should be solved), conclusions from Born-Lande equation, Born-Haber cycle, factors affecting the lattice energy. Covalent character in predominantly ionic bonds, polarizing power, factors governing the degree of polarization, Fajan's rules in predicting the melting and boiling points and solubility of some compounds.

Energetics of solubility of ionic salts in polar solvents, solvation energy, relative effects of ionic radii on lattice energy and ion-solvation energy, relative solubility of ionic compounds (alkali metal halides and silver halides, sulphates, and hydroxides of alkaline earth metals).

Covalent bonding: Bent's rule of hybridization, illustration of Bent's rule with respect to CH_3F, PCl_3F_2).

Molecular orbital theory: Symmetry and overlap, molecular orbital diagrams of diatomic homo nuclear molecules/ions (up to second period elements), heteronuclear molecules/ions (HCl, LiF, CO, NO. Magnetic properties of the molecules/ions based on the MOT, stability of molecules or ions based on bond order.

Metallic bonding: Characteristics of metallic states, V. B. approach, band theory (MOT).

Self-study: **Valence bond theory:** VSEPR theory (*sp*, sp^2, sp^3, dsp^2, sp^3d, sp^3d^2).

Skill component: Determine the bond energy and calculate the lattice energies and discuss their application.

UNIT-II (16 hr)

CHEMISTRY OF NON-TRANSITION ELEMENTS-I

Electron deficient compounds: Classification and nomenclature of boranes**:** Synthesis, structure and properties **of** B_2H_6, B_3H_9, B_4H_{10}, B_5H_9, B_5H_{11} and B_6H_{10}.Polyhedral skeletal electron pair counting using Wade's rules (*styx* numbers): classification of boron clusters using electron pair count.

Carboranes: Classification, Nomenclature, Synthesis and structural aspects of closocarboranes (C_2B_{10} H_{12}).

Metalloboranes: Synthesis and structural aspects of $[B_{11}H_{11}AlCH_3]^{2-}$, $[Fe(CO)_3B_4H_8]$and [2-$CpCoB_4H_8$].

Metallocarboranes: Synthesis of $[(C_2B_9H_{11})_2Fe]^{2-}$, $[C_2B_9H_{11}FeCp]^-$ and $[Co(C_2B_9H_{11})_2]^-$, Structure and Bonding in $[Co(C_2B_9H_{11})_2]^-$

Borazines: Synthesis, reactivity, structure and bonding.
Self-study: Electron deficient compound other than Boran and Lewis acids.
Skill component: Demonstration on the handling of redox sensitive and air/moisture sensitive materials.

UNIT-III (16 hr)
COORDINATION CHEMISTRY

Coordination chemistry: Coordination numbers (1 to 7) and their geometries, geometrical isomerism in square planar and octahedral complexes, optical isomerism in octahedral complexes.
Bonding theories: Spectrochemical series (Irwin-William series), Crystal Field Theory, splitting of d-orbitals in octahedral, tetrahedral, square planar, trigonal bipyramidal and square pyramid geometries, Jahn-Teller distortion in co-ordination compounds.
Limitations of CFT, evidences for metal ligand orbital overlap, Molecular Orbital Theory with sigma bonding applied to octahedral, tetrahedral, and square planar complexes. MO-Theory with π(pi)–bonding applied to octahedral complexes.
***Self-study*:** Basics of Coordination Chemistry (Review of VBT, EAN and their limitations), CFSE.
Skill component: Methods to identify cis- & trans- as well as L- & D-isomerism.

UNIT-IV (16 hr)
Pi (π) ACID METAL COMPLEXES AND ACID-BASE CHEMISTRY

Metal Carbonyls: Different binding modes of CO, pi (π) acidity of CO, back bonding, synergic effect, mononuclear carbonyls, low nuclearity carbonyl clusters and high nuclearity carbonyl clusters, application of 18 electron rule to metal carbonyls.
Structural features of $[Co_2(CO)_8]$, $[Co_4(CO)_{12}]$ and $[Fe_3(CO)_{12}]$.
Preparation and structural aspects of $Ni(CO)_4$, $Fe(CO)_5$ and $Co_2(CO)_8$ by direct reaction of metals, $V(CO)_6$, and $Mn_2(CO)_{10}$ by reductive carbonylation.
Dinitrogen Complexes: Reason for poor coordinating behavior of N_2 compared to its isoelectronic species, binding modes of N_2, preparation of Ru and Mo dinitrogen complexes.
Acid-Base Chemistry: Lux-Flood theory, solvent-system definition, Usanovich concept, Hammett acidity function (super acids), HSAB theory.
Self-study: Bronsted Lowry & Lewis concepts of Acid Base.
Skill component: Preparation of one metal nitrogen compound and its characterization.

REFERENCE BOOKS:
01. Inorganic Chemistry: Principles, structure and reactivity, 1997, J. E. Huheey, Keiter and Keiter.
02. Inorganic Chemistry, 3rd edition, C. E. Housecroft and A. G. Sharpe.
03. Inorganic Chemistry by Purcel and Kotz.
04. Inorganic Chemistry by J. D. Lee.

05. Inorganic Chemistry by W. W. Porterfield.
06. Concepts and Models of Inorganic chemistry by Douglass, Alexander and Mcdaniel.
07. Advanced Inorganic Chemistry by Cotton and Wilkinson.
08. Inorganic Chemistry by Miessler and Tarr.
09. Fundamental concepts of Inorganic Chemistry by A. K. Das, volume 1 to 7.

CHIPr-1.5: INORGANIC CHEMISTRY PRACTICALS-I

Duration: 4 hr/ week & Total: 64 hr **Credits : 2**

Part A. Ore Analysis:

01. Hematite: Iron by volumetric using potassium dichromate.

02. Pyrolusite: Determination of manganese dioxide in pyrolusite using permanganate titration

03. Estimation of calcium and magnesium carbonates in dolomite using EDTA titration, and gravimetric analysis of insoluble residue.

Part B. Alloy Analysis:

04. Quantitative analysis of Copper-Nickel in alloy /mixture.

i. Copper volumetrically using KIO_3.

ii. Nickel gravimetrically using DMG.

Part C.

05. Determination of COD and BOD of polluted water.

Scheme of Examination:

i. Duration of examination: 04 hours
ii. Experiment: 30 marks
iii. Viva-Voce : 05 marks
iv. Journal : 05 marks
v. Internal assessment: 10 marks

Total: 50 marks

CHOT-1.2 ORGANIC CHEMISTRY-I

Teaching: 4 hr/ week & Total: 64 hr **Credits: 4**

UNIT-I 16 hr

BASIC CONCEPTS AND REACTION MECHANISM

Concept of hybridization: sp^3, sp^2, sp – with examples.

Electronic effects: Inductive, electronic, resonance and hyperconjugation.

Reactive Intermediates: carbocations, carbanions, free radicals, carbenes, nitrenes, and arynes-their formation, stability, structure and reactions.

Organic acid and bases: Effect of substituents with examples

Reaction Mechanism: Determination of reaction mechanism by kinetic and non-kinetic-methods.

Kinetic Method: Mechanistic implications from rate laws, the transition state theory, ambiguities in interpreting kinetic data, solvent effect, isotopic effect, solvent isotopic effect, substituent effect, steric effect, linear free energy relationships–Hammett equation and Taft treatment.

Non-kinetic methods: Energy profile diagram, identification of products, testing possible intermediates, trapping of intermediates, cross over experiments, isotopic labelling, stereochemical studies, limitations.

Self-study: Basic of atom, molecules, hybridization, ionization energy, electron affinity, electronegativity, delocalization, Bohr theory, Aufbau principle, steric effect, rate of reaction, activation energy, isotopes, stereochemistry.

Skill components: Free radical- ESR spectra of some of the molecule analyzed. Carbocation-isolated compound list and analysis.

UNIT-II 16 hr

ADDITION AND ELIMINATION REACTIONS

Addition reactions:

Types of addition reactions, mechanism and stereochemistry of addition, effect of substrates and solvents during addition. Addition to Carbon-Carbon double bond; addition of hydrogen halide (Markonikov's & anti-Markovnikov's rule), bromine and peroxide effect. Addition to carbon-hetero multiple bonds (C=O)-Introduction, structure and reactivity; HCN, bisulphate, Grignard reagent, hydride, amino compounds, alcohols and thiols.

Elimination reactions:

Introduction, types of elimination-E_1, E_2, E_{1CB} mechanisms, orientation during elimination reactions-Saytzeff and Hoffmann rules, pyrolytic eliminations, Chugaev, Cope eliminations, Hoffmann degradation and dehalogenation of vicinal di halides. Substitution v/s elimination with suitable example.

Self-study: Basics of saturated and unsaturated compounds, electrophiles and nucleophiles, geminal and vicinal compounds, difference between addition and elimination reactions.

Skill components: Analyse some addition and elimination product by FT-IR, UV-vis available from open access/recorded.

UNIT-III 16 hr
SUBSTITUTION REACTIONS

Aromatic electrophilic substitution reactions:
General mechanism of electrophilic substitution in aromatic systems using examples of nitration, halogenations, sulphonation and Friedel Craft alkylation and acylation. Orientation effect of di substitution in aromatic systems with suitable examples.

Nucleophilic substitution at saturated carbon:
Mechanism of SN_1, SN_2, SN_i reactions–effect of solvent, substrate and leaving group, neighboring group participation, substitution at vinylic and allylic carbon.
Aromatic nucleophilic substitution reactions:
Substitution of hydrogen, substitution other than hydrogen, SN_{Ar} reactions, SN1, SN2 and benzyne mechanism, Bucherer reaction.
Self-study: Basics of Aromaticity, electrophiles and nucleophiles, electron withdrawing and electron releasing groups and their examples, difference between solute and solvents, vinylic and allylic groups, acids and bases, saturated and unsaturated carbons. stereochemistry (retention & inversion), rate of reaction and activation energy.
Skill components: SN1, & SN2 products may be analyzed by polarimeter method and record and analyzed nitration and halogenation products using UV-Vis and FT -IR.

UNIT-IV 16hr
STEREOCHEMISTRY AND CONFORMATIONAL ANALYSIS

Optical isomerism: Concepts of chirality-symmetry elements and cause for optical activity, chiral structures, relative configuration- Fischer's DL notation, threo and erythro nomenclature, absolute configurations- R, S nomenclature.
Molecular presentation: Sawhorse, Newman, Fischer and fly wedge formulae, enantiomers, epimers, anomers, racemic mixtures, resolution of racemic mixtures-Mechanical, biochemical and chemical method.
Geometrical isomerism: Cis-trans, E-Z and syn-anti notations for geometrical isomers, geometrical isomerism in substituted alkenes, oximes, monocyclic and fused and bridge ring system, determination of configuration of geometrical isomers-physical and chemical methods.
Conformational analysis: Conformational study of acyclic system (n-butane, ethylene, glycol, chlorohydrin) and cyclic systems cyclohexane chair and boat forms, monosubstituted and disubstituted (1,2, 1,3, 1,4), cis and trans decalins, chirality of cyclohexanes. stereoisomerism in biphenyls, allenes, and spirans**.**
Self-study: Basics of stereochemistry, classification, Isomerism, optical activity, chiral compounds, priority order, cis-trans, dextro-laevo, oxidizing and reducing agents, plane of polarization.

Skill components: Students need to create suitable model for R & S configuration by stick & ball method. Dextro & leavo rotation of some samples record/analyzed by suitable data.

REFERENCE BOOKS:

01. Understanding organic reaction mechanisms, A. Jacob, Cambridge Univ. Press, 1997.
02. Introduction to organic chemistry A. Streitweiser, Jr and C. H. Heathcock, Macmillan, 1985.
03. Physical and mechanistic organic chemistry, R.A.Y. Jones, 1st Edn. Cambridge Univ. Press, 1979.
04. Mechanisms of molecular migrations, Vols I and II, B. S. Thiagarajan, 1st Edn. Pergamon Press, Oxford, 1979.
05. P. J. Garratt in Comprehensive organic chemistry, D. Barton and W. D. Ollis, 1st Edn. Pergamon Press, Oxford, 1979.
06. Radicals in organic synthesis, B. Giese, Pergamon Press, 1986.
07. Stereoelectronic effects in organic chemistry, P. Deslongchamps, 1st Edn. Pergamon Press, 1983.
08. Organic photochemistry, J. M. Coxon and B. Halton, 1st Edn, Cambridge Univ. Press, London, 1974.
09. Molecular reactions and photochemistry, C. H. Deputy and D. S. Chapman, 1st Edn. Prentice-hall India, New Delhi, 1972.
10. Stereochemistry of carbon compounds, E. L. Eliel, S. H. Wilen and L. N. Mander, John Wiley & Sons, 1994.
11. Stereochemistry, Potapov, MIR, Moscow, 1984.
12. Stereochemistry, Nasipuri, D, New Age, 1999.
13. Advanced organic chemistry, J. March, 4th Edn. John Wiley, 2008.
14. Organic Chemistry, R. E. Ireland Prentice-Hall India, New Delhi, 1975.
15. Some modern methods of Organic Synthesis, W. Caruthers, Cambridge Uni. Press London, 2nd Edn. 1998.
16. Stereochemistry of organic compounds- Principle and applications, D. Nasipuri, 2nd Edn., New Age International Publishers, 2001.
17. The text book of stereochemistry, Shikha Agarwal, Dinesh Jangid , Pragati publication, 2019

CHOPr-1.6: ORGANIC CHEMISTRY PRACTICAL-I

Duration: 4 hr/ week & Total: 64 hr **Credits : 2**

TWO STEP PREPARAT IONS

01. Preparation of acetanilide from aniline
02. Preparation of p-bromoacetanilide from acetanilide
03. Preparation of hydrolysis of p-bromoacetanilide to p-bromoaniline
04. Preparation of p-nitroacetanilide from acetanilide
05. Preparation of hydrolysis of p-nitroacetanilide to p-nitroaniline
06. Preparation of benzoic acid from benzaldehyde
07. Preparation of 2-hydroxynaphthaldehye from 2-naphthol
08. Preparation of 2,4,6-tribromo aniline from aniline
09. Preparation of phenylazo-β-naphthol
10. Preparation of 1-phenyl-3-methyl-pyrazolone

NOTE: Two preparations are to be given for Practical Examinations.

Scheme of Examination:

i. Duration of examination : 04 hours
ii. Experiment : 30 marks
iii. Viva-Voce : 05 marks
iv. Journal : 05 marks
v. Internal assessment: 10 marks

Total: 50 marks

REFERENCE BOOKS:

01. Vogel's Text Book of Practical Organic Chemistry, Furniss, Hannaford, Smith and Tatchell, ELBS Longmann
02. Advanced Practical Organic Chemistry, N.K. Vishnoi, Vikas, Publishing House
03. Handbook of Practical Organic Chemistry, Clark 04. Practical Organic Chemistry, O.P. Agrawal

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CHPT-1.3 PHYSICAL CHEMISTRY-I

Teaching: 4 hr/ week & Total: 64 hr **Credits: 4**

UNIT-I (16 hr)

QUANTUM CHEMISTRY-I

A brief resume and comparative studies of classical and quantum mechanical phenomenon, Summarization of the results of some experiments (black body radiation, Plank quantum theory, term symbols), Photoelectric and Compton effects. de- Broglie concept (to be derived). Uncertainty principle, Postulates of quantum mechanics, operators, algebra of operators, ψ properties. Hamiltonian operators and their properties, Schrodinger's equation (with respect to space and time time), derivation for time independent equation, Physical significance and characteristics of wave function, eigen function and eigen values, normalization of ψ, orthogonality of ψ boundary valued condition. Particle in one dimension box-derivation of equation Schrodinger's equation with respect to one dimension box (calculation of energy and wave function).

Self Study: Basic study about quantum and classical chemistry, study postulates of quantum chemistry, learning linear algebra.
Skill Component: Installation and operating DFT Software.

UNIT-II (16 hr)

THERMODYNAMICS-I

Review of basic principles of thermodynamics (I and II laws of thermodynamics, concept of free energy and entropy, combined form of first and second laws of thermodynamics. Entropy change during spontaneous process. Helmholtz and Gibbs free energies. Thermodynamic criteria of equilibrium and spontaneity. Variation of free energy with temperature and pressure. Third law of thermodynamics-calculation of absolute entropies. Thermodynamics of dilute solutions: Raoult's law, Henry's law. Ideal and non-ideal solutions: Liquid-liquid solutions, Azeotropic solutions. Maxwell's relation (to be derived). Thermodynamic equations of equipartition of energy, Clausius clapeyron equation equation (to be derived) and its application. Vant-Hoff's equation, integrated form of van't Hoff's equation. (problems to be solved).
Self Study: Study terms used in chemical thermodynamics, standard units of measurement of length, weight, time and capacity, zeroth law thermodynamics.
***Skill Component*:** Temperature dependent chemical reactions, explaining state and path functions.

UNIT–III (16 hr)

ELECTROCHEMISTRY –I

Arrhenius theory of strong and weak electrolytes and its limitations, theory of ionic conductance in solutions, ionic atmosphere, relaxation and electrophoretic effects, Debye-Huckel theory of strong electrolytes, Debey-Huckel-Onsagar equation(derivation) and Debey-Huckel limiting law(derivation), quantitative and qualitative treatment of Debye-Huckel limiting law, Onsagar activity co-efficient, mean ionic strength (Debey-Huckel limiting law). A brief survey of Helmholtz-Perrin, Gouy-Chapman and Stern electrical double layer (No Derivation). Fundamentals of batteries,

classification of batteries, battery characteristics, primary batteries, dry cell, alkaline MnO_2 batteries and other batteries, secondary batteries-lead acid, lithium batteries, alkaline storage batteries.

Self Study: Redox reactions, conductance in electrolytic solutions, specific and molar conductivity, variations of conductivity with concentration, Kohlrausch's law, electrolysis and law of electrolysis (Elementary idea)

Skill Component: Cyclic Voltammetric Study of ferrocyanide/ferricyanide Redox couple.

UNIT–IV **(16 hr)**

POLYMER AND DENDRIMER CHEMISTRY

Basic concepts: Monomers, polymers and degree of polymerization, general classification of polymers, homopolymers, copolymers. Polymer molecular weight: Number average and weight average molecular weights. Addition polymers and condensation polymers, comparison between thermoplastics and thermosetting polymers. Transition in Polymers: Definition of glass transition temperature (Tg) and flow temperature (Tf) and melting temperature (Tm). Thermal behavior of amorphous and crystalline polymers, factors affecting Tg. Plasticizers, properties and their effect on Tg. Preparation, properties, and commercial importance: polyethylene, polystyrene, polyvinyl chloride. Ziegler-Natta polymerization, bio-degradable polymers – synthesis and applicationss of poly(ethylene glycol) and poly(vinyl alcohol). Dendrimers and hyper-branched polymers: Introduction to dendrimers, methods of preparation, common properties, and applications.

***Self Study*:** Study of polymers in everyday life. Physical and Chemical properties of Polymers.
Skill Component: Visiting polymer industries around Belgaum

REFERENCE BOOKS:

01. Physical chemistry –Moore, Orient Longman,1972.
02. Principle of polymer science, by Bhahadur and N.V Shastry, 2nd addition Nonasa, 2011
03. An introduction to Chemical Thermodynamics –R. P.Rastogi and S.S.Misra, Vikash, Delhi, 1978.
04. Thermodynamics –Rajaram and Kunakose, East West, Nagin Cx,Dehli,1986.
05. An introduction to Electrochemistry –Glastone,East west Ltd.
06. Electrochemistry principles and applications –Porter
07. Introduction to electrochemistry by S. Glasstone.
08. Modern electrochemistry Vol. I and II, by J.O.M. Bockris and A.K.N. Reddy, Pentium Press, New York (1970).
09. Electrochemistry –Principles and applications by E.G. Potter.
10. Electrochemistry by Reiger, Prentice Hall (1987).
11. Industrial Electrochemistry–D. Pletcher and F.C. Walsh, Chapman, II Edition, 1984
12. Introductory Quantum Mechanics – Atkins ,Claredon,Oxford
13. Quantum chemistry-Kauzman,Academic Press,1957.
14. Quantum chemistry-R.K.Prasad ,II.Ed,New Age Int-2000

15. Textbook of polymer science –Billmeyer, Willey Intersection.
16. Polymer Science- V. R. Gowariker, 2010.
17. Physical Chemistry – Gurtu and Gurtu Vol 1 and 2
18. Advanced Physical Chemistry – Gurdeep Raj
19. Physical Chemistry, A Molecular Approach – Donald McQuarrie
20. Thermodynamics for Chemists - Samuel Glasstone
21. Quantum Chemistry – Ira Levine
22. Electrochemistry, Vol 1 and 2 – Bockris and Reddy
23. Polymer Science – Alcock
24. Polymer Science – Fried
25. An Introduction to Macromolecular Science- Aminabhavi and Munk

CHPPr-1.7: PHYSICAL CHEMISTRY PRACTICALS-I

Duration: 4 h/ week & Total: 64 h **Credits: 2**

1. **Conductometry**

a. Acid mixture versus NaOH

b. Weak acid with salt versus NaOH

c. Strong acid with salt versus NaOH

d. To determine the acidic and basic dissociation constant of an amino acid and determination of isoelectric point by pH metry.

e. Determine the equivalent conductance at infinite dilution for acetic acid by applying Kohlrausch's law of independent migration of ions.

2. **Potentiometry**

1. K2Cr2O7 versus FAS
2. Acid mixture versus NaOH
3. KMnO4 versus FAS
4. Determination of dissociation constant of H_3PO_4 using potentiometric method.
5. Determination of pKa value of phosphoric acid by pH meter.

Scheme of Examination:

i. Duration of examination: 04 hours
ii. Experiment: 30 marks
iii. Viva-Voce: 05 marks
iv. Journal: 05 marks
v. Internal assessment: 10 marks

Total: 50 marks

REFERENCE BOOKS:

1. Advanced Physico-Chemical Experiments –J. Rose.
2. Practical Physical Chemistry –S.R. Palit.
3. Experiments in Physical Chemistry – Yadav, Geol Publishing House.
4. Experiments in Physical Chemistry – Palmer.
5. Experiments in Chemistry –D.V. Jahagirdar, Himalaya Publishing House, Bombay, (1994).
6. Experimental Physical Chemistry –Das. R.C. and Behera B, Tata Mc Graw Hill

CHAC-1.4 ANALYTICAL CHEMISTRY

Teaching: 4 hr/ week & Total: 64 hr **Credits: 4**

UNIT-I (16 hr)
DATA ANALYSIS

Classification of analytical methods: Types of instrumental analysis, analytical methods on the basis of simple size. Statistical treatment of finet samples, measure central tendency -mean, medium, range, average deviation, relative average deviation, standard deviation, and variance. Students' confidence interval of the mean. Testing for significance, comparison of two means and two standard deviations. Criteria for rejection of an observation-Q test, control chart, propagation of errors. Least square methods of deriving calibration of plots.

Principles of sampling the sampling step. Methods for sampling solid, liquid and gaseous samples. Effect of sampling uncertainties. Sampling hazards, need for quality assurance: ISO 9000 series of quality of system.

Self-study: Errors, types of errors, determinate and indeterminate errors, accuracy and precision. Distribution of random errors, frequency distributions normal error curves. Significant figures.

Skill components: Students should able to identify the errors occurred during the volumetric (Ore/ Alloy) analysis by laboratory method.

UNIT-II (16 hr)
CHROMATOGRAPHY

Introduction, Principles, classifications, fundamentals of chromatography (Partition coefficient, Retardation factor, retention volumes), Dynamics of chromatography

(Efficiency, zone spreading, eddy diffusion) chromatograms, retention time and column efficiency, plate theory and rate theory, Van-Deemeters equation, column resolution, factors influencing resolution.

ION EXCHANGE CHROMATOGRAPHY

Introduction, principle, classification of ion exchange resins, mechanism of ion exchange, synthesis of ion exchange resins (cation and anion), characteristics of ion exchange resins (size, capacity, cross linking and swelling and resistance) applications in analytical and metal separations.

HIGH PERFORMANCE LIQUID CHROMATOGRAPHY

Introduction, principles, instrumentation, mobile phase, stationary phase, types of column, various detectors used, and applications.

Self-study: Basics of Chromatography, TLC, R_f value.

Skill components: Prepare the TLC plates, analyze the mixtures, identify and check the purity of compound.

UNIT–III (16hr)

SEPERATION TECHNIQUES AND THERMAL METHODS OF ANALYSIS

Solvent Extraction: Definition, types, principle and efficiency of extraction, sequence of extraction process, factors affecting extraction-pH, oxidation state, modifiers, synergistic, masking and salting out agents, techniques-batch and continuous extraction, applications, Separation of lanthanides.

Thermal Methods of Analysis: Introduction, thermogravimetric analysis (TGA), types of thermogravimetric analysis, principle and method, automatic thermogravimetric analysis, instrumentation, types of recording thermobalances, sample holders, factors influencing thermograms and applications, isothermal analysis, Differential Thermal Analysis (DTA), principle of working, theory and instrumentation, simultaneous DTA-TGA curves, factors affecting results and applications. Differential Scanning Colorimetry (DSC), principle of working, theory, instrumentation, and applications.

Self-study: Types of titrations and gravimetric analysis.

Skill components: Students should be able to do the binary mixture separation of given compounds by using separation technique (Solvent extraction).

UNIT–IV (16 hr)

ELECTROANALYTICAL TECHNIQUES

Introduction, electrochemical cells, faradic and non-faradic current, mass transfer in cells, galvanic and electrolytic cells, anodes and cathodes, liquid junction potential, schematic representation of cells.

Polarography: Theory, principle and applications classical polarography, dropping mercury electrode, polarogram, polarographic measurements, polarographic current, Ilkovic equation, current and concentration relationship, half wave potential, oxygen interference- advantages and limitations. Qualitative and quantitative analysis. Derivative polarography.

Amperometry and Coulometry at controlled potential and at constant current.

Cyclic voltammetry - basic principles, instrumentation and applications, stripping voltammetry and its applications including Electro -organic synthesis.

Electrogravimetry - theory, electrode reactions, over-voltage, characteristics of a good deposit, completeness of deposition, Determination of copper and nickel in Cu- Ni alloy.

Self study: Basics of electrochemical cells, galvanic and electrolytic cells, polarography, Qualitative and quantitative analysis.

Skill components: Students need to do the chemical analysis of the given reducible/oxidizable substances using polarogram.

REFERENCE BOOKS:

01. Principle of Quantitative Chemical Analysis – Robert de levie, International edition (1997) McGraw Hill Co.

02. Quantitative Analysis- Day and Underwood, Prinitce Hall Indian, Pvt Ltd 6thedition (1993).

03. Vogel's Textbook of quantitative chemical analysis- Revised by G.H.jaffery, J Bassett, J. Mendhm and R.C. Denney ELBS 5thedition (1998).
04. Quantitative Chemical Analysis: D.C Harris W.M. Freeman and Co, NY, USA, Ed, (1995).
05. Introduction to Instrumental Analysis – R.D Brun, McGraw Hill Book company (1982).
06. Physical Methods in Inorganic Chemistry- R. Drago, Affiliated to East west Pvt, (1968).
07. Introduction to chromatography- theory and practice-V.K. Srivastava and K.K.Srivastava, S. chand Company Ltd., IV Ed (1991).
08. Basic Concepts of analytical Chemistry- S.M Khopkar, New Age Intentional Publishers, IIEd.,(1998).
09. Analytical chromatography- G.R Chatwal, Himalaya Publishing House, VII Ed., (1998).
10. Principle Instrumental Analysis- Skoog, Hollar and Nieman, , Harcourt, Asia pvt Ltd., Indian New Delhi, VEd, (1998).
11. Fundamentals of Analytical Chemistry- Skoog, West and Hollar, Harcourt, Asia pvt Ltd., Indian New Delhi, VEd, (1998).

CHACPr 1.8:

Analytical Chemistry Practical - I

Duration: 4 hr/ week & Total: 64 hr **Credits: 2**

I. Organic Chemistry Practical

Quantitative analysis

1. Titrimetric Estimation of amino acids.
2. Estimation of glucose by Bertrand's method.
3. Estimation of keto group.
4. Iodine value of oil (Chloramine - T method)
5. Estimation of Nitro group by reduction using SnCl2.

Qualitative Analysis

Separation of binary mixture of organic compounds using ether and identification of separated compounds by systematic qualitative organic analysis.

Please Note:

1) Individual organic compounds are to be given after the candidate reports the nature of the mixture. 2) Ether insoluble acids and ether insoluble Neutral organic compounds may be given. 3) Low boiling liquids and Amino acids need not be given.

The following mixtures may be given.

1. Acid + Base
2. Acid + Neutral
3. Base + Neutral
4. Phenol + Acid
5. Base + Phenol

- Recrystallization
- Fractional distillation
- Thin layer chromatography
- Column chromatography

Scheme of Examination:

i. Duration of examination: 04 hours
ii. Experiment : 30 marks
iii. Viva-Voce: 05 marks
iv. Journal: 05 marks
v. Internal assessment: 10 marks

Total: 50 marks

REFERENCE BOOKS:

01. Text book of Quantitative Analysis by A. I. Vogel, ELBS, Harlow.
02. Advanced Practical Organic Chemistry, N.K. Vishnoi, Vikas, Publishing House
03. Handbook of Practical Organic Chemistry, Clark 04. Practical Organic Chemistry, O.P. Agrawal

SECOND SEMESTER

CHIT-2.1: INORGANIC CHEMISTRY-II

Teaching: 4 h/ week & Total: 64hr **Credits: 4**

UNIT-I (16 hr)

SYMMETRY AND GROUP THEORY

Molecular symmetry: Symmetry elements and symmetry operations, rotation axis, rules for orientation of molecules, plane of symmetry, rotation-reflection axis, centre of symmetry and identity element of symmetry, products of symmetry operations, general relations among symmetry elements and symmetry operations.

Group theory: Concept of a group, definition of a point group, procedure for classification of molecules into point groups, subgroups, Schoenflies and Hermann-

Maugin symbols for point groups, multiplication tables for the symmetry operations of simple molecules, matrix notation for the symmetry elements and for geometric transformations, class of a group and similarity transformation.

Representation of groups: Reducible and irreducible representations, Great Orthogonality theorem and its consequences, labeling of irreducible representations, group theory and hybrid orbitals to form bonds, character tables (Cs, Ci, C2, C2v and C3v).

Applications of group theory: Applications of group theory to crystal field theory, bonding in octahedral and tetrahedral complexes, symmetry and dipole moments, symmetry and optical activity.

Self-study: Finding the symmetry elements in compounds with higher CN (> 6)

Skill component: Construct the ball and stick model of any chiral compound and deduce the representations.

UNIT-II (16hr)

COORDINATION CHEMISTRY-REACTIONS, KINETICS AND MECHANISMS

Types of mechanisms in substitution reactions-dissociation, interchange and association.

Metal-ligand equilibria step-wise and overall stability/formation constant, factors affecting stability of metal complexes. Determination of stability constant by spectrophotometric (Job's) method. Trans/cis effect, thermodynamic and kinetic stability, labile an inert complex, complimentary and non-complimentary reactions.

Reactions and kinetics of substitution in octahedral complexes: Ligand field effects and reaction rates, mechanism of substitution in octahedral complexes, reaction rates influenced by acid and base.

Redox reactions-outer sphere and inner sphere mechanisms. Marcus theory, excited state outer sphere electron transfer reactions (solar energy conversion).

Photochemistry of metal complexes-type of photochemical reactions, photo substitution and photo-redox reaction.

Self study: Fundamental of Solar cell and its reaction mechanism.

Skill component: Find the rate law of substitution reaction using UV-Vis spectrophotometer.

UNIT –III (16hr)

SOLID STATE AND STRUCTURAL CHEMISTRY

Types of solids, close packing of identical solid spheres, tetrahedral and octahedral voids, packing fraction, and radius ratio.

Crystallographic systems: Bravias lattices, Miller indices, external features of crystals.

Structures of selected crystals: normal and inverse spinels, hexagonal structures, pervoskites.

Defects in solids: Point defects (stoichiometric and non-stoichiometric), line defects and plane defects, stacking faults and grain boundaries.

Structural transformation of solids

Solid solutions: Hume – Rothery rules, substitutional solid solutions and interstitial solid solutions, solid solution mechanism.

Alloy systems: Phase diagram and their features with respect to alloys - two and three component systems, copper–zinc system, steels with reference to iron-carbon systems.

Self study: X-ray diffraction technique for powder sample and single crystal.

Skill component: Indexing of XRD pattern of a cubic system.

UNIT-IV (16 hr)

NUCLEAR CHEMISTRY

Radioactivity, nuclear reactions, nuclear power reactors–radioactivity, determination of half life, radioactive decay kinetics, parent-daughter decay-growth relationships, secular and transient equilibria, nuclear reactions, spallation, nuclear fission and fusion, types of nuclear power reactors, basic features and components of a nuclear power reactor, safety measures, an introduction to breeder reactors, applications of radioisotopes-synthesis of various useful radioisotopes, physico-chemical and analytical applications-isotope dilution method, activation analysis, radiometric titration and 14C dating, medical, agricultural and industrial applications of isotopes.

RADIATION CHEMISTRY

Interaction of matter with radiation, radiation dosimetry-units and measurement of chemical dosimeters (Fricke and ceric sulphate dosimeters), radiation chemistry of water, a brief introduction to radiolysis of liquids and solids, industrial applications of radiation chemistry (radiation polymerization, food irradiation and radiation synthesis).

Health and Safety Aspects: Biological effects of radiation, hazards in radiochemical work, radiation protection, decontamination procedures, permissible exposure doses, nuclear waste management including waste storage and disposal procedures.

Self study: Safety measures from radiation field

Skill component: Measuring the radioactivity present in standard sample using GM counter OR construct the Fricke dosimeter and measure the absorbed radiation.

REFERENCE BOOKS:

01. Symmetry and Spectroscopy of Molecules by K. Veera Reddy.
02. Chemical Applications of Group Theory by F. A. Cotton.
03. Symmetry and Group theory by P. K. Bhattacharya.

04. Inorganic Chemistry: Principles, structure and reactivity, 1997, J. E. Huheey, Keiter and Keiter.
05. Inorganic Chemistry, 3rd edition, C. E. Housecroft and A. G. Sharpe.
06. Inorganic Chemistry by Purcel and Kotz.
07. Inorganic Chemistry by W. W. Porterfield.
08. Concepts and Models of Inorganic chemistry by Douglass, Alexander and Mcdaniel.
09. Inorganic Chemistry by Miessler and Tarr.
10. Introduction to Solids by Azaroff.
11. Solid State Chemistry and its Applications by Anthony R. West.
12. Solid State Chemistry: An Introduction, 3rd edition, Lesley E. Smart and Elaine A. Moore.
13. Fundamental concepts of Inorganic Chemistry by A. K. Das, volume 1 to 7.
14. Essentials of Nuclear Chemistry by H.J. Arnikar, Eastern Wiley (1990).
15. Nuclear Chemistry by U.N. Dash, Sultan Chand and Sons (1991).

CHIPr-2.6: INORGANIC CHEMISTRY PRACTICAL-II

Duration: 4 h/ week & Total: 64 h **Credits: 2**

Part A. Qualitative analysis:

Qualitative analysis of at least FIVE ternary mixtures containing one rare cation and one interfering anion.

Part B: Preparation of complexes:

1) Copper glycine complex: cis and trans forms
2) Optical isomers of $[Co(en)_3]^{3+}$
3) Tris thiourea copper (I) sulphate monohydrate
4) $K_3[Al(C_2O_4)_3]$ $3H_2O$.
5) Tris ethylenediamine Ni(II) chloride
6) Estimation of Copper in tristhiourea copper (I) sulphate by Iodometric method.

Scheme of Examination:

i. Duration of examination: 04 hours
ii. Experiment: 30 marks
iii. Viva-Voce:05 marks
iv. Journal :05 marks
v. Internal assessment: 10 marks

Total: 50 marks

CHOT-2.2: ORGANIC CHEMISTRY-II

Teaching: 4 h/ week & Total: 64hr **Credits: 4**

UNIT-I (16 hr)

NAMED REACTIONS

C-C bond forming reactions: Aldol condensation, Dickmann condensation, Stobbe condensation, Micheal addition, Perkin reaction, Reimer-Tiemann reaction, Reformtsky reaction, Wittig reaction, Mannich reaction, Shapario reaction.

C-N bond forming reactions: Chichibabin reaction, Barton reaction, Hofmann-Loffler-Freytag reaction, Stork enamine reaction.

C-O bond forming reactions: Sharpless asymmetric epoxidation, Bayer-Villeger reaction.

C-Cl bond forming reaction: Hell-Volhard-Zelinski reaction.

Self-study: Basic of reaction mechanisms, addition, substitution and rearrangement reactions. Stereochemistry.

Skill components: Aldol condensation, Michel addition & HVZ reaction products are analyzed by spectroscopic (FT-IR, UV-Vis and NMR spectroscopy) available from online sources.

UNIT-II (16 hr)

OXIDATION AND REDUCTION REACTIONS

Oxidation reactions: Introduction, Oxidation reactions examples and applications of chromium series-$K_2Cr_2O_7$, PDC, PCC, Sorret and Jones reagents. Manganese compounds-$KMnO_4$, MnO_2. Oxidation reactions involving ozone, peracids, lead tetra acetate, per iodic acid, osmium tetroxide, selenium dioxide, Oppenauer oxidation.

Reduction reactions: Introduction, Catalytic hydrogenation-both heterogeneous (examples Nickel and palladium) and homogeneous, metal hydride reductions ($NaBH_4$ and $LiAlH_4$), reduction with dissolved metal, diimide reduction, Birch, Clemmenson, Wolf Kishner, Meerwin-Varley-Ponndorf reduction, Leukart reaction and reductions with diborane.

Self-study: Basics of oxidation and reduction, calculation of oxidation number, oxidizing and reducing agents with examples.

Skill components: Oxidizing and reducing agents are identified with model reaction (two examples), and monitor reaction using TLC, UV-Vis and FT-IR.

UNIT –III (16 hr)

REARRANGEMENT REACTIONS

Classification and general mechanistic treatment of nucleophilic, electrophilic, and free radical rearrangements.

Rearrangement reactions involving migration to electron deficient carbon: Pinacol-pinacolone, Wolf, Wagner-Meerwein, and Benzil-benzilic acid rearrangement.

Rearrangement reactions involving migration to electron rich carbon: Favorskii, Sommelet-Hauser, Naber and Steven rearrangement.

Rearrangement reactions involving migration to electron deficient nitrogen: Hoffmann, Curtius, Schmidt, Beckmann, Lossen rearrangement.

Rearrangement reactions involving migration to electron deficient oxygen: Dakin, Bayer-Villiger and Hydroperoxide rearrangement.

***Self-study*:** Basics of rearrangement, nucleophiles, electrophiles and free radicals with examples, migration and rearrangement of atoms, electron rich and electron deficient atoms.

***Skill components*:** Students need to give one nucleophilic, electrophilic & free radical rearrangement reactions with suitable examples, analyze reactants and products using spectral data (record/online source).

UNIT-IV (16 hr)

HETEROCYCLIC COMPOUNDS

Nomenclature, structure, reactivity, synthesis and reactions of pyrazole, isoxazole, isothiazole, imidazole, oxazole, thiazole.

Indole, benzofuran, quinolone, pyridine, Dimroth rearrangement.

Self-study: Basics of heterocyclic compounds, nomenclature and examples, aromatic, non-aromatic and anti-aromatic compounds.

Skill components: List out each heterocyclic ring contain drug molecule (one each) and give its biological applications with mechanism/mode of action.

REFERENCE BOOKS:

01. Understanding organic reaction mechanisms, A. Jacob, Cambridge Univ. Press, 1997.

02. Introduction to organic chemistry A. Streitweiser, Jr and C. H. Heathcock, Macmillan, 1985.

03. Physical and mechanistic organic chemistry, R.A.Y. Jones, 1st Edn. Cambridge Univ. Press, 1979.

04. Mechanisms of molecular migrations, Vols I and II, B. S. Thiagarajan, 1st Edn. Pergamon Press, Oxford, 1979.

05. P. J. Garratt in Comprehensive organic chemistry, D. Barton and W. D. Ollis, 1st Edn. Pergamon Press, Oxford, 1979.

06. Radicals in organic synthesis, B. Giese, Pergamon Press, 1986.

07. Stereoelectronic effects in organic chemistry, P. Deslongchamps, 1st Edn. Pergamon Press, 1983.

08. Organic photochemistry, J. M. Coxon and B. Halton, 1st Edn, Cambridge Univ. Press, London, 1974.

09. Molecular reactions and photochemistry, C. H. Deputy and D. S. Chapman, 1st Edn. Prentice-hall India, New Delhi, 1972.

10. Stereochemistry of carbon compounds, E. L. Eliel, S. H. Wilen and L. N. Mander, John Wiley & Sons, 1994.

11. Stereochemistry, Potapov, MIR, Moscow, 1984.

12. Stereochemistry, Nasipuri, D, New Age, 1999.

13. Advanced organic chemistry, J. March, 4th Edn. John Wiley, 2008.

14. Organic Chemistry, R. E. Ireland Prentice-Hall India, New Delhi, 1975.

15. Some modern methods of Organic Synthesis, W. Caruthers, Cambridge Uni. Press London, 2nd Edn. 1998.

16. Stereochemistry of organic compounds- Principle and applications, D. Nasipuri, 2nd Edn., New Age International Publishers, 2001.

CHOPr-2.6 ORGANIC CHEMISTRY PRACTICAL-II

Teaching: 4 h/ week & Total: 64hr **Credits: 4**

ANALYSIS OF BINARY ORGANIC MIXTURE

Systematic qualitative analysis of binary mixture (solid+solid, solid+ liquid). Chemical equations to be discussed for all tests.

Scheme of Examination:

i. Duration of examination: 04 hours
ii. Experiment: 30 marks
iii. Viva-Voce:05 marks
iv. Journal :05 marks
v. Internal assessment: 10 marks

Total: 50 marks

REFERENCES

01. Vogel's Text Book of Practical Organic Chemistry Furniss, Hannaford, Smith and Tatchell, ELBS Longmann
02. Advanced Practical Organic Chemistry N.K. Vishnoi, Vikas, Publishing House
03. Handbook of Practical Organic Chemistry Clark
04. Practical Organic Chemistry O.P. Agrawal

CHPT-2.3: PHYSICAL CHEMISTRY-II

Teaching: 4 h/ week & Total: 64 h **Credits: 4**

UNIT-I (16hr)
QUANTUM CHEMISTRY-II

Particle in three dimension box-derivation of Schrodinger's wave equation w.r.t three dimension box (calculation of energy and wave function), Rigid rotator and harmonic oscillator ,applications of Schrodinger's equation to hydrogen atom (to be derived), quantum numbers and their significance, Approximate methods in quantum mechanics, variations method, linear and nonlinear variation functions, application to the Helium atom, hydrogen molecule and ion, normal and degenerate states, Perturbation theory- first and second order perturbation theory, Slater's determination terms symbols and spectroscopic states.

***Skill development*:** Brief explanation and experimental results on Density Functional Theory (DFT).
Self-study: Study history of quantum mechanics, overview of electronic structure of molecules, VBT, MOT and DFT

UNIT-II (16hr)
STATISTICAL THERMODYNAMICS-II

Statistical thermodynamics: Introduction to statistical thermodynamics, energy states, unit cells, microscopic state and macroscopic state, phase space, system, assembly and ensemble, use of ensemble, micro canonical ensemble, canonical ensemble, probability, thermodynamic probability, molecular basis of residual entropy.

Sterling's approximation, Maxwell Boltzmann distribution law and its applications. Bose-Einstein statistics, Fermi-direc statistics and their comparisons. Derive the relationship between entropy and thermodynamic probability, partition function, thermodynamic functions in terms of partition function (energy, heat capacity, entropy, Gibb's free energy, enthalpy Helmholtz free energy). (problems to be solved).

***Skill development*:** Plotting of radial wave functions using origin software
Self-study: principles of mechanics and ensembles, fundamental postulates of Statistical thermodynamics and applications.

UNIT-III (6hr)
CHEMICAL KINETICS

Complex reactions: Kinetics of parallel, consecutive and reversible reactions. Chain reactions: Branched chain reactions, general rate expression. Theories of reaction rates: Collision theory and its limitations, Activated complex theory (postulates -derivation). Energy of activation.

Lindemann theory, Hinshelwood's theory of unimolecular reactions.

Reactions in solution: Ionic reactions - salt effects, effect of dielectric constant (single and double sphere models). Effect of pressure, volume and entropy change on the rates of reactions. Cage effect

with an example. Fast reactions- Introduction, study of fast reactions by continuous and stopped flow techniques, relaxation methods (T- jump and P-jump methods), pulse and shock tube methods.

Skill development: Kinetics Studies of the Bleaching of Food Dyes
Self-study: study of rate of reaction (average and instantaneous), factors affecting rate of reaction.

UNIT-IV (16 hr)
PHOTOCHEMISTRY

Electronic transitions in molecules, The Franck-Condon principle, electronically excited molecules - singlet and triplet states. Life times of excited states of atoms and molecules. Quantum yield and its determination.

A review of laws of photochemistry – Grottus-Draper law, Beer-Lambert law, Stark-Einstein law. Photo physical processes – kinetics of unimolecular reactions, experiments in photochemistry, photo properties - fluorescence, phosphorescence (Joblonski diagram), chemiluminescence. State diagrams, Stern-Volmer equation (to be derived), lasers in photochemical kinetic studies, photo electrochemistry, solar energy conversion and storage.

Photochemical processes – types of photochemical reactions – electron transfer, photo dissociation, oxidation and isomerization reactions with examples. Photosensitization. Flash photolysis.

***Skill development*:** Degradation of Methylene blue using ZnO or TiO2 nanosemiconductors.
Self-study: Mechanistic background of electrochemistry, chemistry of electronically excited states.

REFERENCE BOOKS:

01. Statistical themodynamics by B.C. Meclelland, Chapman and Hall, London (1973).
02. Text book of Physical Chemistry by Samuel Glasstone, MacMillan Indian Ltd., 2 nd edition, (1974).
03. Thermodynamics –Rajaram and Kunakose,East West, Nagin Cx,Dehli,1986.
04. Introductory Quantum Mechanics – Atkins ,Claredon,Oxford
05. Quantum chemistry-Kauzman,Academic Press,1957.
06. Quantum chemistry-R.K.Prasad ,II.Ed,New Age Int-2000.
07. Physical chemistry-Atkins,ELRS,1982.
08. Physical chemistry –Moore,Orient Longman,1972.
09. Quantum Chemistry – Eyring, Walter and Kimball. John Wiley and Sons, Inc., New York.
10. Theoretical Chemistry – S. Glasstone. East West Press, New Delhi, (1973).
11. Quantum Chemistry – R.K. Prasad, New Age International Publishers (1996).
17. Physical Chemistry – Gurtu and Gurtu Vol 1 and 2
18. Advanced Physical Chemistry – Gurdeep Raj
19. Physical Chemistry, A Molecular Approach – Donald McQuarrie
20. Thermodynamics for Chemists - Samuel Glasstone
21. Quantum Chemistry – Ira Levine
22. Chemical Kinetics – Keith J. Laidler

CHPPr-2.7 : PHYSICAL CHEMISTRY PRACTICALS-II

Duration: 4 h/ week & Total: 64 h **Credits : 2**

Chemical Kinetics

a. Determine the specific reaction rate of potassium persulphate-iodide reactionby initial rate method.

b. Study of kinetics of autocatalytic reaction between $KMnO_4$ versus oxalic acid.

c. Evaluation of Arrehenius parameter for the reaction between $K_2S_2O_8$ versus KI (first order)

d. Study the kinetics of the iodination of acetone in the presence of acid by initial rate method.

e. Study the acid catalyzed inversion of cane sugar and find out: (i) the order with respect to sucrose, (ii)the rate constant, (iii)compare kinetically strength of two acids(HCL and H2SO4).

pH metery:

a. Determination of degree of hydrolysis of aniline hydrochloride at room temperature and calculation of dissociation constant of the base by pH metry.

b. Determination of pH of acetic acid with sodium acetate buffer by pH metry method.

c. Determination of pH of formic acid with sodium formate buffer by pH metry method.

Colorimetric:

a. Determination of dissociation constant of a given indicator by colorimetric method.

b. Verification of Beers lamberts law by colarimetric method and calculation of molar extinction co-efficient (molar absorption co-efficient)

c. To construct the calibration curve Fe2+-KCNS and Cu2+-NH3 systems and estimate the amount of respective salt present in a given solution by colorimetrically

Scheme of Examination:

i. Duration of examination: 04 hours
ii. Experiment: 30 marks
iii. Viva-Voce:05 marks
iv. Journal :05 marks
v. Internal assessment: 10 marks

Total: 50 marks

REFERENCE BOOKS:

01. Selected Experiments in Physical Chemistry – Latham.
02. Experiments in Physical Chemistry – James and Prichard.
03. Experiments in Physical Chemistry – Shoemaker.
04. Advanced Physico-Chemical Experiments –J. Rose
05. Experimental Inorganic/Physical Chemistry- Mounir A. Malati.
06. Quantitative Chemical Analysis – Daniel C. Harris, (2006) 7th edition.

Soft core: CHORT 2.2.1
Spectroscopy - I

Teaching: 2 h/ week & Total: 32 h **Credits: 2**

UNIT–I **16h**

ULTRAVIOLET and VISIBLE SPECTROSOPY

UV-visible spectroscopy: Types of transitions and their theoretical interpretation, Beer's law, Lambert's law, Beer's-Lambert's law, limitations, chromophores, auxochromes, effect of substituents on the position of λ max, prediction of λ max for polyenes, α, β-unsaturated aldehydes and ketones (Woodward- Fisher rules), aromatic systems and their derivatives. basic components of instrumentation-single and double beam designs, applications-analysis of binary mixtures, measurement of dissociation constants of acids and bases.

Stereochemical factors in electronic spectroscopy. Quantitative electronic spectroscopy, Fluorescence and phosphorescence. Absorption spectra of charge transfer complexes. Symmetry restrictions on the allowdness of electronic transition,

Optical rotatory dispersion and circular dichroism; defintition and nomenclature, cotton effect and stereochemistry, the octant rule.

Self study (SS): Basic of UV Visible spectroscopy, emission and absorption spectroscopy.

Skill component (SC): Selected organic compounds may record UV-vis absorption of benzophenone, benzaldehyde and substituted compounds. And student needs to study, how to calculate molar extinction co-efficient (ε), λ max and concentration of some of the molecules/proteins.

UNIT–II **16 h**

IR spectroscopy

Vibration of diatomic molecules, vibrational energy curves for simple harmonic oscillator, effects of anharmonic oscillation, vibration-rotation spectra of carbon monoxide(No derivation), expressions for fundamental and overtone frequencies, vibrations of polyatomic molecules–The number of degrees of freedom of vibration, , modes of vibration (CO_2 and H_2O), fundamental, overtone, combination, hot bands, Fermi resonance, force constant and its significance, theoretical group frequency, intensity of absorption band and types of absorptions,

identification of functional groups- alkanes, alkenes, aromatics, carboxylic acids, carbonyl compounds (aldehydes and ketones, esters), amides and amines, fingerprint region, vibrational coupling, hydrogen bonding, steric effect and ring strain.

Quantitative infrared analysis, Absorbance, slit width, Path lengths, molar absorptivity, Attenuated total reflectants and multiple internal reflectants. Laser Raman spectroscopy, The Raman effect, comparision of IR and Raman spectra.

Self study: Basic of IR spectroscopy, Quantum theory of IR, Polarity of bond,.

Skill component: Selected six organic compounds may record FT-IR and analyzed complete spectrum of stretching and bending.

REFERENCES

01. Introduction to Spectroscopy. Pavia, Lampman and Kriz, 3rd edition, Thomson.
02. Spectroscopy, B. P. Straughan and S. Walker, John Wiley & Sons Inc., New York, Vol. 1 & 2, 1976.
03. Vibration Spectroscopy Theory and Applications, D. N. Satyanarayana, New age International, New Delhi.
04. Organic Spectroscopy, William Kemp, 3rd edition, Palgrava, 1991.
05. Optical Method of Analysis, E. D. Olsen, McGraw Hill Inc, 1975.
06. Spectroscopy of organic compounds – P. S. Kalasi, Wiley Eastern Ltd, India 1993.
07. Introduction to instrumental analysis – R. D. Braun, McGraw Hill Book company 1982.
08. Physical methods in inorganic chemistry – R. Drago, East West Pvt. Ltd, 1968.
09. Instrumental methods of chemical analysis – Gurdeep Chatwal and Anand.
10. Organic Spectroscopy, 2nd edition– Jag Mohan, Narosa Publishing House New Delhi.
11. Spectroscopy by H. Kaur, Pragati prakashan, 2017

[OPEN ELECTIVE]

CHEG-2.5: CHEMISTRY FOR EVERY DAY LIFE

Teaching: 4 h/ week & Total: 64 hr **Credits:4**

UNIT-I 16hr
POLLUTION

Air pollution: Air pollutants, prevention and control, greenhouse gases and acid rain, ozone hole and CFC's, photochemical smog and PAN, catalytic converters for mobile sources, Bhopal gas tragedy.

Hydrologic cycle, sources, criteria and standards of water quality-safe drinking water, public health significance and measurement of water quality parameters-(colour, turbidity, total solids, acidity, alkalinity, hardness, sulphate, fluoride, phosphate, nitrite, nitrate, BOD and COD), water purification for drinking and industrial purposes.

Toxic chemicals in the environment.

Detergents- pollution aspects, eutrophication. Pesticides and insecticides- pollution aspects, heavy metal pollution, solid pollutants -treatment and disposal, treatment of industrial liquid wastes. Sewage and industrial effluent treatment.

Oils and fats: Composition of edible oils, detection of purity, rancidity of fats and oil, tests for common edible oils Tests for adulterants like argemone oil and mineral oils.

UNIT-II 16 hr
INDUSTRIAL CHEMISTRY

Composition of soil - Inorganic and organic components in soil- micro and macro nutrients.

Fertilizers: Classification of Fertilizers- straight fertilizers, compound/complex fertilizers, fertilizer mixtures, manufacture and general properties of fertilizer products-Urea and DAP.

Ceramics: general properties, porous and non-porous wares, Manufacturing process, extrusion, turning, drying, decoration, Porcelain and china.

Cement: Types, manufacture, additives, setting, properties & testing of cement.

Glass: Manufacture, properties, shaping of sheets & plate glasses. Annealing, finishing. special glasses.

Paints and Pigments: White pigments (white lead, ZnO, lithopone, titanium dioxide), blue, red, yellow and green pigments. paints and distempers, requirements of a good paint, emulsion, latex, luminescent paints, fire retardant paints, varnishes, enamels, lacquers, solvents and thinners.

UNIT-III 16 hr
BIOORGANIC COMPOUNDS

Carbohydrates: Chemistry of important derivatives of monosaccharides - ethers, esters, acetals, ketals, deoxysugars and aminosugars.

Vitamins: Classification and Nomenclature. Source and deficiency diseases, biological functions of Vitamins- Vitamin A2, Vitamin B, Vitamin C, Vitamin D & Vitamin K. 32

Food Analysis: Dairy products- composition of milk and milk products, analysis of fat content, minerals in milk and butter, Estimation of added water in milk.

Beverages: Analysis of caffeine in coffee and tea, detection of chicory in coffee, chloral hydrate in toddy, estimation of methyl alcohol in alcoholic beverages.

Food additives, adulterants and contaminants- Food preservatives like benzoates, propionates, sorbates, bisulphites, artificial sweeteners like saccharin, dulcin and sodium cyclamate.

Flavours: vanillin, esters (fruit flavours) and monosodium glutamate. Artificial food colourants - coal tar dyes and non-permitted colours and metallic salts. Pesticide residues in food.

Drugs: Classification and nomenclature. Analgesics - aspirin, paracetamol; Anthelmentics – mebendazole, Antiallergics - chloropheneramine malleate.

Antibiotics: Pencillin, chloromycetin and streptomycin.

UNIT-IV 16 hr

INDUSTRIAL ORGANIC CHEMISTRY

Chemical energy systems and limitations, principles and applications of primary and secondary batteries and fuel cells, Basics of solar energy, Energy storage devices, Polymers in everyday life: from buckets to rockets: types and classification of polymers, source and general characteristics of natural and synthetic polymers, typical examples of polymers used as commodity plastics, textiles, electronic and automobile components, medical and aerospace materials, problems of plastic waste management, strategies for development of environmental friendly polymers.

Dyes: Colour and constitution (electronic concept). Classification of dyes, methods of applying dyes to the fabrics. A general study of Azo dyes, Orange –II, Mordant brown, Congo red and methyl orange.

Corrosion: Types and prevention, corrosion failure and analysis.

REFERENCE BOOKS:

01. B.K. Sharma: introduction to Industrial Chemistry, Goel Publishing, Meerut(1998).
02. Medicinal Chemistry by Asthoush Kar.
03. Drugs and Pharmaceutical Sciences Series, Marcel Dekker, Vol.II, INC, New York.
04. Analysis of Foods – H.E. Cox; 13. Chemical Analysis of Foods- H.E. Cox and Pearson.
05. Foods – Facts and Principles. N. Shakuntala Many and S. Swamy, 4th ed. New Age Internatl (1998).
06. Physical Chemistry – P. Atkins and J. de Paula -7 th Ed. 2002, Oxford University Press
07. Handbook on Fertilizer Technology by Swaminathan and Goswamy, 6 th ed. 2001, FAI.
08. Organic Chemistry by I. L. Finar, Vol. 1 & 2
09. Polymer Science and Technology, J. R. Fried (Prentice Hall)

M.Sc. in CHEMISTRY (Organic Chemistry) @ GSS

III SEMESTER

CHORT-3.1: ORGANIC CHEMISTRY-IIIA

Teaching: 4 h/ week & Total: 64 h **Credits: 4**

UNIT-I **16hr**

AROMATICITY

Aromaticity and Huckel's rule: HMO theory, energy level diagrams, Huckel's rule, benzenoid and non–benzenoid aromatic compounds, alternant and non-alternant hydrocarbons, annulenes. Antiaromaticity, homo aromaticity.

Aromaticity of charged rings (3-8 membered): Aromatic character and chemistry of Cyclopropynyl cyclopentadienyl anion, tropylium cation, tropone and tropolone

Heterocyclic Systems: Systems of the type pyrrole, pyridines, pyrilium cation, ferrocene.

Physical methods to study aromaticity: X-ray, UV and 1H–NMR methods. Ring current as criteria for aromaticity. Annulenes and hetero annulenes [10-18]

Self-Study: Review fundamental concepts of bonding and molecular orbital theory. study the application of Hückel's Rule to various complex cyclic systems and charged rings (e.g., annulenes, ferrocene).

Skill Component: Practice predicting the aromaticity, anti-aromaticity, or non-aromaticity of novel cyclic compounds using Hückel's rule. Develop the ability to interpret spectroscopic data (NMR, UV-Vis) to determine aromatic character and ring current effects.

UNIT –II **16hr**

REAGENTS IN ORGANIC SYNTHESIS

Use of the following reagents in organic synthesis and functional group transformation:

1. Gilmann reagent
2. Lithium diisopropyl amide (LDA)
3. Dicyclohexyl carbodimide (DCC)
4. 1,3-Dithiane (reactivity umpolung)
5. Trimethylsilyl iodide
6. Tri-n-butyl tin hydride (TNBH)
7. DDQ
8. Woodward-Prevost hydroxylation
9. Baker's Yeast
10. Phase transfer catalysts
11. Crown ethers
12. Peterson synthesis

Self-study: Basics of reagents, storage, handling, expire date. Basic of Crown ethers and Phase transfer catalyst.

Skill components: Students need to list out hazardous and nonhazardous reagents in the above 12 synthesis. Give model for storing safe and handling during reaction (gaggle, Fume hood and other safety measures)

UNIT –III **16hr**

PHOTOCHEMISTRY

Interaction of radiation with matter, types of excitations, rate of excited molecules, quenching, quantum efficiency, quantum yield, transfer of excitation energy, actinometry, singlet and triplet states, experimental methods in photochemistry of carbonyl compounds, and transition, Norrish type I and Norrish type II reactions Paterno–Buchi reaction, photoreduction, photochemistry of enones, hydrogen abstraction rearrangement of unsaturated ketones and cyclohexadienones, photochemistry of parabenzoquinones, photochemistry of aromatic compounds with reference to isomerization, addition and substitution, photochemical isomerization of cis and trans alkenes, photo-Fries rearrangement, Barton reaction, Hoffmann- Loefler-Freytag reaction, photochemistry of vision.

Self-study: Basics of photochemistry (PC), principle of PC, effect of photon on organic molecules. ***Skill components:*** Students select at least FOUR photoreaction products and analyse using different spectroscopic data (UV-Vis, FT-IR, NMR and mass spectrometry from online source).

UNIT –IV **16hr**

PERICYCLIC REACTIONS

Pericyclic Reactions: Classification of pericyclic reactions, molecular orbital symmetry, frontier orbitals of ethylene, 1,3-butadiene, 1, 3, 5-hexatriene, allyl system, Woodward-Hoffman correlation diagram method and Perturbation of molecular orbital (PMO) approach of pericyclic reaction under thermal and photochemical conditions, FMO and PMO approach to the following reactions.

Electrocyclic reactions- Con rotatory and dis rotatory ring closure 4n and 4n+2 and allylic systems, Woodward and Hoffmann selection rules for pericyclic reactions.

Cycloadditions reactions - Antarafacial and suprafacial additions, more emphasis on [2+2] and [4+2] Cycloadditions, Diels-Alder reaction, 1,3-dipolar cycloaddition reactions.

Sigmatropic rearrangements: Antarafacial and suprafacial shift involving carbon moieties, retention and inversion of configuration, Ene, Claisen and Cope reaction.

Self-study: Basics of pericyclic, electrocyclic and cycloaddition reactions. Orbital shape, conrotation and dis-rotation, stereochemistry.

Skill components: Students need to prepare some models (ball & Stick) to show some of the selected reactions.

REFERENCE BOOKS:

1. Fundamentals of photochemistry, K.K. Rohatgi Mukhergee, Wiley Eastern Limited, (1986)
2. Organic Photochemistry, J. M. Cozen and B. Halton, Cambridge University Press (I Edition) 1974
3. Molecular Reactions and Photochemistry, C H Deputy and D S Chapman, Prentice Hall India, New Delhi (1st Edition) , 1972.
4. Understanding organic reaction mechanisms, A. Jacob, Cambridge Univ. Press, 1997.
5. Introduction to organic chemistry A. Streitweiser, Jr and C. H. Heathcock, Macmillan, 1985.
6. Physical and mechanistic organic chemistry, R.A.Y. Jones, 1st Edn. Cambridge Univ. Press, 1979.
7. Mechanisms of molecular migrations, Vols I and II, B. S. Thiagarajan, 1st Edn. Pergamon Press, Oxford, 1979.
8. Radicals in organic synthesis, B. Giese, Pergamon Press, 1986.
9. Stereoelectronic effects in organic chemistry, P. Deslongchamps, 1st Edn. Pergamon Press, 1983.
10. Organic photochemistry, J. M. Coxon and B. Halton, 1st Edn, Cambridge Univ. Press, London, 1974.
11. Molecular reactions and photochemistry, C. H. Deputy and D. S. Chapman, 1st Edn. Prenticehall India, New Delhi, 1972.

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CHORT-3.2: ORGANIC CHEMISTRY-IIIB

Teaching: 4 h/ week & Total: 64 h **Credits: 4**

UNIT-I **16hr**

METALS AND NON-METALS IN ORGANIC SYNTHESIS

Organomagnesium compounds (Grignard reagents):

Preparation and structure.

Reactions:

Nucleophilic addition reaction:

With aldehydes and ketones, with imines and nitriles,

Nucleophilic substitution reaction:

At sp2 hybrid carbon- reaction with acid chloride, esters, amides, and lactones at sp3 hybrid carbon- reaction with organic halide, oxiranes,

Synthetic uses: For the preparation of hydrocarbons, alcohols, aldehydes, and ketones.

Organo Boron and Silicon compounds: Preparation and applications, hydroboration, hydroboration-oxidation, rearrangements, nucleophilic substitution at silicon. Silyl ethers as protecting groups, ipso substitution with electrophilic reactions, Brook rearrangement.

Self study: Recent advances in organometallic compounds.

Skill components: Preparation of any organozinc compound.

UNIT-II **16 hr**

DYNAMIC STEREOCHEMISTRY

Prochirality: Homotopic, heterotopic, enantiotopic and diastereotopic ligands and faces, identification using addition, substitution and symmetry criteria, nomenclature of stereoheterotopic ligands and faces, symbols for stereoheterotopic ligands in molecules with one or more prochiral centres, chiral and prochiral centre; prochiral plane, symbols for enantiotopic and diastereotopic faces.

Dynamic Stereochemistry: Stereoselectivity in organic synthesis: stereospecific and stereoselective reactions, principle of stereoselectivity-enantioselectivity and diastereoselectivity, use of chiral auxiliaries, Cram's and Prelog's rules. Stereoselectivity in addition, elimination, substitution reactions.

Asymmetric synthesis: using optically active reagents, optically active substrates and optically active catalysts with suitable examples.

***Self study*:** Basic of stereochemistry, enantiomers, diastereomers, R&S configurations, thrio
***Skill components*:** Analyse benzenoid (Napthalene, Antracene) and non-benzenoid.

UNIT-III 16 hr

DYES AND PIGMENTS

Colour and Constitution (electronic concept).Classification of dyes. Methods of applying dyes to the fibres. A general study of the following dyes (Principle involved and synthesis of typical dyes).

Azo dyes: Orange – II, Mordant brown, Congo red, Methyl orange and Methyl red.

Triphenyl methane dyes: Malachite green, Rosaniline, Crystal violet and Phenolphthalein.

Cyanine dyes: Ethyl red, Cyanine blue and Quinaldine.

Reactive dyes and Optical brightners: Tinopal and Blankophorppp.

Pigments: Fast violet, Lake red and Orange R.

Self study: Basics of dyes, their classification, and synthesis of typical dyes and pigments.

principles involved in the

***Skill components*:** Students need to prepare some derivatives using azo dyes by laboratory method.

UNIT-IV 16 hr

OILS, FATS AND LIPIDS

Oils, fats and waxes: Definition, chemical composition, chemical properties-hydrogenation, hydrogenolysis, hydrolysis, drying oils, rancidity, analysis of oils and fats- saponification value, iodine and acid value. Soaps-Manufacture of soaps by hot process, cleansing action.

Synthetic detergents, comparison of soaps and detergents, types of detergents (cationic, anionic and nonionic). Animal and plant waxes-composition, examples.

Lipids: Sphingolipids, phospholipids and glyco1ipids, naturally occurring fatty acids and their triglycerides, essential fatty acids, unusual fatty acids, methods of isolation: Gunstone's partition method, reactions of fatty acids-Fischer and trans esterification, oxidation and acyl group transfer reactions, analytical values-cetane number, emulsions and biodiesel.

Self study: Basics of hydrogenation, hydrogenolysis, hydrolysis,drying, oils,fats, saponification, soaps, detergents, waxes, esterification, and fatty acidification, soaps, detergents, waxes, estification, emulsion, biodiesels, and fatty acids.

***Skill components*:** students need to carry out some small experiments of soap and detergents with oil and compare the difference between them.

REFERENCE BOOKS:

01. F. A. Carey and Sundberg, Advanced Organic Chemistry – Part A & B, 3rd edition, Plenum Press, New York, 1990.
02. F. A. Carey and Sundberg, Advanced Organic Chemistry – Part A & B, 3rd edition, Plenum Press, New York, 1990.
03. Comprehensive Organic Synthesis – B. M. Trost and I. Fleming series, Pergamon Press, New York, 1991.
04. S. K. Ghosh, Advanced General Organic Chemistry, Book and Alleied (P) Ltd, 1998 05. Principles of organic synthesis, Richard Norman and J. M. Coxon
06. Disconnection approach, by Steurt Warren.
07. Natural products: Their chemistry and biological significance-J. Mann,
08. R. S. Davidson, J. B. Hobbs, D. V. Banthorpe & J. B. Harborne, Longman, UK, 1994.
09. Terpenes, J. Verghese, Tata McGraw-Hill, New Delhi, 1982.
10. Chemistry of terpenes and terpenoids, A. Newman, Academic Press, London, 1975.
11. Handbook of naturally occurring compounds Vol. II: Terpenes, T. K. Davon, I. Scott, Academic Press, NY, 1972.
12. Natural products chemistry Vol. I & II, K. Nakanishi, T. Goso, S. Ito, S. Natori & S. Nozoe, Academic Press, NY, 1974.
13. Total synthesis of natural products Vol. I & VI, Apsimon, John Wiley, NY, 1973-1981.
14. Organic chemistry Vol.II, I. L. Finar, 6th Edn. Longman, 1992.
15. Chemistry of natural products Vol. I & II, O. P. Aggarwal, Goel Publishing House, 6th Edn.
16. Total synthesis of natural products: The chiral approach Vol.III, S. Hanessian Pergamon Press,
17. Total synthesis of steroids, Akhaun & Titov, Jerusalem, 1969.
18. Medicinal natural products: A biosynthetic approach, P. M. Dewick. John Wiley, Chichester,
19. The colours of life: An introduction to the chemistry of porphyrins and related compounds, L. R. Milgrom, Wiley Chichester, 1995.
20. Spectral data of natural products Vol. I- K.Yamaguchi, Elsevier Publishing Co, London,1970.
23. Chemistry of natural products: A unified approach, N. R. Krishnaswamy, University Press, India, 1999.

CHORT-3.3: ORGANIC CHEMISTRY-IIIC

Teaching: 4 h/ week & Total: 64 h **Credits: 4**

UNIT-I 16 hr

ORGANIC POLYMER CHEMISTRY-I

Preparation and Significance: Preparation of polymers based on different types of monomers. Industrial applications. Nylon, Urea formaldehyde, phenol-formaldehyde and melamine resin. polycarbonates and its applications.

Rubbers: Natural and synthetic rubbers. Structural elucidation of natural rubber. Polymers degradation reactions. Thermal, oxidative and radiative processes.

Synthesis and properties of Buna-S and butyl rubber.

Biodegradable Polymers: Polymer degradation mechanisms, types, synthetic methods and applications of specific polymers like PLA, Polyurethane and Poly-lactico glycolic acid and factors affecting their biodegradability.

Self study: Basics of polymers, rubbers, thermal, oxidative and radiative processes, and analytical chemistry (Electrophoresis, thermal methods of analysis and chromatography)

Skill components: Students need to do the characterization of the given polymers by

Thermogravimetric (TG), Differential thermal analysis (DTA) and Differential scanning calorimetry
(DSC) methods.

UNIT-II 16hr

ORGANIC POLYMER CHEMISTRY-II
(BIOPOLYMER CHEMISTRY)

Carbohydrates: Introduction, ring size determination of monosaccharides-glucose and fructose, configuration and conformations of monosaccharides, anomeric effect, epimerization and mutarotation.

Configuration of aldoses and ketoses, osazone formation, chain elongation, chain shortening, reducing and non-reducing sugars, redox reactions of monosaccharides.

Polysaccharides: Structural elucidation of starch, structure of cellulose, glycogen, industrial importance starch, cellulose.

Polypeptides and Proteins: Introduction, Bruce-Merrifield synthesis of polypeptides.
Structure of proteins- End group analysis (Edman's and Sanger's methods).

Nucleic acids: Introduction, classification, components of nucleic acids, structures and synthesis of nucleosides and nucleotides, Watson-Crick model of DNA, role of DNA and RNAs in protein synthesis, genetic code-salient features.

Self-study(SS): Basics of carbohydrates, origin, types, examples, stereo isomers of D Glucose, Basic chemistry of amino acids, types of amino acids, history of nucleic acids.

Skill components: Students need to analyse spectral data of D- Glucose and D Fructose (open source/record). Pentapeptide sequence (H_2N-Leu-Ala-Phe-Pro-Gly- OH) analyzed mass spectrometry fragmentation pattern and confirm the sequence. DNA and RNA mass determination techniques may be model/analyzed (open source).

UNIT–III 16 hr

PETROCHEMICALS

Petroleum refining, constituents of petroleum and their separation. Conversion process (Cracking, reforming, alkylation etc.) for precursors of petrochemicals. Brief description of the chemistry and applications of ethylene, propylene, butylenes, acetylene, benzene and some of their derivatives and conversion into useful products.

Synthetic fibres, rubbers and plastics.

Newer Reactions: Japp-Klingaman reaction, Meerwein arylation, Nef reaction, Raush asymmetric allylation, Sharpless asymmetric dihydroxylation, Ugi-multicomponent reaction and Williamson ether synthesis.

Self study*:* Basics of petroleum refining, constituents of petroleum their separation, Synthetic fibres, rubbers and plastics.

Skill components*:* By using the application of the given alkenes (ethylene, propylene butylenes, acetylene, benzene) and their derivatives, covert them into useful products by laboratory methods.

UNIT–IV 16hr

CARBON NANOPARTICLES

Introduction :carbon molecules, nature of carbon bond, carbon structure. Small carbon clusters-C60: Discovery, structure and bonding in Fullerenes and other bulky balls. (, crown ether complexes and cryptands, inclusion compounds, cyclodextrins, catenanes and rotaxanes)

Carbon nano-tubes: Fabrication structure, mechanical properties of Graphene and CNT

Drug delivery using nanomaterials: Targeted and controlled drug release through covalent, non-covalent and defect functionalization (conjugation) of carbon nanotubes (CNTs).

Conjugation of biomolecules to other nanomaterials (noble metals, metal oxides, fullerenes and graphene) for targeted drug / gene delivery.

Bio-sensors: An overview, types, design and applications.

Self study: Basics of drugs, Nanomaterials (CNTs), biomolecules, enzymes, hormones, DNA and RNA.

Skill components: Students need to prepare a model on Bio- sensors.

REFERENCES

1. Polymer chemistry – An introduction by Malcolm P.Stevens, 3 rd edition, Oxford university press, 1998.
2. Organic polymer chemistry by K.J.Saunders 2nd edition, chapmann and hall publishers,.
3. Polymer science and technology : Plastics, rubbers, blends and composites by Dr. Premamoy Ghosh 3rd edition . McGraw Hill Education (India) Pvt.Ltd. 2011.
4. Amino acids peptides synthesis , structures and applications . Edited by Bernd Gutte
5. Amino acids peptides and proteins in organic chemistry volume 5 by Andrew B. Hughes, Wiley publications, 2013.43
6. Amino acids and peptides by G.C.Barrett, D.T.Elmore, Cambridge university press, 1998.
7. Amino acids peptides and proteins volume 31, by G.C.Barrett, Don T. Elmore, Jenny A. Littlechild, Anand S.Dutta, Imer sovago, Etelka Farkas. Royal society of chemistry, 2007.
8. Nanotubes and Nanowires- C.N.R. Rao and A. Govindaraj. Editor: Paul O Brien. 2nd illustrated edition. Royal society of chemistry publishing, 2011.
9. Nanoscale materials, edited by Kenneth J. Klabunde, Ryan M.Richards 2nd edition, Wiley publishers, 2009.
10. Synthesis, functionalization and surface treatment of nanoparticles , edited by Marie Isabelle Baraton. Amer scientific publications, 2002.
11. BioMEMS (Microsystems) edited by Gerald A. Urban, 1st edition,
12. Introduction to Nanoscale Science and Technology (Nanostructure Science and Technology volume 6) , edited by -Massimiliano Di Ventra, Stephane Evoy and James R.Heflin, Jr. Springer sciece and business media, 2004.
13. Nanomaterials for drug delivery and therapy by Alexandru Mihai Grumezescu
14. Introduction to RNA/DNA cleavage by James K.Bashkin , ACS publication , 1998.

Soft-core: CHORT-3.4

SPECTROSCOPY-II

Teaching: 2 h/ week & Total: 32 h **Credits: 2**

UNIT–I **16 hr**

NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY

Magnetic properties of Nuclei – Nuclear spin, magnetic moment, g factor. Effect of External Magnetic field on the spinning nuclei, Larmor frequency, Resonance condition. Magnetic Energy levels, Relaxation processes – Mechanism & Relaxation time. Line width and factors affecting line width.

Instrumentation: continuous wave methods, sample handling, reference and solvents. (D2O exchange).

Chemical shift – Factors affecting chemical shift, Electronegativity, Shielding & deshielding mechanisms. Ring current and anisotropic effects, to be illustrated with Alkanes, Alkenes, Alkynes, Alkyl halides, Aromatic and carbonyl compounds. Chemical shifts of different types of organic compounds. NMR of Annulenes

Nature of protons attached to carbon: Integrals, Equivalence of protons – chemical and Magnetic Equivalence. Spin–Spin coupling. Geminal and Vicinal coupling constants, Karplus equation – curve.

First order spectra – High order spectral Analysis. Simplification of spectra – effect of increasing magnetic field strength.

Long range coupling, NOE, Lanthanide shift reagents, Temperature effect, Nuclear double resonance. Study of H-bonding in OH, SH, NH – compounds.

Self-study (SS): Basic of spectroscopy, Electromagnetic radiation, nuclear spin, NMR solvent, theory of NMR.

Skill component (SC): Download simple molecules NMR spectra of C_2H_5OH, CH_3- CO-CH_3, C_6H_6, CH_3OH and $CH_3CH_2CH_2OH$, analyze ^1H, ^{13}C

UNIT–II 16 hr

MASS SPECTROMETRY

Ionisation and Mass analysis.
Instrumentation, methods of ionization, EI, CI, DI, SI - Methods.
Fragmentation : principles, odd and EE ions, molecular ion and base peak, Nitrogen rule, metastable ions. Isotope effects in chloro and bromo compounds. Stevenson rule.
Fragmentation of :
i) Normal and Branched Alkanes. ii) Alkenes. iii) benzene and its derivatives.
iv) Alcohols. v) Aldehydes. vi) Ketones. vii) Acids. viii) Esters. ix) Ethers. x) Amines.
xi) Nitro compounds. xii) Halo compounds. xii) Peptides
McLafferty and McLafferty + 1 rearrangement. Calculation of molecular formula. Composite problems:
Calculation of H- deficiency Index..

Combined applications of spectroscopic techniques

Combined applications of IR, UV-Visible, ^{1}H NMR, ^{13}C NMR and Mass spectrometry in the structural elucidation of organic compounds.

01. Structure analysis when spectral data of the organic compound is given

02. Structure analysis when spectra of organic compound are given

Self-study (SS): Origin of mass spectrometry, ionization, principle, types of detector.
Skill component (SC): Download some six simple different functional group contain compounds and analyse fragmentation pattern and justify how this help for structure elucidation of new compounds.

REFERENCE BOOKS:

01. Introduction to Spectroscopy. Pavia, Lampman and Kriz, 3rd edition, Thomson.
02. Spectroscopy, B. P. Straughan and S. Walker, John Wiley & Sons Inc., New York, Vol. 1 & 2, 1976.
03. Vibration Spectroscopy Theory and Applications, D. N. Satyanarayana, New age International, New Delhi.
04. Organic Spectroscopy, William Kemp, 3rd edition, Palgrava, 1991.
05. Optical Method of Analysis, E. D. Olsen, McGraw Hill Inc, 1975.
06. Spectroscopy of organic compounds – P. S. Kalasi, Wiley Eastern Ltd, India 1993.
07. Introduction to instrumental analysis – R. D. Braun, McGraw Hill Book company 1982.
08. Physical methods in inorganic chemistry – R. Drago, East West Pvt. Ltd, 1968.
09. Instrumental methods of chemical analysis – Gurdeep Chatwal and Anand.
10. Organic Spectroscopy, 2nd edition– Jag Mohan, Narosa Publishing House New Delhi.
11. Spectroscopy by H. Kaur, Pragati prakashan, 2017

3.6: ORGANIC CHEMISTRY PRACTICALS-IIIA

Duration: 4 h/ week & Total: 64h **Credits: 2**

ORGANIC ESTIMATIONS

1. Estimation of phenol.
2. Estimation of aniline
3. Determination of saponification value of oils.
4. Estimation of sugars by Fehling's method
5. Estimation of amino acids.
6. Determination of iodine value of oils.

Determination of unsaturation by bromination method

Scheme of Examination:

i. Duration of examination: 04 hours
ii. Experiment: 30 marks
iii. Viva-Voce:05 marks
iv. Journal :05 marks
v. Internal assessment: 10 marks

Total: 50 marks

REFERENCES

01. Manual of Organic Chemistry Dey and Seetharaman.

02. Modern experimental Organic Chemistry John H. Miller and E. F. Neugil

03. An introduction to practical Organic Chemistry Robert, Wingrove etc.

04. A Text book of practical Organic Chemistry A I. Vogel Vol.III

05. Practical Organic Chemistry Mann & Saunders

06. An Introduction to Practical Organic Chemistry Robert, Wingrove etc.

07. Semimicro qualitative Organic Analysis Cheronis, Entrikin and Hodnet

08. Laboratory Manual of Organic Chemistry R. K. Bansal New PAGE International (P) Ltd.

London, 3rd edition, 1996.

09. Practical Organic Chemistry N. K. Visno, New PAGE International(P) Ltd. London, 3rd edition, 1996

3.7: ORGANIC CHEMISTRY PRACTICALS-IIIB

Duration: 4 h/ week & Total: 64 h **Credits : 2**

Synthesis via Name Reactions

1. Benzoic acid and benzyl alcohol from benzaldehyde (Cannizarro reaction).
2. Preparation of o-hydroxy benzophenone from phenyl benzoate via Fries rearrangement
3. Esterification: Preparation of benzoccaine from p-nitrotoluene
4. Molecular rearrangement: Preparation of o-chlorobenzoic acid from phthalic anhydride
5. Biginelli Reaction: Synthesis of Dihydropyrimidinone from Benzaldehyde and Urea
6. Preparation benzilic acid from benzaldehyde

Scheme of Examination:

i. Duration of examination: 04 hours
ii. Experiment: 30 marks
iii. Viva-Voce:05 marks
iv. Journal :05 marks
v. Internal assessment: 10 marks

Total: 50 marks

REFERENCES

01. Manual of Organic Chemistry Dey and Seetharaman.
02. Modern experimental Organic Chemistry John H. Miller and E. F. Neugil
03. An introduction to practical Organic Chemistry Robert, Wingrove etc.
04. A Text book of practical Organic Chemistry A I. Vogel Vol.III
05. Practical Organic Chemistry Mann & Saunders
06. An Introduction to Practical Organic Chemistry Robert, Wingrove etc.
07. Semimicro qualitative Organic Analysis Cheronis, Entrikin and Hodnet
08. Laboratory Manual of Organic Chemistry R. K. Bansal New PAGE International (P) Ltd. London, 3rd edition, 1996.
09. Practical Organic Chemistry N. K. Visno, New PAGE International(P) Ltd. London, 3rd edition, 1996

3.8: ORGANIC CHEMISTRY PRACTICALS-IIIC

Duration: 4 h/ week & Total: 64 h **Credits :2**

MULTISTEP ORGANIC PREPARATION

1. Preparation of anthralinic acid from phthalimide.
2. Preparation of p-chlorotoluene from p-toluidine.
3. Preparation of benzophenone oxime and its rearrangement to benzanilide.
4. Preparation of methyl red from anthralinic acid.
5. Preparation of benzopinacolone from benzophenone.
6. Preparation of 6,8-nitro-4-methyl-7-hydroxycoumarine from resorcinol.
7. Preparation of β-anilino-β-phenyl propiophenone from acetaphenone and benzaldehyde

Scheme of Examination:

i. Duration of examination: 04 hours
ii. Experiment: 30 marks
iii. Viva-Voce:05 marks
iv. Journal :05 marks
v. Internal assessment: 10 marks

Total: 50 marks

REFERENCES

01. Manual of Organic Chemistry Dey and Seetharaman.
02. Modern experimental Organic Chemistry John H. Miller and E. F. Neugil
03. An introduction to practical Organic Chemistry Robert, Wingrove etc.
04. A Text book of practical Organic Chemistry A I. Vogel Vol.III
05. Practical Organic Chemistry Mann & Saunders
06. An Introduction to Practical Organic Chemistry Robert, Wingrove etc.
07. Semimicro qualitative Organic Analysis Cheronis, Entrikin and Hodnet
08. Laboratory Manual of Organic Chemistry R. K. Bansal New AGE International (P) Ltd. London, 3rd edition, 1996.
09. Practical Organic Chemistry N. K. Visno, New AGE International(P) Ltd. London, 3rd edition, 1996.

[OPEN ELECTIVE]

CHEG-3.5: ENVIRONMENTAL CHEMISTRY

Teaching: 4 h/ week & Total: 64 h **Credits : 4**

UNIT-I 16 hr

POLLUTION

Environmental segments, evolution of earth's atmosphere.

Air pollution: Air pollutants, prevention and control, greenhouse gases and acid rain, carbon monoxide, industrial sources and transportation sources.

SOx- sources, ambient concentration, test methods, control techniques - scrubbing, limestone injection process. Ozone hole and CFC's, photochemical smog and PAN.

NOx- sources, ambient concentration, test methods, thermodynamics and NOx, control techniques. **Particulates:** Size distribution, particulate collection - settling chambers, centrifugal separators, wet scrubbers, electrostatic precipitators & fabric filters, catalytic converters for mobile sources, Bhopal gas tragedy.

UNIT-II 16 hr

WATER POLLUTION

Hydrologic cycle, sources, chemistry of sea water, criteria and standards of water quality- safe drinking water, maximum contamination levels of inorganic and organic chemicals, radiological contaminants, turbidity, microbial contaminants, public health significance and measurement of colour, turbidity, total solids, acidity, alkalinity, hardness, chloride, residual chlorine, sulphate, fluoride, phosphate and different forms of nitrogen in natural and polluted water, chemical sources of taste and odour, treatment for their removal, sampling and monitoring techniques.

UNIT-III 16 hr

WATER ANALYSIS

Determination and significance of DO, BOD, COD and TOC, water purification for drinking and industrial purposes, disinfection techniques, demineralization, desalination processes and reverse osmosis.

Radioactive waste management, radionuclides in soil, effects of ionizing radiations effect on ecosystem, accidents at atomic power plants-Chernobyl disaster, disposal of radioactive liquid wastes, methods of radiation protection.

UNIT-IV **16 hr**

DETERGENTS, PESTICIDES and SOIL ANALYSIS

Toxic chemicals in the environment, impact of toxic chemicals on enzymes.

Detergents- pollution aspects, eutrophication.

Pesticides-pollution of surface water. Sewage and industrial effluent treatment, heavy metal pollution. Chemical speciation- biochemical effects of pesticides, insecticides, particulates, heavy metals (Hg, As, Pb, Se), carbon monoxide, nitrogen oxides, sulphur oxides, hydrocarbon, particulates, ozone, cyanide and PAN. Solid pollutants and its treatment and disposal.

Composition of soil - Inorganic and organic components in soil, micro and macro nutrients, nitrogen and sulphur pathways, soil pollution: classification of pollutants and their characteristics, sources, prevention and control, sampling and monitoring techniques.

REFERENCES BOOKS:

01. A.K. De : Environmental Chemistry (Wiley Eastern).
02. S.K. Banerji : Environmental Chemistry (Prentice Hall India), 1993.
03. S.D. Faust and O.M. Aly : Chemistry of Water Treatment, (Butterworths), 1983.
04. G.D. Christian : Analytical Chemistry, (4th Ed.), (John Wiley)
05. Sawyer and McCarty, Chemistry for Environmental Engineering (McGraw Hill) 1978
06. I. Williams, Environmental Chemistry, John Wiley, 2001
07. S. M. Khopkar, Environmental Pollution Analysis, (Wiley Eastern).
08. J.W. Moore: Heavy Metals in Water, (Springer-Verlag), 1984.
09. C. Malcolm, K.Killham and Edwards: Soil Chemistry and its Applications, Cambridge (1993)
10. M. Raymond and J.C. Shickluna: Soils, 5th Ed. (Prentice Hall, India),

M.Sc. in CHEMISTRY (Organic Chemistry) @ GSS College, Belagavi

IV SEMESTER

CHORT-4.1: ORGANIC CHEMISTRY-IVA

Teaching: 4 h/ week & Total: 64h **Credits : 4**

UNIT –I **16 hr**

RETROSYNTHESIS

Designing the synthesis based on retrosynthetic analysis

Disconnection Approach: An introduction to synthons and synthetic equivalents, disconnection approach, functional group inter-conversions, the importance of the order of events in organic synthesis, one group C-X and two group C-X disconnections, chemoselectivity, reversal of polarity, cyclization reactions, amine synthesis.

One Group C-C Disconnections: Alcohols and carbonyl compounds, regioselectivity, alkene synthesis, use of acetylenes in organic synthesis.

Two Group C-C Disconnections: Diels-Alder reaction, 1,3-difunctionalised compounds, α,βunsaturated carbonyl compounds, Michael addition and Robinson annulations.

Retrosynthesis: Retrosynthesis of benzocaine, 4-methoxy acetophenone, saccharin and bisavalone.

Protecting Groups: Illustration of protecting and deprotecting groups in organic synthesis. Protection of hydroxyl, carboxyl, carbonyl, thiol and amino groups.

Self study(SS):Basic of retrosynthetic analysis, synthons, synthetic equivalents, chemoselectivity, reversal of polarity, cyclization reactions, basic of protecting group.

Skill Components (SC): Student need to analyze retosynthetic pathways of saccharin and acetophenone product and intermediate analysis using several spectral data. How carbonyl group is protection monitored by FT-IR spectra need to be explained by taking (acetal and cyclic acetal formation one reaction)

UNIT–II **16 h**

AMINO ACIDS AND SOLUTION PHASE PEPTIDE SYNTHESIS

Amino acids, classification, stereochemistry, acid and base properties, biologically active amino acids, peptides and proteins–enzymatic hydrolysis, N-terminus protection, protecting reagents both acid and base labile, C-terminus protection,

Amide bond formation: methods and strategies, Acyl chlorides synthesis, Coupling reactions with acyl chlorides, Limitations of acyl chlorides, Acyl fluorides, fluorinating agents, Acyl azides,

Acyl imidazoles using CDI, Anhydrides: Symmetric anhydrides, Mixed anhydrides, N-carboxy anhydrides or Leuch's anhydrides Esters, Active esters of penta fluorophenol and Succinimidyl esters synthesis and applications, Phosphonium salts and Uronium salts reagents in peptide formation.

Self study: Basic of Amino acid classification, polypeptides, proteins and nuclic acids. Definition classification, characteristics and examples.

Skill components: Analyze and interpret with some suitable data for DNA and RNA in protein synthesis

UNIT –III **16 hr**

ALKALOIDS ,TERPENOIDS AND STEROIDS

Alkaloids: Introduction, classification, methods of isolation, general methods of isolation from plants, general methods of structural elucidation, structural elucidation and synthesis of ephedrine and quinine. Structure and biological importance of cocaine, codaine, thiebane and morphine.
Terpenoids: Introduction, classification, isoprene rule, structural elucidation and synthesis of menthol and zinzeberine.

Steroids: Introduction, classification; Diels hydrocarbon- its importance and synthesis, stereochemistry of cholesterol. Structural elucidation of cholesterol-Blanc's rule, location of double bond, hydroxyl group, angular methyl groups and side chain in cholestrerol, total synthesis.

Self-study (SS): Basics of alkaloids, terpenoids and antibiotics, isolation and nomenclature.

Skill components (SC): Analyze each one compound of the above class using various spectra.

UNIT –IV **16 hr**

PROSTAGLANDINS, HARMONES AND VITAMINS

Prostaglandins: Introduction, classification and biological importance, constitution of PGE1, synthesis of PGE1 by Corey's and Upjohn's approach.

Hormones : Classification of hormones into steroid, peptide/protein, and amino acid–derived types; general structural features of steroid hormones and their simple biosynthesis from cholesterol; overview of peptide hormones such as insulin and oxytocin; amino acid–derived hormones including adrenaline, noradrenaline, and thyroxine and physiological importance

Vitamins: Definition, Classification and biological importance, synthesis of vitamin C from D(+)Glucose, synthesis of vitamin A.

Self-study(SS): Basics of steroids , Prostaglandins, Vitamins, occurrence, nomenclature and isolation.

Skill components (SC):Students can make model of cholesterol.Students need to perform a small group project on water soluble & fat soluble vitamins, and analyze Vit- A UV-vis and FT-IR data (record/open source).

REFERENCE BOOKS:

01. F. A. Carey and Sundberg, Advanced Organic Chemistry – Part A & B, 3rd edition, Plenum Press, New York, 1990.
02. F. A. Carey and Sundberg, Advanced Organic Chemistry – Part A & B, 3rd edition, Plenum Press, New York, 1990.
03. Comprehensive Organic Synthesis – B. M. Trost and I. Fleming series, Pergamon Press, New York, 1991.
04. S. K. Ghosh, Advanced General Organic Chemistry, Book and Alleied (P) Ltd, 1998 05. Principles of organic synthesis, Richard Norman and J. M. Coxon
06. Disconnection approach, by Steurt Warren.
07. Natural products: Their chemistry and biological significance-J. Mann,
08. R. S. Davidson, J. B. Hobbs, D. V. Banthorpe& J. B. Harborne, Longman, UK, 1994.
09. Chemistry of natural products: A unified approach, N. R. Krishnaswamy, University Press, India, 1999.
10. Terpenes, J. Verghese, Tata McGraw-Hill, New Delhi, 1982.
11. Chemistry of terpenes and terpenoids, A. Newman, Academic Press, London, 1975.
12. 4. Handbook of naturally occurring compounds Vol. II: Terpenes, T. K. Davon, I. Scott, Academic Press, NY, 1972.
13. Natural products chemistry Vol. I & II, K. Nakanishi, T. Goso, S. Ito, S. Natori & S. Nozoe, Academic Press, NY, 1974.
14. Total synthesis of natural products Vol. I & VI, Apsimon, John Wiley, NY, 1973-1981.
15. Organic chemistry Vol.II, I. L. Finar, 6thEdn. Longman,1992.
16. Chemistry of natural products Vol. I & II, O. P. Aggarwal, Goel Publishing House, 6thEdn. 1982.
17. Total synthesis of natural products: The chiral approach Vol.III, S. Hanessian Pergamon Press, 1983.
18. Spectral data of natural products Vol. I- K.Yamaguchi, Elsevier Publishing Co, London,1970.
19. Total synthesis of steroids, Akhaun &Titov, Jerusalem, 1969.
20. Medicinal natural products: A biosynthetic approach, P. M. Dewick. John Wiley, Chichester, 1997.
21. The colours of life: An introduction to the chemistry of porphyrins and related compounds, L. R. Milgrom, Wiley Chichester, 1995.

CHORT-4.2: ORGANIC CHEMISTRY-IVB

Teaching: 4 h/ week & Total: 64 h **Credits: 4**

UNIT-I 16hr

STEREOCHEMISTRY OF COMPOUNDS OTHER THAN CARBON

Stereochemistry of nitrogen compounds: Quaternary ammonium salts, amines, tertiary amine oxides, oximes, determination of configuration of aldoximes and ketoximes, pyramidal inversion and configurational stability.

Phosphorus – chirality in phosphines, phosphine oxides, phosphonium salts; stability and inversion barrier.

Sulphur – stereochemistry of sulfoxides, sulfones, sulfonium salts; configurational stability and resolution.

Silicon – stereogenic silicon in organosilanes and silanols.

Other heteroatoms – brief introduction to chirality in arsenic, selenium, and related compounds.

UNIT-II 16 hr

ANTHOCYANINS CAROTENOIDS AND PORPHYRINS

Anthocyanins: Classification, method of isolation, basic structural features of anthocyanins, structural elucidation of cyanin chloride, pelargonin chloride, delphonin chloride. Structural elucidation of quercetin and wedelactone (synthesis not included).
Carotenoids: Methods of isolation. Structural relationship of α-, β- and γ-carotenes. Structure elucidation and synthesis of β-carotene.

Porphyrins: Structure elucidation and synthesis of haemin, chlorophyll-a.

Self study: Carotenoids biosynthesis and its pathway, MEP pathway, Structure and its functions.
Skill components: Physiological effects of carotenoids, Anthocyanins, porphyrins & List of aroma chemicals.

UNIT III 16hr

INSECTICIDES, FUNGICIDES AND HERBICIDES

Insecticides: Introduction, classification, mode of action and synthesis of chlorinated insecticides (DDT, chlordane, heptachlor and hexachlorocyclohexane), Naturally occurring insecticides-pyrethroids-natural pyrethrins-isolation and structures, synthetic pyrethroids, allethrin,cypermethrin, phenvalerate. Organophosphorous insecticides: Malathion, parathion,

DDVP, diazenon.Carbamate insecticides: Sevin, carbofluron, aldicab, beygon.

Fungicides: Introduction, Inorganic & organic fungicides, Systemic fungicides-types & examples.

Herbicides: Introduction, study of sulfonyl ureas, heterocyclic sulfonamides, heterocyclicamines, dihydropyrano[2,3-b]pyridylimidazolinones, pyrrolopyridylimidazolinones,1,2,4-triazine-3,5-diones, hydroxyoxazolidinones & hydroxypyrrolidinones, pyridine herbicides & 1,3,4-oxadiazoles. Mechanism of action and toxicities of insecticides, fungicides and herbicides.

***Self study(SS)*:** Background and Approach to the Study of Insecticides, fungicides and herbicides, and their types.

***Skill components(SC)*:** Applications and effects of Insecticides, fungicides and herbicides.

UNIT-IV **16 hr**

GREEN CHEMISTRY

Modern Technology: Modern techniques in organic synthesis. Brief outline of microwave. Ultrasound, clay catalyzed techniques and uses of ionic liquids and polymer supports in organic synthesis. Phase-transfer catalysts & Crown-ethers. Super critical fluid extractions

Microwave synthesis: Introduction, reaction vessel, reaction medium, concept, specific effects, atom efficiency, percentage atom utilization, advantage and limitation. N-alkylation and alkylation of active methylene compounds. Condensation of active methylene compounds with aldehydes. Synthesis of Ibuprofen by BHC and BOOTS approach. Diels- Alder reaction, Leuckarts reductive amination of lactones. Oxidation of alcohols and sulphides. Supramolecules

Self study: Basics of chemistry in daily life, green chemistry, choosing of starting materials, reagents, catalysts, solvents, and green synthesis.

Skill components: Real time analysis for pollution prevention, Use of renewable feedstocks, design for energy efficiency.

REFERENCE BOOKS:

01. Natural products: Their chemistry and biological significance-J. Mann,
02. R. S. Davidson, J. B. Hobbs, D. V. Banthorpe & J. B. Harborne, Longman, UK, 1994.
03. Terpenes, J. Verghese, Tata McGraw-Hill, New Delhi, 1982.
04. Chemistry of terpenes and terpenoids, A. Newman, Academic Press, London, 1975.
05. Handbook of naturally occurring compounds Vol. II: Terpenes, T. K. Davon, I. Scott, Academic Press, NY, 1972.
06. Natural products chemistry Vol. I & II, K. Nakanishi, T. Goso, S. Ito, S. Natori & S. Nozoe, Academic Press, NY, 1974.
07. Total synthesis of natural products Vol. I & VI, Apsimon, John Wiley, NY, 1973-1981.
08. Organic chemistry Vol.II, I. L. Finar, 6th Edn. Longman,1992.
09. Chemistry of natural products Vol. I & II, O. P. Aggarwal, Goel Publishing House, 6^{th} Edn. 1982.
10. Total synthesis of natural products: The chiral approach Vol.III, S. Hanessian Pergamon Press, 1983.
11. Total synthesis of steroids, Akhaun & Titov, Jerusalem, 1969.
12. Medicinal natural products: A biosynthetic approach, P. M. Dewick. John Wiley, Chichester, 1997.
13. The colours of life: An introduction to the chemistry of porphyrins and related compounds, L. R. Milgrom, Wiley Chichester, 1995.
14. Spectral data of natural products Vol. I- K.Yamaguchi, Elsevier Publishing Co, London,1970.
15. Chemistry of natural products: A unified approach, N. R. Krishnaswamy, University Press, India, 1999.
16. R. K. Bansal, Organic Reaction Mechanism, Wiley Eastern Limited, New Delhi, 1993 31. Green Chemistry-Environment friendly alternatives, R.Sanghi & M.M.Srivatsava, Narosa, 2003.
17. Green Chemistry-Environment benign reactions, V.K. Ahluwalia, Ane Books, India, 2006.

CHORT-4.3: ORGANIC CHEMISTRY-IVC
Medicinal Chemistry

Teaching: 4 h/ week & Total: 64 h **Credits : 4**

UNIT-I 16hr

CHEMOTHERAPEUTIC AGENTS

Introduction, definition of drug, requirements of drugs, chemotherapy, pharmacokinetics, pharmacodynamics, metabolites and anti-metabolites, prodrug and soft drugs, agonists and antagonist, concept of drug receptor, elementary treatment of drug receptor interactions, theories of drug activity-occupancy theory, rate theory, induced fit theory, classification of drugs.

Sulphonamides: Introduction, classification, synthesis and SAR studies of sulphathiazole, sulphanilamide, sulphadiazine.

Antimalarials: Introduction, classification, synthesis and drug action- Chloroquin and Pamaquin.

Analgesics: Introduction, classification, synthesis and drug action-Paracetamol, aspirin, salol, phenyl butazone, antipyrine.

Anti-inflammatory: Introduction, classification, synthesis and drug action- Indomethacin and Ibuprofen.

Self-study: Basics of drugs, chemotherapy, receptor, drug action and SAR studies.

Skill components: Student need to list each class (four) one drug molecule, analyze using spectral data (UV-Vis, FT-IR and NMR) and list out pharmacological and pharmacodynamics data (online source).

UNIT–II 16hr

ANTINEOPLASTIC AGENTS AND CARDIOVASCULAR DRUGS

Antineoplastic Agents: Introduction, cancer chemotherapy, role of alkylating agents and antimetabolites in treatment of cancer. Mention of carcinolytic antibiotics and mitotic inhibitors.

Synthesis of mechlorethamine, cyclophosphamide, melphalan, mustards and mercaptopurine.

Recent development in cancer- chemotherapy, radiotherapy, photochemotherapy.

Cardiovascular drugs: Introduction, cardiovascular diseases, drug inhibitors of peripheral symphatetic function, central intervention of cardiovascular output direct acting arteriolar dilators, synthesis of dithiazem, verapamil, methyldopa, atenolol, oxprenolol, antihypertensive drugs, lipid lowering agents (atorvastatin, statin derivatives).

Self study: Overview of Antineoplastic, role of Antineoplastic, Toxicity grading scale.

Skill components: Make list of Antineoplastic agents and Cardiovascular drugs, with their uses.

UNIT–III **16 hr**

DRUGS AFFECTING THE CENTRAL NERVOUS SYSTEM

Sedatives and hypnotics -Barbiturates (structure-activity relationship, metabolism); benzodiazepines (structure -activity relationship, metabolism)

Synthesis of phenobarbital, hexobarbital nitrazepam and oxazepam.

Anesthetics: General anesthetics; local anesthetics- Mode of action, structure-activity relationships.

Synthesis of methohexital and chloro-procaine.

Synthesis of meperidine, methadone and 6,7 -benzomorphans.

Tranquilizers : phenothiazine derivatives - stucture- activity relationship, metabolism and mode of action; other tranquilizers.

Synthesis of chlorpromazine.

Self study: Introduction, Neurotransmitter-receptor relationship, Blood-Brain barrier, Mechanism for action of anticonvulsant drugs.

Skill components: List the major neurotransmitters and neurotransmitter system.

UNIT-IV **16hr**

ANTIBIOTICS AND ANTIMYCOBACTERIAL

Antibiotics: Introduction, Development, mechanism of action, uses, doses and side effects of following classes of drugs:

Penicillins-structure activity relationship (SAR) and spectral characterization, streptomycine, chloromycitin and tetracyclins, synthesis of cepahloshorin-C.

Antimycobacterial: Introduction, Development, mechanism of action, uses, doses and side effects of following classes of drugs:

a. Antitubercular agents: i) Isoniazid ii) Antibiotics: Rifamycin, Streptomycin, Capriomycin, Canamycin, Clarithromycin, Azithromycin iii)Other Drugs: Pyrazinamide, Ethambutol, para amino Salicylic acid, Ethionamid

b. Antifungal: 1) Polyene membrane disruptors 2) Ergosterol biosynthesis inhibitors

REFERENCE BOOKS:

01. Medicinal Chemistry- An introduction , Gareth Thomas , 2nd edition, John Wiley & sons publications , 2011.
02. Medicinal Chemistry by D.Sriram and P.Yogeeswari, Pearson education , India, 2009.
03. Burger's Medicinal Chemistry and Drug Discovery, Vols. 4, Edited by Donald.J. Abraham, 6th edition John Wiley publication, 2003
04. Foye's Principles of Medicinal Chemistry, 6th Edn., T. L. Lemke, Wolters Kluwer, Lippincott Williams and Wilkins, 2007
05. Medicinal Chemistry, Ashutosh Kar, revised and expanded 3 rd edition, New age international(P) limited, publishers, 2005.
06. An Introduction to Medicinal Chemistry, P Graham, 5th edition, OUP Oxford, 2013.
07. Medicinal Chemistry – G R Chatwal, Himalaya publishing house , New Delhi, 2012.
08. Wilson and Gisvold's Text Book of Organic Medicinal and Pharmaceutical chemistry, Edited by J .H Block , J .M Beale, Jr. published by Wolters Kluwer Lippincott, Williams and Wilkins, 12th edition, 2011.
09. Goodman and Gilman's Pharmacological Basis of Therapeutics, by Laurence L.Brunton , John S. Lazo and Keith L.Parker , 11th Edition., Tata McGraw-Hill, 2005.
10. Essentials of medicinal chemistry, eds., Korolkovas and Burkhaltar, J.H., John wiley & sons,

Text book of Organic medicinal and pharmaceutical chemistry by wilson and Gisvold.

11. Synthetic drugs by O. D. Tyagi.
12. Swinyard, E.A.,Remington's phramaceutical sciences ", Ed., Artor Osal, Mack publishing company co., 1980, p.873.
13. "Medicinal Chemistry " Volumes, ed. Burger. '
14. The Organic Chemistry of Drug synthesis by Daniel Lednicer and Lester A. Mitscher

Soft-core: CHORT 4.4

ADVANCED TECHNIQUES FOR ORGANIC COMPOUNDS

Teaching: 2 hr/ week & Total: 32 hr **Credits : 2**

UNIT-I 16hr

MOLECULAR LUMINSCENCE SPECTROSCOPY

Molecular luminescence spectroscopy: Theoretical basis for fluorescence and phosphorescence. Singlet and triplet excited states. Variables affecting luminescence-quantum efficiency, transition types, structure and structural rigidity, temperature and solvent effects, effect of pH, dissolved oxygen and concentration effect.

Excitation spectra *vs* emission spectra.

Fluorescence instrumentation: fluorometers and spectrofluorometers. Sensitivity and selectivity. Modification necessary to measure phosphorescence.

General scope of applications of luminescence.

UNIT-II 16hr

COMPUTATIONAL CHEMISTRY

Chem Draw and Chem Sketch: Structure drawing and editing, construction of reaction schemes, automated generation of IUPAC nomenclature, molecular formulae and physicochemical properties, and conversion of 2D structures into 3D representations.

Drug discovery process: Computer Aided Drug Design (CADD), Development of New Drugs, Factors Affecting development of New Drugs.

Molecular Modeling: Fundamental techniques of geometry optimization, energy minimization, and conformational analysis through molecular visualization.

Molecular Docking: Rigid docking, flexible docking, manual docking. Autodock and Dock software with examples Preparation of ligands and protein targets, execution and analysis of docking scores with interpretation of non-covalent interactions.

AI Tools for Chemists: Application of artificial intelligence–based platforms for advanced literature search, spectral prediction (NMR, IR), scientific writing assistance, and reference management in research projects.

REFERENCES:

01. Molecular luminescence spectroscopy : Methods and applications by Stephen Gregory Schulman , Wiley publications 1993, dizitized on 2010.

02.Cramer, C. J. Essentials of Computational Chemistry: Theories and Models. Wiley, 2nd Edition, 2004.

03. Leach, A. R. Molecular Modelling: Principles and Applications. Pearson, 2nd Edition, 2001.

04. Gasteiger, J., Engel, T. (Eds.). Chemoinformatics: A Textbook. Wiley-VCH, 2003.

05. Gasteiger, J. (Ed.). Handbook of Chemoinformatics. Wiley-VCH, 2003.

06 Jensen, F. Introduction to Computational Chemistry. Wiley, 3rd Edition, 2017.

07. Ertl, P., Schuffenhauer, A. Chemoinformatics in Drug Discovery. Wiley-VCH, 2006

08. V.K.Raman Computational Chemistry

4.6: ORGANIC CHEMISTRY PRACTICALS-IVA

Duration: 4 h/ week & Total: 64 h **Credits :2**

QUALITATIVE ANALYSIS OF TERNARY MIXTURE USING ETHER

Ternary Mixture Analysis: Qualitative analysis of three component mixture using ether containing amino acids, low boiling liquids, nitro phenols etc.

Note: Separation of given ternary mixture and analyzing any one component.

Scheme of Examination:

i. Duration of examination: 04 hours
ii. Experiment: 30 marks
iii. Viva-Voce:05 marks
iv. Journal :05 marks
v. Internal assessment: 10 marks

Total: 50 marks

SUGGESTED BOOKS

01. Semi-micro qualitative organic analysis, Cheronis, Entrikin &Hoanett.
02. Preparation of organic intermediates, D. A. Hirley, John Wiley.
03. Text book of practical organic chemistry, A. I. Vogel, Pearson, 5th Edition, Delhi, 2004.
04. Organic experiments, L. F. Fieser, 2nd Edn. D. C. Heath & Co. USA, 1974-2000.
05. Practical organic chemistry F.G. Mann and B. C. Saunders 4th Edn. Longman, 2002. 06. Comprehensive practical organic chemistry : Preparation and quantitative Analysis,
07. V. K. Ahluwalia, R. Aggarwal, Universities Press (India), 2000.
08. Comprehensive practical organic chemistry: Qualitative analysis, V. K. Ahluwalia, S.
09. Dhingra, Universities Press (India), 2000.
10. An advanced course in practical chemistry, A. Ghoshal, B. Mahapatra and A. K. Nad,
11. New central book agency, Calcutta, 2000.
12. Advanced practical organic chemistry, J. Mohan, Vol. I and II, Himalaya Publishing House, 1992.
13. Practical organic chemistry (Quantitative analysis), B. B. Dey, M V Sitaraman
14. T. R. Govindachari, Allied Publishers, New Delhi, 1992.
15. Laboratory Techniques in Organic Chemistry, V K Ahluwalia, Pooja Bhagat

4.7: ORGANIC CHEMISTRY PRACTICALS-IVB

Duration: 4 h/ week & Total: 64 h **Credits : 2**

PART – A: Preparation of Derivatives: Base, Phenol, Ether soluble neutral, Ether insoluble neutral, Ether insoluble acid, Ether soluble acid.

PART-B : **Instrumental methods in Organic analysis**

1. Recording/predicting/downloading from web sites the UV, IR, NMR and GC-MS/mass spectra of the compounds prepared in Organic Practical – I, Organic Practical – II, Organic Practical – III and Organic Practical – IV.
02. Structural elucidation of organic compounds with the help of spectra provided by the instructors/examiners.

Note: In Practical examination;

a) Preparation of any two derivatives.

b) Elucidation of organic molecule by spectral analysis.

Scheme of Examination:

i. Duration of examination: 04 hours
ii. Experiment: 30 marks
iii. Viva-Voce:05 marks
iv. Journal :05 marks
v. Internal assessment: 10 marks

Total: 50 marks

REFERENCES

01. Modern experimental Organic Chemistry John H. Miller and E. F. Neugil
02. An introduction to practical Organic Chemistry Robert, Wingrove etc.
03. A Text book of practical Organic Chemistry A I. Vogel Vol.III
04. Practical Organic Chemistry Mann & Saunders
05. Laboratory Manual of Organic Chemistry R. K. Bansal New AGE International (P) Ltd. London, 3rd edition, 1996.
06. Practical Organic Chemistry N. K. Visno, New AGE International(P) Ltd. London, 3rd edition, 1996.

4.8 : ORGANIC CHEMISTRY PRACTICALS-IVC

Duration: 4 h/ week & Total: 64 h **Credits :2**

ISOLATIONS

01. Isolation of cysteine from human hair
02. Isolation of hesperidine from orange peel
03. Isolation of myristine from nutmug
04. Isolation of lycopene from tomato
05. Isolation of piperine from pepper
06. Isolation of caffeine from tea
07. Isolation of casein from milk
08. Isolation of nicotine from tobacco

Scheme of Examination:

i. Duration of examination: 04 hours
ii. Experiment: 30 marks
iii. Viva-Voce:05 marks
iv. Journal :05 marks
v. Internal assessment: 10 marks

Total: 50 marks

REFERENCES

01. Modern experimental Organic Chemistry John H. Miller and E. F. Neugil
02. An introduction to practical Organic Chemistry Robert, Wingrove etc.
03. A Text book of practical Organic Chemistry A I. Vogel Vol.III
04. Practical Organic Chemistry Mann & Saunders
05. Semimicro qualitative Organic Analysis Cheronis, Entrikin and Hodnet
06. Laboratory Manual of Organic Chemistry R. K. Bansal New AGE International (P) Ltd. London, 3rd edition, 1996.
07. Practical Organic Chemistry N. K. Visno, New AGE International(P) Ltd. London, 3rd edition, 1996.

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QUESTION PAPER PATTERN

PAPER CODE: –

Title of the paper:

Time: 3 Hours **Max. Marks: 80**

Answer any TEN of the following 10X2=20

1.a

b

c

d

e

f

g

h

i

j

k

l

Answer any **FOUR** of the following 5X4=20

2

3

4

5

6

7

Answer any **FOUR FULL QUESTIONS** of the following 4X10=40

8 a)

b)

9 a)

b)

10 a)

b)

11 a)

b)

12 a)

b)

Instructions to the Question paper setter:

Please select the questions as follows,

PART A: Three questions from each Unit

PART B: Atleast one question from each Unit

PARTC: 8 a) and b) from Unit I

9 a) and b) from Unit II

10 a) and b) from Unit III

11 a) and b) from Unit IV

12 a) and b) are the questions from the two units where the second questions are not asked in the part B

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QUESTION PAPER PATTERN

PAPER CODE: –

Title of the paper:

Time: 2 Hours **Max. Marks: 40**

Note 1) Answer all the parts

2) Draw diagrams wherever necessary

PART – A

Answer any FIVE of the following (2X5 =10)

1) a.
   b.
   c.
   d.
   e.
   f.

PART – B

Answer any TWO of the following (2X5 =10)

2)
3)
4)

PART – C

Answer any TWO of the following questions (2X10 =20)

5) a)
   b).
6) a)
   b)

7) a).

b)

Instructions to the Question paper setter:

Please select the questions as follows,

PART A: Three questions from each Unit

PART B: Atleast one question from each Unit

PARTC: Atleast one question from each Unit