



CVM
UNIVERSITY

(Established under Gujarat Private Universities
(Second Amendment) Act : 2019 Gujarat Act No. 20 of 2019)

FACULTY OF SCIENCE

Courses of Study

Master of Science

(Organic Chemistry)

Effective from June 2020

CVM UNIVERSITY
VALLABH VIDYANAGAR
Structure for M. Sc. Semester I
Organic Chemistry
(Total 650 marks)

Course Type	Course Code	Name of Course	T /P	Credit	Component of Marks		
					Internal	External	Total
					Total/ Passing	Total/ Passing	Total/ Passing
Core Course	101330101	Electron spectroscopy and Magneto chemistry	T	04	40/16	60/24	100/40
	101330102	Organic Chemistry-I	T	04	40/16	60/24	100/40
	101330103	Physical Chemistry-I	T	04	40/16	60/24	100/40
	101330104	Lab Synthesis-I (101330101, 101330102 and 101330103)	P	04	40/16	60/24	100/40
	101330105	Lab Analysis-I (101330101, 101330102 and 101330103)	P	04	40/16	60/24	100/40
	101330106	Comprehensive Viva – Voce		01		50/20	50/20
Elective Course	101330107	Biophysical Chemistry	T	04	40/16	70/28	100/40
	101330108	Polymer Chemistry	T	04	40/16	70/28	100/40

CVM UNIVERSITY
VALLABH VIDYANAGAR
Structure for M. Sc. Semester II
Organic Chemistry
(Total 650 marks)

Course Type	Course Code	Name of Course	T /P	Credit	Component of Marks		
					Internal	External	Total
					Total/ Passing	Total/ Passing	Total/ Passing
Core Course	101330201	Quantum Chemistry & Organometallic Chemistry	T	04	40/16	60/24	100/40
	101330202	Organic Chemistry-II	T	04	40/16	60/24	100/40
	101330203	Topics in Physical Chemistry-II	T	04	40/16	60/24	100/40
	101330204	Lab Synthesis-2 (101330201, 101330202 and 101330203)	P	04	40/16	60/24	100/40
	101330205	Lab Analysis-2 (101330201, 101330202 and 101330203)	P	04	40/16	60/24	100/40
	101330206	Comprehensive Viva - Voce		01		50/20	50/20
Elective Course	101330207	Introduction to Biochemistry	T	04	40/16	70/28	100/40
	101330208	Analytical Chemistry	T	04	40/16	70/28	100/40

CVM UNIVERSITY
VALLABH VIDYANAGAR
Structure for M. Sc. Semester III
Organic Chemistry
(Total 650 marks)

Course Type	Course Code	Name of Course	T /P	Credit	Contact Hrs/ Week	Exam Duration in Hrs	Component of Marks		
							Internal	External	Total
							Total/ Passing	Total/ Passing	Total/ Passing
Core Course	101330301	Organic Spectroscopy	T	04	4	2	40/16	60/24	100/40
	101330302	Disconnection Approach	T	04	4	2	40/16	60/24	100/40
	101330303	Heterocyclic Chemistry	T	04	4	2	40/16	60/24	100/40
	101330304	Spectral Exercise and Organic Separation Lab OR	P	04	6	6	40/16	60/24	100/40
	101330305	Project Work	P	04	6	-	40/16	60/24	100/40
	101330306	Synthesis and Application of Dyes and Intermediates Lab OR	P	04	6	6	40/16	60/24	100/40
	101330307	Project Work	P	04	6	-	40/16	60/24	100/40
	101330308	Comprehensive Viva – Voce		01				50/20	50/20
Elective Course	101330309	Selected Topics in Organic Chemistry	T	04	4	2	40/16	60/24	100/40
	101330310	Occupational Practices	T	04	4	2	40/16	60/24	100/40

* **Project work** (as optional) in place of practicals; to be offered to some of the students, based on their merit, interest and placement with the teachers (Marks : 200). The project shall have to be carried out under the allotted teacher(s) and a dissertation shall be submitted and will be assessed for internal (80 marks) and external (120 marks), in the usual manner.

CVM UNIVERSITY
VALLABH VIDYANAGAR
Structure for M. Sc. Semester IV
Organic Chemistry
(Total 650 marks)

Course Type	Course Code	Name of Course	T / P	Credit	Contact Hrs/ Week	Exam Duration in Hrs	Component of Marks		
							Internal	External	Total
							Total/ Passing	Total/ Passing	Total/ Passing
Core Course	101330401	Natural Products	T	04	4	2	40/16	60/24	100/40
	101330402	Medicinal Chemistry	T	04	4	2	40/16	60/24	100/40
	101330403	Stereochemistry of Organic Compounds	T	04	4	2	40/16	60/24	100/40
	101330404	Multistep Synthesis of Heterocyclic Compounds Lab OR	P	04	6	6	40/16	60/24	100/40
	101330405	Project Work	P	04	6	-	40/16	60/24	100/40
	101330406	Spectral Analysis & Synthesis of Drugs, Intermediates and Esters Lab OR	P	04	6	6	40/16	60/24	100/40
	101330407	Project Work	P	04	6	-	40/16	60/24	100/40
	101330408	Comprehensive Viva – Voce		01				50/20	50/20
Elective Course	101330409	Topics in Organic Chemistry	T	04	4	2	40/16	60/24	100/40
	101330410	Applied Organic Chemistry	T	04	4	2	40/16	60/24	100/40

* **Project work** (as optional) in place of practicals; to be offered to some of the students, based on their merit, interest and placement with the teachers (Marks : 200). The project shall have to be carried out under the allotted teacher(s) and a dissertation shall be submitted and will be assessed for internal (80 marks) and external (120 marks), in the usual manner.

CVM UNIVERSITY

M. Sc. (Organic Chemistry)

Semester: I

101330101: Electron spectroscopy and Magneto chemistry

Total Credit: 4

Unit	Description in details	Weightage (%)
I	Electron spectroscopy of transition metal complexes: I Concept of crystal field theory(CFT), ligand field theory (LFT) and molecular orbital theory (MOT); splitting of d-orbitals in various stereochemistry; tetragonal distortion in octahedral complexes; spectrochemical series; nephelauxetic series; Electronic states and term symbols; microstates; derivation of terms for closed subshell; derivation of terms for p^2 , d^2 & f^2 configuration.	25%
II	Electron spectroscopy of transition metal complexes: II Correlation diagrams; Orgel diagram; Tanabe- Sugano diagram; selection rule; determination of Dq and electronic parameters; interpretation of spectra.	25%
III	Magnetochemistry: I Magnetic susceptibility; sources of paramagnetism; diamagnetic susceptibility; Pascal constants and constitutive corrections; Langevin equation; Van Vleck's formula; antiferromagnetism; Types of antiferromagnetism; antiferromagnetism exchange pathway; Ferromagnetism and magnetic domains; molecular field theory of ferromagnetism; magnetic sublattice, ferrimagnetism and canting.	25%
IV	Magnetochemistry: II Spin-orbit coupling; Lande interval rule; quenching of orbital magnetic moment by crystal field; spin-orbit coupling on A and E terms; spin-orbit coupling on T term; Spin pairing: Spin pairing in octahedral complexes; in non-octahedral complexes; some aspects of spin pairing and cross over region. Chemistry of lanthanides and actinides: Term symbols, spectral and magnetic properties of the compounds of lanthanides and actinides; use of lanthanide compounds as shift reagents.	25%

Basic Text & Reference Books:-

- Molecular Spectroscopy, Theory and Applications, By: Raman Patel and Raman Patel
- Electronic absorption spectroscopy and related techniques, By: D.N. Sathyanarayana

CVM UNIVERSITY
M. Sc. (Organic Chemistry)
Semester: I
101330102: Organic Chemistry-I

Total Credit: 4

Unit	Description in details	Weightage (%)
I	<p>Stereochemistry:</p> <p>Concept of Chirality, Chirality and Symmetry, Sawhorse, Newman and Fischer Projections, Interconversion of Projection formula, Elements of Chirality including Chiral centre, Chiral axis, Chiral plane and Helicity, CIP Nomenclature, Molecules with more than one Chiral centre, Total number of Stereoisomer in such molecules, Enantiomeric and Diastereomeric Relationship, Chirogenicity and Stereogenicity, Pseudochirality, Topicity and Prostereoisomerism, Determination of Topic relationship between Homomorphous ligands in Intact Molecules, Concept of stereoselective and stereospecific reactions, Optical Purity.</p>	25%
II	<p>Name Reaction Mechanism and their Application:</p> <p>Molecular Rearrangement involving Non-classical Carbocation, Wagner- Meerwein and Related Rearrangements, Wolff, Curtius, Schmidt, Lossen, Beckmann, Benzil-Benzilic acid, Favorskii, Stevensen, Sommelet-Hauser Rearrangements, Fries reaction, aldol and related reactions, Knoevenagel, Dieckman, Darzen, Claisen reaction. [Emphasizing on Various Techniques for Determination of Mechanism]</p>	25%
III	<p>Elimination and Addition Reactions :</p> <p>Mechanisms and Orientation, E_1, E_{1cb}, E_2 spectrum, Effects of Changes in Substrate, Base, Leaving Group and Medium on Reactivity, Hoffman and Saytzeff eliminations, Bredt's Rule, Pyrolytic Eliminations- Cope and Chugaev eliminations; Addition reactions: Mechanisms, Orientation and Reactivity, Markonikoff and anti-Markonikoff additions, Reactions including Hydro-Halo, Hydro-Hydroxy, Hydro-Alkoxy, Dihydro, Dihydroxy, dihalo, ozonolysis [Emphasizing on Various Techniques for Determination of Mechanism]</p>	25%
IV	<p>Aromatic substitution reactions (Electrophilic and Nucleophilic):</p> <p>Mono-substituted benzenes - Reactivity and Orientations, Orientation in Benzene Rings with more than One Substituent, ipso substitution, Orientation in Other Ring Systems, Mechanisms of Friedel- Craft reactions, Nitration, Sulphonation, Halogenation, Diazocoupling and Formylation. Benzyne Mechanisms for Aromatic Nucleophilic substitution reactions.</p>	25%

Basic Text & Reference Books:-



- Organic Reactions, Stereochemistry and Mechanism: P.S. Kalsi (New Age.)
- Principles of Organic Synthesis: R.O.C Norman & J.M. Coxon (ELBS)
- Mechanism in Organic Chemistry: Peter Sykes (Orient Longman)
- Modern Methods of Organic Synthesis: W. Carruthers (Cambridge)
- Organic Reaction Mechanism: V.K.Ahluwalia and R.K.Parashar (Narosa)
- Organic Chemistry: Clayden, Greeves and Warren (Oxford)

CVM UNIVERSITY
M. Sc. (Organic Chemistry)
Semester: I
101330103: Physical Chemistry-I

Total Credit: 4

Unit	Description in details	Weightage (%)
I	Chemical Thermodynamics : Brief resume of concepts of laws of thermodynamics, free energy, chemical potential and entropies. Partial molar properties: partial molar free energy, partial molar volume and partial molar heat content and their significances. Determinations of these quantities. Concept of fugacity and determination of fugacity. Non-ideal systems: Excess functions for non-ideal solutions, Activity, activity coefficient, Debye-Huckel theory for activity coefficient of electrolytic solutions; determination of activity and activity coefficients; ionic strength.	25 %
II	Chemical Kinetics – I : Chemical kinetics and its scope, rate of reaction, factors influencing the rate of a reaction, measurements of reaction rates, differential and integral rate laws, rate laws and equilibrium constants for elementary reactions, temperature dependence of rate constants, Arrhenius equation, concept of activation energy, reaction mechanisms and examples ; - uni-molecular reactions, bi-molecular reactions, trimolecular reactions.	25 %
III	Electrochemistry : Electrochemistry of solutions, ion solvent interactions. Structure of electrified interfaces, Guoy-Chapman, Stern, Graham-Devanathan-Mottwatts, Bockris, Devanathan models. Over potentials/voltage and factors affecting on it, exchange current density, derivation of Butler-Volmer equation, Tafel plot and equations. Ionic liquids, Electrochemistry in ionic liquids.	25 %
IV	Surface Chemistry : Surface tension, capillary action, pressure difference across curved surface (Laplace equation), vapour pressure of droplets (Kelvin equation), Surface films on liquids (Electro-kinetic phenomenon), catalytic activity at surface. Micelles: Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, critical micelle concentration (CMC), factors affecting the CMC of surfactants, Ionic Liquids, synthesis, properties and applications.	25 %

Basic Text & Reference Books:-

- An Introduction to Chemical Thermodynamics, R. P. Rastogi and P. R. Misra, (Vikas Publishing House Pvt.Ltd.
- Thermodynamics, P. C. Rakshit, (The New Book Stall, Calcutta).
- Fundamentals of Chemical Thermodynamics, M. L. Lakhanpal, (Tata McGraw-Hill Publishing Company, New Delhi).
- Elements of Physical Chemistry, Peter Atkins, Julio De Paula, David Smith,(Oxford University Press, 6th Edition)
- Physical Chemistry, Ira N Levine (Tata McGraw-Hill Publishing Company, New Delhi, Fifth Edition).
- Micelles, Theoretical and Applied Aspects, V. Moroi, Plenum Press
- Modern Electrochemistry, Vol. I and Vol. II, J. O. M. Bockris and A. K. N. Reddy, Plenum press
- Chemical Kinetics, K. J.Laidler, Mc-Graw Hill Publisher
- Thermodynamics for Chemists, S. Glasstone, (East-West Edition, Third Edition)
- Surfactants and Interfacial Phenomena, Milton J. Rosen, (Willey Interscience, Third Edition).
- Colloid and Interface Science, Pallab Ghosh (PHI Learning Private Limited)

CVM UNIVERSITY
M. Sc. (Organic Chemistry)
Semester: I
101330107: Biophysical Chemistry

Total Credit: 4

Unit	Description in details	Weightage (%)
I	Cell Structure and Functions : Structure of prokaryotic and eukaryotic cells, intracellular organelles and their functions, comparison of plant and animal cells, biomolecules : introduction and building blocks, amino acids, peptides and proteins, structure and functions of proteins, enzymes – mechanism, Carbohydrates :structure and functions, lipids and biological membranes	25 %
II	Nucleic Acids : Purine and pyrimidine bases of nucleic acids, base pairing via H-bonding. Structure of ribonucleic acids (RNA) and deoxyribonucleic acids (DNA), double helix model of DNA and forces responsible for holding it. Properties of DNA in solution, Chemical and enzymatic hydrolysis of nucleic acids. The chemical basis for heredity, an overview of replication of DNA, transcription, translation and genetic code, Chemical synthesis of mono and trinucleoside. Denaturation of DNA, RNA –types, hydrolysis, analysis and nucleic acid – protein complexes, helix coil transition	25 %
III	Thermodynamics of Biopolymer solutions : Osmotic pressure, membrane equilibrium, muscular contraction and energy generation, mechano-chemical system, chain configuration of biopolymers, statistical distribution of end – to – end and average dimensions, Cell membrane and transport of ions : Structure and functions of cell membrane, ion transport across cell membrane, passive mediate transport, active transport.	25 %
IV	Bioenergetics : Overview of metabolic processes – catabolism and anabolism, ATP – the biological energy currency, Principles and ATP cycles – properties of ADP, ATP and AMP, synthesis of ATP from ADP, hydrolysis of ATP, Standard free energy change in biochemical reactions, exergonic reactions, endegonic reactions, coupled reactions and energy conservation. Working numerical based on energetic of biochemical reactions.	25 %

Basic Text & Reference Books:-

- Lehninger Principles of Biochemistry, M. M. Cox and D. L. Nelson (W. H. Freeman and Co., New York, Firth Edition)

- Biochemistry, J. M. Berg, J. L. Tymoczko and L. Stryer (W. H. Freeman and Co., New York, Fifth Edition)
- Fundamentals of Biochemistry, D. Voet and C. W. Pratt (John Wiley & Sons, Inc., Second Edition)
- Biochemical calculations, Irwin H. Segel (John Wiley & Sons, New York, Second Edition)
- Biophysical Chemistry, M. Satake, Y. Hayashi, M. S. Sethi and S. A. Iqbal (Discovery Publishing House, New Delhi)
- Physical Chemistry : Principles and Applications in Biological Sciences, I. Tinoco Jr., K. Sauer, J. C. Wang, J. D. Puglisi (PEARSON publisher, Fourth Edition).
- Fundamentals of Biochemistry, A. C. Deb (New Central Book Agency, Kolkata)

CVM UNIVERSITY
M. Sc. (Organic Chemistry)
Semester: I
101330108: Polymer Chemistry

Total Credit: 4

Unit	Description in details	Weightage (%)
I	<p>Introduction: Historical development in polymeric materials, Basic concepts: Oligomer, Monomer, Polymer, Polymerization and Functionality, Repeating Unit, Degree of Polymerization, Bonding in Polymers, Notation and Nomenclature of Polymers, Classification of Polymers depending on- (i) Origin (Natural, Semi-Synthetic, Synthetic); (ii) Chemical Structure (Organic Inorganic, Homochain and Heterochain); (iii) Thermal Response or the behaviour of heat or pressure (Thermoplastics and Thermosetting); (iv) Line Structure (Linear, Branched, Cross-linked, hyper branched and dendrimer); (v) Ultimate forms and Applications (Plastics, Elastomers, Fibers and Liquid Resins); (vi) Tacticity or the Stereochemistry of the Polymers (Optical Isomerism in Polymers: Isotactic, Syndiotactic, Atactic and Geometrical isomerism in Polymers); (vii) Crystallinity (Crystalline, Semi-crystalline and Amorphous) and (viii) Mode of Synthesis (Homopolymers, Copolymers, Addition, Condensation), Glass Transition Temperature (T_g) and Factors Influencing the Glass Transition Temperature</p> <p>Average Molecular Weight Concepts and Measurement of Molecular Weights (M_n, M_w and M_z): Number Average and Weight Average Molecular Weights, Molar Mass & Molar Mass Distribution, Polydispersity, Method of Working out Weight Average Molecular Weight and Number Average Molecular Weight, Molecular Weight and Degree of Polymerization, Polydispersity and Molecular Weight Distribution in Polymers, Practical Significance of Polymer Molecular Weight, End Group Analysis, Freezing Point Depression (Cryoscopy), Boiling Point Elevation (Ebullioscopy), Membrane Osmometry, Vapour Phase Osmometry, Dilute Solution Viscosity, Light Scattering, Ultracentrifugation and GPC</p>	25 %
II	<p>Chain-Growth Polymerization:</p> <p>(i) Chain Radical (Addition) Polymerization: Free radical addition polymerization mechanism of vinyl polymerization (Generation of free radicals, initiation, propagation, termination, chain transfer inhibition of retardation, configuration of monomer units in vinyl polymer chains), Methods of Initiating Free Radical Polymerization, Kinetics of free radical addition polymerization (experimental determination of rate constants, derivations for rate expressions and</p>	25 %

	expressions for kinetic chain length, degree of polymerization and average life time of a kinetic chain), Control of molecular weight by transfer, The Mayo Equation and Evaluation of the Chain Transfer Constant, Factors (Temperature, Initiator Concentration, Monomer Concentration and Pressure) determining radical polymerization and the properties of the resulting polymer, Equilibrium of Radical Polymerization (ii) Ionic (Catalytic) Polymerization - common features of two types of ionic polymerization, Mechanism of cationic polymerization, expressions for overall rate of polymerization and the number average degree of polymerization. Mechanism of anionic, polymerization, expressions for overall rate of polymerization and the average degree of polymerization, Living polymers. (iii) Coordination (Insertion) Polymerization : Ziegler – Natta Catalysis	
III	Step-growth Polymerization: Ring – opening Polymerization (Mechanism of polymerization of cyclic ethers, cyclic amides and cyclosiloxanes), Atom transfer Polymerization, Kinetics of catalyzed and non – catalysed polyesterification. Copolymerization: Free Radical Copolymerization, Determination of Reactivity Ratio, Reactivity Ratios and Copolymerization Behaviour, Copolymer Composition at Higher Conversations, Structure and Reactivity of Monomers and Radicals, The Q-e scheme of Alfrey and Price.	25 %
IV	Techniques of Polymerization: Bulk – Solution – Suspension and Emulsion polymerization, Melt Polycondensation, Solution Polycondensation, Interfacial Condensation, Solid and Gas Phase Polymerization, Salient features of different polymerization techniques, Kinetics of emulsion polymerization. Polymer solubility and solutions: Introduction, General rules for polymer solubility, Thermodynamic basis of Polymer Solubility, Prediction of Solubility. Organometallic Polymers, Ion-containing Polymers, Additives for Polymers	25 %

Basic Text & Reference Books:-

- Polymer Chemistry – An Introduction by Malcom P. Stevens, Addison Wesley Publishing Co. Inc. Massachusetts.
- Polymer Chemistry by C. Carraher, Marcel Dekker Inc., New York-Basel.
- Textbook of Polymer Science by F. W. Billmeyer, Wiley – Interscience, New York
- Introduction to Polymer Chemistry by R. B. Seymour, Mc – Graw – Hill, New York
- Polymer Science by V. R. Gowariker, N. V. Viswanathan and Jayadev Sreedhar, New Age International Publishers
- Introduction to Polymer Chemistry by R. J. Young and P. A. Lovell
- Principles of Polymer Chemistry (IInd Edition) by A. Ravve

- Principles of Polymers Systems, F. Rodriguez, Hemisphere, Publishing Corporation, Washington, DC.
- Principles of Polymer Science (Second Edition) by P. Bahadur and N. V. Sastry, Narosa Publishing House, New Delhi

CVM UNIVERSITY
M. Sc. (Organic Chemistry)
Semester: I

101330104: Lab Synthesis-I (101330101, 101330102 and 101330103)

101330105: Lab Analysis-I (101330101, 101330102 and 101330103)

INORGANIC CHEMISTRY

(Weightage 33.33%)

Total Credit : 4

❖ **Synthesis of metal complexes, double salts and estimation by gravimetry.**

1. Hexa ammine nickel(II) chloride.
2. Ferrous ammonium sulphate.
3. Mercury tetrathiocyanatocobaltate.
4. Tris-acetylacetonato Manganese(II) chloride.
5. Potassiumtrioxalatoferrate
6. Prussian blue
7. Hexaure chromic chloride.
8. Tetra ammine copper sulphate
9. Cis – trans- bis oxalate, diaquo chromate(III)

❖ **Qualitative Analysis (6 + 1 Radicals)**

- 6 – Cation, Anion variable
1 – Rare earth element form the following:
Th, Ce, Li, Mo, Se, Te, V, Ti and Zr etc.

Basic Text & Reference Books:-

- Advanced Practical Inorganic Chemistry – Gurdeep Raj Goel Publishing House, Meerut.
- Qualitative Inorganic Analysis. – A. I. Vogel, 6th Edition revised by G. Svehla ELBS– London
- Textbook of Chemistry Analysis – A. I. Vogel
- Qualitative Chemistry semi micro analysis – edited by P. K. Agasyan CBS Publisher– Delhi.
- Chemistry: Inorganic Qualitative Analysis in the Laboratory, Clyde Metz, Elsevier, 2012, ISBN : 978032316104

ORGANIC CHEMISTRY

(Weightage 33.33%)

Total Credit : 4

❖ List of Synthesis

1. Claisen-Schmidt Reaction:

Benzal-acetophenone from acetophenone/ Dibenzalacetone from Benzaldehyde

2. Pechmann Condensation:

7-Hydroxy-4-methyl Coumarin

3. Diels-Alder reaction:

9,10-dihydroanthracene- α,α -succinic anhydride from anthracene

4. Sandmeyer reaction:

Aniline to chlorobenzene, *p*-nitroaniline to *p*-nitrochlorobenzene, Anthranilic acid to *o*-chlorobenzoic acid, *o*-toluidine to *o*-chlorotoluene, *p*-iodonitrobenzene from *p*-nitroaniline, *m*-nitrophenol from *m*-nitroaniline etc.

5. Fisher indole synthesis:

1,2,3,4-Tetrahydrocarbazole from Cyclohexanone

6. Lieben haloform reaction:

Iodoform from Acetone

7. Knorr-Quinoline synthesis:

2-hydroxy-4-methylquinoline from Acetoacetanilide

8. Dye Synthesis: [DIAZOTIZATION & COUPLING]

1-Phenyl azo-2-naphthol

9. Cannizarro reaction:

Benzyl alcohol and Benzoic acid from Benzaldehyde

10. Aspirin from salicylic acid [Acetylation]

Boiling point determination of unknown liquid sample

❖ Estimations

1. Hydroxyl Group Estimation

2. Unsaturation Estimation

3. Phenol/ Aniline Estimation

4. Ascorbic Acid (Vitamin-C) Estimation

5. Acid + Amide / Acid + Ester Estimation

Basic Text & Reference Books:-

Elementary Practical Organic Chemistry (part-1 to 3) By A. I. Vogel (CBS publication)

PHYSICAL CHEMISTRY

(Weightage 33.33%)

Total Credit : 4

(Physical –I)

Sr. No.	Description in detail
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1. To determine the heat of solution of the given acid by solubility method
2. Determination of hydrolysis constant of aniline hydrochloride by distribution method
3. Determination of the critical solution temperature (CST) of the phenol/water system and to study the effect of additive on CST
4. To determine the surface tension of methyl acetate, ethyl acetate, hexane and chloroform and hence calculate the atomic parachors of C, H, Cl etc
5. To determine partial molar volume of sodium chloride in aqueous solution at room temperature

(Physical –II)

Sr. No.	Description in detail
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1. To determine the dissociation constants (k_1 and k_2) of a dibasic acid pH metrically
2. To find out the (a) cell constant of given conductivity cell, (b) to determine the critical micelle concentration (CMC) of an ionic surfactant
3. Determination of DG, DH and DS for a reaction using an electrochemical cell
4. To verify law of additivity of absorbance for a mixture of colored substances in solution using potassium permanganate and potassium dichromate solutions
5. To determine the concentration of a given solution of an optically active substance by polarimetric measurements

Basic Text & Reference Books:-

- Experimental Physical Chemistry by R. C. Das & B. Behera, (Tata McGraw hill Publishing Company Ltd., New Delhi)
- A Laboratory Manual of Experiments in Physical Chemistry by D. Brennan and C. F. H. Tipper, (McGraw hill Publishing Company Ltd., London)
- Systematic Experimental Physical Chemistry by S. W. Rajbhoj and T. K. Chondhekar, (Anjali Publication, Aurangabad)

- Advanced Practical Physical Chemistry by J. B. Yadav, (Goel Publishing House, Meerut)
- Experimental Physical Chemistry by G. Peter Matthews, (Clarendon Press, Oxford, London)
- Experimental Physical Chemistry by V. D. Athawale and Parul Mathur, (New Age International Publishers, New Delhi)
- Advanced Physical Chemistry Experiments by Gurtu and Gurtu, (Pragati Prakashan, Meerut)
- Advanced Physico-Chemical Experiments by J. Rose, (Sir Isaac Pitman & Sons Ltd., London)
- Experiments in Physical Chemistry by D. P. Shoemaker, C. W. Garland and J. W. Nibler, (McGrawHill International Edition, London).

CVM UNIVERSITY
M. Sc. (Organic Chemistry)
Semester: I

Paper Code: 101330106	Total Credit: 1
Title of Paper: Comprehensive Viva	
Description in detail	Weightage (%)
Viva Voce From the Subjects Studied in Semester – I	100%

CVM UNIVERSITY
M. Sc. (Organic Chemistry)
Semester: II
Quantum Chemistry & Organometallic Chemistry

Total Credit: 4

Unit	Description in details	Weightage (%)
I	<p>Commutation relations Commutative property; momentum operator; Hamiltonian operator; angular momentum operator; angular momentum operators and their commutation relations; shift operators and their commutation relations; the effect of shift operators on an eigenvalue of the angular momentum; some theorems and problems.</p> <p>Translational motion of a part Free particle; particle in a box with infinite potential barrier; quantization and quantum numbers; symmetry of the wave functions; use of the box model; cubical box and degeneracy; quantum mechanical tunneling and problems.</p>	25%
II	<p>Rotational motion of a particle Particle on a sphere; normalization of the wave functions; rotation of a diatomic molecule and problems</p> <p>Vibrational motion of a particle: One dimensional harmonic oscillator; Hermite's differential equation; recursion formula for the Hermite's differential equation normalization and the characteristic of eigenfunctions of a harmonic oscillator; polynomials of different degree and problems.</p> <p>The hydrogen like atoms: The r-dependent part of the wave function; Laguerre and associated Laguerre polynomials; radial eigen function wave functions of hydrogen like atom</p>	25%
III	<p>Organometallic chemistry-1 An introduction of organometallic compounds, Main group organometallic compounds, Applications of organometallic compounds, Electron count in complexes, Classification of Metal carbonyl, Synergistic effect, Factors affecting the Magnitude of stretching frequency, Nature of Lewis acid other than a Metal, Bonding modes of CO, Synthesis of Metal Carbonyls, Reactions and Synthetic applications of Carbonylate ions.</p>	25%
IV	<p>Organometallic chemistry-2 Metal carbonyl Clusters, Electron Counting in carbonyls clusters, Binuclear Clusters containing M-M multiple bonds, Zintl ions, Reactions of Organometallic Compounds (Concerted reaction, Radical reactions, ionic mechanism, oxidative coupling, reductive elimination, Migratory insertion, β-H elimination).</p>	25%

Basic Text & Reference Books:-

- Introductory Quantum Chemistry, A. K. Chandra, Tata McGraw-Hill Publishing Company Ltd. 4th ed. (2004).
- Quantum Chemistry, R. K. Prasad, New Age International Publishers, 4th ed. (2010).
- Quantum Chemistry, N. Levine, Pearson India Pvt. Ltd., 7th ed. (2016).
- Quantum Chemistry Through Problem and Solutions, R. K. Prasad, New Age International Publishers, 1st ed. (2006).
- Introduction to Magnetochemistry, Alan Earshaw, Academic Press, Academic press, London and new york 1st ed. (2013).
- Elements of Magnetochemistry, Dutta and Symal, East-West Press Pvt. Ltd. 2nd ed. (2004).
- Bio-inorganic Chemistry an Introduction, J. A. Cowan, Wiley-VCH, 2nd ed. (1997).
- Fundamentals of Analytical Chemistry, D. A. Skoog, D. M. West, F. J. Holler, Saunders College Publishing, 9th ed. (2013).
- Metal ions in Biochemistry, P. K. Bhattacharya, Alpha Science International Ed. 1st Ed. (2005).
- Organometallic & Bioinorganic Chemistry, Ajai Kumar, Aaryush Education, 3rd edition (2018)
- ❖ **Books for further Reading :-**
- Organotransition Metal Chemistry, John F. Hartwing, University Science Books, Sausalito, 1st ed. (2009).
- An Introduction to Quantum Chemistry, M. Satake, Y. Mido, H. Yasuhisa, S. Taguchi, M. S. Sethi, S. A. Iqbal, Discovery Publishing House, 2nd print (2006).
- Elements of Bioinorganic Chemistry, G. N. Mukerjee, Arabinda Das, U. N. Dhur & Sons Pvt. Ltd. 4th ed. (1993).
- Bioinorganic Chemistry, G. R. Chatwal, A. K. Bhagi, Himalaya Publishing House, 1st ed. (2014).
- Bioinorganic Chemistry, Bertini, H. B. Gray, S. J. Lippard, University Science Books, 1st ed. (1994).
- Inorganic Chemistry, Shriver and Atkins Oxford Press, 5th ed. (2009).
- Bio-inorganic Chemistry, R.W. Hay – R.W. Hay, Ellis Horwood Limited Publishers, 1st ed. (1990).
- Bioinorganic Chemistry, Bertini, Gray, Lippard, & Valentine Viva books Pvt Ltd (2007).

CVM UNIVERSITY
M. Sc. (Organic Chemistry)
Semester: II
101330202: Organic Chemistry-II

Total Credit: 4

Unit	Description in details	Weightage (%)
I	Organic Name Reactions-I and their applications: Robinson ring Annulation, Wittig reaction and its modifications; Peterson olefination, Shapiro reaction, Bamford Steven's Reaction, Julia Olefination, Vilsmyer-Heck Reaction, Mitsunobu Reaction	25%
II	Organic Name Reactions-II and their applications: Stork Enamine reaction, Buchwald–Hartwig amination, Sonogashira Coupling, Brown's Hydroboration reactions; Bayer Villiger Reaction, Prevost and Woodward Hydroxylation, Suzuki Reaction, Stobbe condensation.	25%
III	Reagents in Organic Synthesis [Oxidation] :CrO ₃ , MnO ₂ , KMnO ₄ , SeO ₂ , Pb(OAc) ₄ , OsO ₄ , HIO ₄ , DMSO, H ₂ O ₂ , Ozone, HgO, NBS, K ₃ Fe(CN) ₆ , DDQ, Al(O-t-Bu) ₃ Some Miscellaneous Reagents in Organic Synthesis : Dess- Martin reagent Trimethylsilylhalide, alkyl lithium, LDA.	25%
IV	Reagents in Organic Synthesis [Reduction] :Al(O-iPr) ₃ , Zn/HCl, N ₂ H ₄ /OH ⁻ , NaBH ₄ , LiAlH ₄ , Complex Hydrides, Na/NH ₃ , Cat.H ₂ , TBTH Some Miscellaneous Reagents in Organic Synthesis: Wilkinson catalyst, Grignard Reagent and Gilman reagent, PTC, DCC.	25%

Basic Text & Reference Books:-

- Organic Reactions, Stereochemistry and Mechanism: P.S. Kalsi (New Age.)
- Principles of Organic Synthesis: R.O.C Norman & J.M. Coxon (ELBS)
- Mechanism in Organic Chemistry: Peter Sykes (Orient Longman)
- Modern Methods of Organic Synthesis: W. Carruthers (Cambridge)
- Organic Reaction Mechanism: V.K.Ahluwalia and R.K.Parashar (Narosa)
- Organic Chemistry: Clayden, Greeves and Warren (Oxford)

CVM UNIVERSITY
M. Sc. (Organic Chemistry)
Semester: II
101330203: Topics in Physical Chemistry-II

Total Credit: 4

Unit	Description in details	Weightage (%)
I	<p>Chemical Kinetics – II :</p> <p>Complex reactions :- Opposing reactions, Consecutive reactions, Parallel reactions, Reactions in flow systems, Ionic reactions and salt effect, enzyme catalyzed reactions, kinetics of fast reactions.</p>	25 %
II	<p>Chemical Dynamics :</p> <p>Methods of determining rate laws, collision theory of reaction rates, steric factor, activated complex theory, kinetic and thermodynamic control of reactions, treatment of uni-molecular reactions.</p> <p>Dynamic chain (pyrolysis of acetaldehyde, decomposition of ethane), photochemical (hydrogenbromine and hydrogen-chlorine reactions) and oscillatory reactions (Belousov-Zhabotinsky reaction).</p>	25 %
III	<p>Group theory in Chemistry :</p> <p>Concepts of symmetry in molecule:- Symmetry elements, symmetry operations, definitions and theorems in group theory, examples of groups, subgroups and classes, Molecular Point groups :- Identification and classification, notation of point groups, Matrix representation of symmetry operations, Types of matrices, matrix notations for symmetry elements : E, C_n, i, s, S_n. Matrix representation of point groups : product and square rule, inverse rule, matrices for C_{3v}, C_{4v} etc., Construction of character tables :-rules, reducible and irreducible representations, character of a representation, properties of a irreducible representations, orthogonality theorem, character tables for C_{2v}, C_{3v}, C_{4v}, D_{nh}, uses of character tables.</p>	25 %
IV	<p>Chemical Applications of Group Theory :</p>	25 %

	Molecular vibrations, molecular vibration of symmetrical AB ₂ (bent) molecule, symmetry of normal modes of ethylene, tetrahedral hybridization, Hybridization in Boron Trifluoride (trigonal planar geometry), Binding in water molecule, calculations on naphthalene. Electronic spectra of carbonyl chromophore.	
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Basic Text & Reference Books:-

- Elements of Physical Chemistry, Peter Atkins, Julio De Paula, David Smith,(Oxford University Press, 6th Edition)
- Chemical Kinetics, K. J. Laidler, (McGraw Hill Publication)
- Chemical Applications of Group Theory, F. A. Cotton, (Wiley Eastern Ltd., Third Edition)
- Group Theory and Its Chemical Applications, P. K. Bhattacharya (Himalya Publishing House, Mumbai, Second Revised Edition).
- Group theory in Chemistry, M. S. Gopinathan, V. Ramakrishnan (Vishal Publishing Co. Second Edition)
- Symmetry and Spectroscopy of Molecules, K. Veera Reddy (New Age International Publishers, Second revised Edition)
- Symmetry and Group Theory For Chemists, N. N. Das, (Asian Books Private Limited, New Delhi, First Edition)
- Physical Chemistry, Ira N Levine (Tata McGraw-Hill Publishing Company, New Delhi, Fifth Edition).
- Physical Chemistry, Alberty and Stilby, (John Wiley & Sons, New York)

CVM UNIVERSITY
M. Sc. (Organic Chemistry)
Semester: II
101330207: Introduction to Biochemistry

Total Credit: 4

Unit	Description in details	Weightage (%)
I	<p>Vitamins: Classification, introduction, chemistry, absorption, transport, mobilization and biochemical functions of Vitamins: A, D, E, K, C, B1, B2, B6, B12, H, CoA, Folic acid, Niacin</p> <p>Lipids: Nomenclature, Structure and physical properties of some naturally occurring fatty acids, triacylglycerol and waxes as sources of stored energy, insulation and water repellents, Types of membrane lipids, Introduction to glycerophospho lipids, galactolipids, sphingolipids, phospholipids and sterols.</p>	25 %
II	<p>Proteins: Properties, Classification and Conventions of common amino acids, stereoisomerism in α-amino acids, Peptides: Formation, Merrifield Synthesis, compositions and Sizes, protein Separation, Purification and Characterization; Sequencing of Peptides: Sanger's method, Edman degradation, outline of other methods; Protein Sequences and Evolution; Oxygen binding Proteins – Hemoglobin and Myoglobin in oxygen transport and storage.</p>	25 %
III	<p>Carbohydrates: Classification and stereochemistry, Biologically important hexose derivatives, Nomenclature for disaccharides, structure and role of some Homo and Hetero Polysaccharides, Glycoconjugates: Proteoglycans, Glycoproteins and Glycolipids, Introduction to Glycobiology (The sugar code)</p>	25 %

	Water: Interaction among biomolecules in aqueous systems, Buffering against pH changes in biological systems, participation of water in biological reactions	
IV	Enzymes: Classification Nomenclature & extraction factors affections, catalytic activity and specificity in action, regulation of enzyme activity, enzyme inhibition, Illustrative enzymatic reactions using Chymotrypsin , Hexokinase , enolase and Lysozyme Nucleic acids: Components of nucleic acids, Nomenclature of nucleotides, structure of DNA – Chargaff's Rule of DNA Composition, Watson and Crick Model, structure and types of RNA.	25 %

Basic Text & Reference Books:-

- Lehninger Principles of Biochemistry, David L. Nelson and Michael M. Cox [Palgrave MacMillan / W.H.Freeman & company, New York]
- Principles of Biochemistry, Donald J. Voet , Judith G. Voet , Charlotte W. Pratt [John Wiley & Sons]
- Biochemistry, U. Satyanarayana, Books & Allied (p) Ltd. , Kolkata(India)
- Skoog, Holler, Niemon, "Principles of instrumental analysis" 5th edition, Saunder college publisher.
- Robert D. Braun "Introduction to chemical analysis" McGraw-HILL International Edition.
- Robert D. Braun "Introduction to instrumental analysis" McGraw-HILL International Edition. Gary D. Christian. "Analytical chemistry" 6th edition John Wiley & sons, Inc. 2004
- Judith F. Rubinson, Kenneth A. Rubinson, "Contemporary Chemical analysis" Ist edition, Prentice-Hall International Inc., 1998.
- B. K. Sharma. "Instrumental method of chemical analysis" 29th edition, GOEL Publishing house Meerut. 2011.

- R. A. Day, Jr , A. L. Underwood., "Quantitative analysis" 6th edition, Prentice –Hall of India Private Limited, New Delhi. 2006.
- David Harvey. "Modern analytical chemistry" McGraw-HILL International Edition. 2000 chemistry series.
- L. Huber, "Validation and qualification in analytical laboratories" 2nd Edition, 2007.
- B. Sivasankar, "Instrumental Methods of Analysis" Oxford University Press, 2012.

CVM UNIVERSITY
M. Sc. (Organic Chemistry)
Semester: II
101330208: Analytical Chemistry-I

Total Credit: 4

Unit-1	Description in details	Weightage (%)
I	Fundamental of Analytical Chemistry: Definitions, classification of analytical techniques and importance, Classical and Instrumental methods, Factors affecting choice of analytical methods. Verification and validation in chemical analysis: Introduction, Fundamental definitions. Categories of validation. Quality Management System, Good laboratory practices.	25 %
II	Assessment of Analytical Data and Numerical Chemistry: SI units, calibrations in laboratory practice and numerical. Measures of central tendency, validation parameters: Accuracy, precision, mean and standard deviation, calibration, classification of errors, minimization of errors, significant figures and computation, Q-test (Student t-test), tests for rejection of outlying data. numerical of statistical analysis	25 %
III	Fundamentals of spectroscopy and Components of optical instruments: Brief introduction to spectroscopy, Classification of spectroscopic techniques, Electromagnetic Radiation (EMR) and Interaction of EMR with Matters. Spectrometers and their components: Sources of radiations, wave length selectors, sample holders, detectors and signal processors and display units.	25 %
IV	Separation Methods : Introduction & classification of various separation methods. Chromatography techniques: General introduction, Principles	25 %

	<p>and classification of chromatography according to types of chromatographic bed, physical state of mobile phase, mechanism of separation. Paper chromatography & Thin layer chromatography: Principle, types, choice of paper and solvent, location of spot and measurement of R_f Values.</p> <p>Gas Chromatography: Principle, Introduction, instrumentation.</p>	
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Reference Books:

- Skoog, Holler, Niemon, "Principles of instrumental analysis" 5th edition, Saunders college publisher.
- Robert D. Braun "Introduction to chemical analysis" McGraw-HILL International Edition.
- Robert D. Braun "Introduction to instrumental analysis" McGraw-HILL International Edition.
- Gary D. Christian. "Analytical chemistry" 6th edition John Wiley & sons, Inc. 2004
- Judith F. Rubinson, Kenneth A. Rubinson, "Contemporary Chemical analysis" Ist edition, Prentice-Hall International Inc., 1998.
- B. K. Sharma. "Instrumental method of chemical analysis" 29th edition, GOEL Publishing house Meerut. 2011.
- R. A. Day, Jr , A. L. Underwood., "Quantitative analysis" 6th edition, Prentice –Hall of India Private Limited, New Delhi. 2006.
- David Harvey. "Modern analytical chemistry" McGraw-HILL International Edition. 2000 chemistry series.
- L. Huber, "Validation and qualification in analytical laboratories" 2nd Edition, 2007.
- B. Sivasankar, "Instrumental Methods of Analysis" Oxford University Press, 2012.

CVM UNIVERSITY
M. Sc. (Organic Chemistry)
Semester: II

101330204: Lab Synthesis-2 (101330201, 101330202 and 101330203)

101330205: Lab Analysis-2 (101330201, 101330202 and 101330203)

INORGANIC CHEMISTRY

(Weightage 33.33%)

Total Credit : 4

❖ **(Inorganic-I)-Quantitative Analysis:**

1. Direct Titration (Cu^{+2} , Ni^{+2} , Ca^{+2} , Mg^{+2} and Fe^{+3})
2. Indirect Titration of Calcium
3. By Back Titration and Replacement titration
4. Determination of composition of complex and interference study.
5. Water Analysis

❖ **(Inorganic-II)-Qualitative Analysis (6 + 1 Radicals)**

6– Cation Anion variable

1 – Rare earth element form the following:

Th, Ce, Li, Mo, Se, Te, V, Ti and Zr etc.

Basic Text & Reference Books:-

- Advanced Practical Inorganic Chemistry – Gurdeep Raj Goel Publishing House, Meerut.
- Qualitative Inorganic Analysis. – A. I. Vogel, 6th Edition revised by G. Svehla ELBS London
- Textbook of Chemistry Analysis – A. I. Vogel
- Qualitative Chemistry semi micro analysis – edited by P. K. Agasyan CBS Publisher-Delhi.
- Water Quality-An Introduction, Second edition ISBN: 978-3-319-17445-7 (Print) 978-3-319-17446-4 (Online) Authors: Claude E. Boyd
- Inorganic Qualitative Analysis in the Laboratory, Clyde Metz, Elsevier, 2012, ISBN : 978032316104

ORGANIC CHEMISTRY

(Weightage 33.33%)
Total Credit : 4

❖ List of Synthesis

1. p-Bromoaniline from Acetanilide [Protection, Bromination and Deprotection]
2. p-nitroaniline from Acetanilide [Protection, Nitration and Deprotection]
3. p-nitrobromobenzene from bromobenzene
4. Picric acid from phenol
5. 2,4,6-tribromophenol/ 2,4,6-tribromoaniline [Bromination]
6. Methylorange from sulphanilic acid
7. 2,5-Dimethylbenzenesulfonic acid [Sulphonation]
8. Terphthalic acid from p-xylene [Oxidation]
9. m-nitroaniline from nitrobenzene [nitration and partial Reduction]
10. TLC for separation and Rf value determination of components in a mixture

❖ Estimation

1. Estimation of Aniline.
2. Polyhydric alcohol estimation.
3. Percentage halogen estimation by modified Stepanow's method
4. Estimation of aldehydes/ketones.
5. Sugar estimation [Reducing and Non-reducing].

Basic Text & Reference Books:-

- Elementary Practical Organic Chemistry (Part 1-3) By A. I. Vogel (CBS publications)

PHYSICAL CHEMISTRY

(Weightage 33.33%)

Total Credit : 4

(Physical –I)

Sr. No.

Description in detail

1. To determine the transition temperature of Glauber's salt by solubility method.
2. Determination of distribution coefficient of ammonia between chloroform and water.
3. Determine the surface tension of liquids (methyl acetate, ethyl acetate, chloroform, hexane.) and hence calculate the atomic parachloro of C, H & Cl.
4. Determine the molecular weight of the given liquid by Steam distillation.
5. To determine the rate of acid-catalyst iodination of acetone in presence of Excess acid & acetone at room-temperature.

(Physical –II)

Sr. No.

Description in detail

1. To determine the molecular composition of ferric – salicylate complex by Job's method (Spectrophotometer).
2. To determine the rate of the saponification of ethyl acetate at different temperature conductometrically and calculate the energy of activation of the reaction (Conductometer).
3. (a) To determine the transport numbers of Ag^+ and NO_3^- ions in silver Nitrate solution potentiometrically.
(b) Determination of concentration/ amounts of iodide, bromide and chloride in the mixture by potentiometric titration with silver nitrate (Potentiometer)
4. To verify the law of refraction for given mixture of glycol + water system. (Refractometer)
5. To find the rate constant of acid – catalyzed hydrolysis of sucrose. (Polarimeter)

Basic Text & Reference Books:-

- Experimental Physical Chemistry by R. C. Das & B. Behera, (Tata McGraw hill Publishing Company Ltd., New Delhi)

- Experimental Physical Chemistry by R. C. Das & B. Behera, (Tata McGraw hill Publishing Company Ltd., New Delhi)
- A Laboratory Manual of Experiments in Physical Chemistry by D. Brennan and C. F. H. Tipper, (McGraw hill Publishing Company Ltd., London)
- Systematic Experimental Physical Chemistry by S. W. Rajbhoj and T. K. Chondhekar, (Anjali Publication, Aurangabad)
- Advanced Practical Physical Chemistry by J. B. Yadav, (Goel Publishing House, Meerut)
- Experimental Physical Chemistry by G. Peter Matthews, (Clarendon Press, Oxford, London)
- Experimental Physical Chemistry by V. D. Athawale and Parul Mathur, (New Age International Publishers, New Delhi)
- Advanced Physical Chemistry Experiments by Gurtu and Gurtu, (Pragati Prakashan, Meerut)
- Advanced Physico-Chemical Experiments by J. Rose, (Sir Isaac Pitman & Sons Ltd., London)
- Experiments in Physical Chemistry by D. P. Shoemaker, C. W. Garland and J. W. Nibler, (McGraw Hill International Edition, London)

CVM UNIVERSITY
M. Sc. (Organic Chemistry)
Semester: II

Paper Code: 101330206	Total Credit: 1
Title of Paper: Comprehensive Viva	
Description in detail	Weightage (%)
Viva Voce From the Subjects Studied in Semester – II	100%

CVM UNIVERSITY
M. Sc. (Organic Chemistry)
Semester: III

Paper Code: 101330301		Total Credit: 4
Title of Paper: Organic Spectroscopy		
Unit	Description in detail	Weightage
1	<p>UV Spectroscopy: Theory and principles of electronic transition and UV absorption; chromophores and auxochromes; Woodward-Fieser rules for dienes and enones; characteristic absorptions in alkenes and alkynes, alcohols, ethers, amines, carbonyl compounds, Characteristic absorptions in aromatic compounds; Factors influencing λ_{\max}, effects of conjugation, effect of solvent; Differentiation of compounds/isomers by UV</p> <p>Infrared Spectroscopy: Theory and principles; molecular vibrations; calculations of vibrational frequencies; Factors influencing IR frequency; characteristic group absorptions in hydrocarbons, aromatic compounds, alcohol and phenols, ethers, carbonyl compounds, amines, nitriles, nitro compounds, carboxylic acids and halide, Differentiation of compounds/isomers by IR</p>	25%
2	<p>PMR Spectroscopy: Proton resonance condition, Various aspects of PMR spectra–(1) Number of signals, (2) Position of signals: chemical shifts, shielding and deshielding, (3) Splitting of the signals (spin-spin coupling), coupling constants – vicinal, geminal, long range and virtual couplings, (4) Intensity of signal (Peak area or integration); factors affecting chemical shifts, paramagnetic and diamagnetic anisotropy; Pople notation and spin assignments; chemical shift equivalence and magnetic equivalence; first order and second order spectra, complex PMR spectra; simplification of the complex PMR spectra- (1) Increasing field strength (high resolution spectra), (2) Use of shift reagents, (3) Spin-spin decoupling (Double resonance), (4) Proton exchange, (5) Deuterium exchange, (6) Nuclear Overhauser Effect (NOE); Differentiation of compounds/ isomers by PMR; To identify structure from PMR data</p>	25%
3	<p>¹³C-NMR Spectroscopy: Difficulties and solution for recording ¹³C-NMR spectra; recording of ¹³C-NMR spectra – scale, solvents, solvent signals and their positions,</p>	25%

	<p>multiplicity, ^{13}C-^1H coupling constant; proton coupled and decoupled ^{13}C spectra, broad band decoupling, off resonance technique; Chemical shifts in ^{13}C spectra – chemical shift calculation for alkanes, alkenes and alkynes, chemical shift calculation in internal and terminal substituted compounds, aromatic compounds; To identify structure from ^{13}C NMR data; Use of ^{13}C spectra in differentiating compounds/isomers; ^{13}C-DEPT Spectra – Differentiation in Primary, Secondary and Tertiary Carbons by DEPT-45°, DEPT-90°, DEPT-135° spectra; 2D NMR Spectroscopy: Theory and Principles Of 2D NMR Spectroscopy (COSY); To interpret or to draw HOMCOR (^1H-^1H COSY, DQF-COSY, INADEQUATE), HETCOR (^{13}C-^1H COSY, ^1H-^{13}C COSY i.e. HMQC, HMBC), NOESY and TOCSY spectra.</p> <p>Introduction to NMR of nuclei other than proton and carbon.</p>	
4	<p>Mass Spectroscopy: Theory and principles of mass spectroscopy; Instrumentation; low and high resolution mass spectra; Ionization techniques – Electron Impact (EI) ionization, Chemical Ionization (CI), Field Desorption (FD), Fast Atom Bombardment (FAB), Electrospray Ionization (ESI) and Matrix Assisted Laser Desorption/Ionization (MALDI); Determination of molecular weight and molecular formula, nitrogen rule, detection of molecular ion peak, metastable ion peak; Fragmentations – rules governing the fragmentations, McLafferty rearrangement; Interpretation of mass spectra of different class of compounds – saturated and unsaturated hydrocarbons, aromatic hydrocarbons, alcohols, ethers, ketones, aldehydes, carboxylic acids, amines, amides, compounds containing halogens; To write possible fragmentation for given compound; To identify structure from mass spectral data; To identify structure from combined spectral data.</p>	25%

Basic Text & Reference Books:-

1. Spectroscopic Identification of Organic Compounds, R. M. Silverstein and F. X. Webster, 6th edition (John Wiley & Sons)
2. Introduction to Spectroscopy, D. L. Pavia, G. M. Lampman and G. S. Kriz, 3rd edition (Thomson Brooks/Cole)
3. Spectroscopic Methods in Organic Chemistry, D. H. Williams and I. Fleming, 4th edition (Mcgraw – Hill Book Company)
4. Organic Spectroscopy, William Kemp, 3rd edition (Palgrave)
5. Organic Spectroscopy – Principles and Applications, Jag Mohan, 2nd edition (Narosa Publishing House)

6. Spectroscopy of Organic Compounds, P. S. Kalsi, 5th edition (New Age International Publishers)
7. Elementary Organic Spectroscopy: Principles and Chemical applications (revised edition), Y. R. Sharma (S. Chand Publishing)
8. [https://ndl.iitkgp.ac.in/homestudy/science/ chemistry & biochemistry/chemistry video lecctrures:CEC, IR Spectroscopy-I & II](https://ndl.iitkgp.ac.in/homestudy/science/chemistry%20&%20biochemistry/chemistry%20video%20lecctrures:CEC,%20IR%20Spectroscopy-I%20&%20II)
9. [https://ndl.iitkgp.ac.in/homestudy/science/ chemistry & biochemistry/chemistry video lecctrures:CEC, Mass Spectroscopy](https://ndl.iitkgp.ac.in/homestudy/science/chemistry%20&%20biochemistry/chemistry%20video%20lecctrures:CEC,%20Mass%20Spectroscopy)
10. [https://ndl.iitkgp.ac.in/homestudy/science/ chemistry & biochemistry/chemistry video lecctrures:CEC, NMR Spectroscopy-I](https://ndl.iitkgp.ac.in/homestudy/science/chemistry%20&%20biochemistry/chemistry%20video%20lecctrures:CEC,%20NMR%20Spectroscopy-I)

CVM UNIVERSITY
M. Sc. (Organic Chemistry)
Semester: III

Paper Code: 101330302		Total Credit: 4
Title of Paper: Disconnection Approach		
Unit	Description in detail	Weightage
1	Introduction and definition of disconnection, various terminology used in disconnection. One and two group disconnection, disconnection and synthesis of alcohols, olefins, simple ketones, acids and its derivatives, disconnections in 1,3- dioxxygenated skeletons, preparation of β -hydroxy carbonyl compounds, α,β - unsaturated carbonyl compounds, 1,3-dicarbonyls, 1,5-dicarbonyls and use of Mannich reaction	25%
2	Illogical Two group disconnection: Disconnection and synthesis of α -hydroxy carbonyl compounds, 1,2-diols, 1,4- and 1,6- dicarbonyl compounds. Disconnections based on Diels-Alder reaction and its use in organic synthesis. Functional group analysis: Strategy of saturated hydrocarbon synthesis, functional group addition to intermediates.	25%
3	Disconnection and synthesis of acyclic and cyclic hetero compounds: Synthesis of ethers, amines, nitrogen, oxygen and sulphur containing five and six membered heterocycles. Synthesis of small ring compounds: Special method for small rings preparations, synthesis of 3 and 4 membered ring compounds. Use of ketenes in organic synthesis, Radical reactions in organic synthesis.	25%
4	Protecting groups: Protection of organic functional groups, protecting reagents and removal of protecting groups. Protection of amine: Via N-benzylamine formation, amide formation, carbamate formation. Protection of alcohol: Via alkyl ether formation, benzyl ether formation, trityl ether formation, silyl ether formation, acetal formation, methoxyl methyl ether formation, ester formation. Protection of 1,2- and 1,3-diols, Protection of acid via ester formation, Protection of aldehyde via acetal formation, Protection of ketone via ketal formation. Fragmentation Reactions: Grob fragmentation: Polarization of C-C bond, fragmentation controlled by stereochemistry, ring expansion by fragmentation. Eschenmoser Fragmentation: Controlling double bond using fragmentation. Synthesis of some complex molecules: Synthesis of Mesoporphyrin – IX and Cephalosporin C. Synthesis of Nootkatone via Fragmentation of three	25%

	membered, four membered and six membered ring.	
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Basic Text & Reference Books:-

1. Designing Organic Synthesis – A Programmed Introduction to the Synthon Approach, Stuart Warren, John Wiley & Sons (1994).
2. Organic Synthesis: The disconnection approach, Stuart Warren, John Wiley & Sons (1994).
3. Selected Organic Synthesis, Ian Fleming, John Wiley & Sons (1977).
4. Organic Chemistry, 2nd edition by Jonathan Clayden, Nick Greeves & Stuart Warren, Oxford University Press.
5. Modern Methods of Organic Synthesis, 4th edition by W. Carruthers & Iain Coldham, Cambridge University Press.
6. Modern Organic Synthesis: An introduction by George S. Zweifel & Michael H. Nantz, W. H. Freeman & Company.
7. Greene's Protective Groups in Organic Synthesis, 4th edition, by P. G. M. Wuts and T. W. Greene, Wiley Interscience.

CVM UNIVERSITY
M. Sc. (Organic Chemistry)
Semester: III

Paper Code: 101330303		Total Credit: 4
Title of Paper: Heterocyclic Chemistry		
Unit	Description in detail	Weightage
1	<p>Hantzsch-Widman nomenclature systems,</p> <p>Indole: Biological importance of indole derivatives, Reactions: protonation, nitration, sulphonation, halogenation, acylation, alkylation, reaction with aldehydes and ketones, reaction of α,β-unsaturated ketones, nitriles and nitro compounds. Mannich reaction, reaction with oxidizing agents, reaction with nucleophilic reagents, reaction with N-metallated indole. Reaction with reducing agents. Reaction with carbenes, electrophilic and photochemical reactions. Reaction of indolyl C-X compounds, electrophilic substitution reactions of substituted indoles.</p> <p>Synthesis: Fischer-indole synthesis (From phenyl hydrazone of aldehyde and ketone), Grandberg synthesis, Reissert synthesis, Modelung synthesis.</p> <p>Reactions and synthesis of benzo(b)thiophene and benzo(b)furan.</p>	25%
2	<p>Reactions and Synthesis of bicyclic heterocycles</p> <p>Quinoline / Isoquinoline</p> <p>Reactions: Substitution of carbon: proton exchange, nitration, sulphonation, halogenation, reactions with nucleophilic reagents with hydride transfer: alkylation, arylation, amination, hydroxylation. Nucleophilic substitutions with displacement of halide, metal halogen exchange, reactions with reducing agents, Grignard reaction. Electrophilic substitution reactions of substituted quinoline and isoquinoline. Reissert reaction. Reactions of quinolone-N-oxide and isoquinoline-N-oxide with acid chloride, POCl_3, SOCl_2, diethylcyanophosphonate. Cyanine dyes.</p> <p>Synthesis of quinoline: Skraup synthesis, Combes synthesis, Conrad Limpach Knorr synthesis, Pfitzinger synthesis, Pomeranz-Fritsch synthesis.</p> <p>Synthesis of isoquinoline: Bischer-Napieralski synthesis</p> <p>Heterocyclic system containing two nitrogen atoms: Cinnoline, Quinazoline, Quinoxaline, Phthalazine: Synthesis and its reactions</p>	25%
3	<p>Reactions and synthesis of six membered heterocycles containing nitrogen.</p> <p>Pyridine: Brief introduction, electrophilic substitution of substituted pyridines.</p>	25%

	<p>Pyridine-N-oxide: Reactivity, electrophilic addition and substitution, nucleophilic addition and substitution reactions, Rearrangement, Electrophilic substitution reaction of substituted Pyridine-N-oxide, Synthesis of PNO.</p> <p>Diazines: Introduction, Reactions: Addition at nitrogen, Substitution at carbon, oxidizing agents, nucleophilic agents, replacement of hydrogen, replacement of good leaving group, Reaction of oxydiazine, Anrorc mechanism. Synthesis of diazines.</p> <p>Triazine: Introduction, reactions and synthesis.</p> <p>Tetrazine: Introduction, reactions and synthesis.</p>	
4	<p>Reactions and synthesis of oxygen containing heterocycle: Typical reactivity of pyrilium and benzopyrilium ions, pyrones and benzopyrones.</p> <p>Pyrilium salts: Reactions: electrophilic reagents, nucleophilic reagents and reducing agent. Synthesis from 1,5-dicarbonyl compounds, 1,3-dicarbonyl compounds and ketones. Alkene acylation.</p> <p>2- and 4-Pyrone: Reactions: Electrophilic addition and substitution, nucleophilic reagents, cycloaddition reactions. Synthesis of 2- and 4-Pyrones.</p> <p>Benzopyrilium salt: Reaction with nucleophilic reagents, reducing and oxidizing agents, Synthesis from phenols and 1,3-dicarbonyl compounds, ortho-hydroxybenzaldehydes and ketones.</p> <p>Benzopyranones: Reaction with electrophilic reagents, nucleophilic reagents, oxidizing and reducing agents, cycloaddition and photochemical reactions. Synthesis of Coumarin: Phenols and 1,3-ketoesters, from o-hydroxy benzaldehydes and anhydrides. Synthesis of Chromone: From o-hydroxy acyl benzenes and esters. Isocoumarin synthesis.</p> <p>Azoles: Typical reaction of 1,2- and 1,3-azoles.</p> <p>1,3-Azoles: Reactions: electrophilic reagents, Addition at nitrogen, substitution at carbon, nucleophilic reagents, C-metalled-1,3-azoles, alkyl-1,3-azoles. Synthesis.</p> <p>1,2-Azoles: Reactions: electrophilic reagents, Addition at nitrogen, substitution at carbon, nucleophilic and reducing reagents. Synthesis.</p>	25%

Basic Text & Reference Books:-

1. Heterocyclic Chemistry, 4th Edition by J. A. Joule & K. Mills, Published by Chapman & Hall (1995)
2. Principles of modern heterocyclic chemistry, Edited by Leo A. Paquette, Published by Pearson Benjamin Cummings (1968)

3. Heterocyclic Chemistry, 3rd Edition by Thomas L. Gilchrist, Published by Prentice Hall (1997)
4. The Structure & Reactions of Heterocyclic Compounds, Edited by Michael Henry Palmer, Published by Edward Arnold (1967)
5. Heterocyclic chemistry by V. K. Ahluwalia, Narosa publishing house.

CVM UNIVERSITY
M. Sc. (Organic Chemistry)
Semester: III

Paper Code: 101330309		Total Credit: 4
Title of Paper: Selected Topics in Organic Chemistry		
Unit	Description in detail	Weightage
1	Dyes: Brief introduction to fundamentals of dyes; Classification of dyes based on structure and applications; Non textile dyes-Leather, food, hair, ink, photographic, indicator, NIR, Indigo dyes, Medicinal dyes, Security dyes.	25%
2	Pigments: Organic and Inorganic Pigments-Introduction, classification, characteristics and applications. Organic pigments- Synthesis and evaluation. FBA-Characteristics, classification, synthesis and applications. Uses and Synthesis of Dyes: Crystal Violet, Ciba Blue 2B, Procion Brilliant M ₅ B, Tartrazine Yellow, Alizarin, Quinazarin, Acid Blue 23, Basic Blue 22, Acryflavine, Saframine T, Methylene Blue, Amido Yellow E, Polar Yellow Brown, Bismark Brown, Direct Deep Black, Congo Red, Fluorecein, Direct Black 38, Eriochrome Black T, Pyrazolone azo, Malachite Green, Rosaniline, Aniline Blue, Rohdomine B, Indoaniline.	25%
3	Pericyclic Reactions-I: General introduction, Theories of pericyclic reactions: FMO, Woodward-Hoffmann rules, Huckel-Mobius rules. Electrocyclic reactions: Ring opening and closing reactions of 4n and 4n+2 system; cation (Nazarov reaction) and anion type molecules; small ring opening. Sigmatropic reactions: [1, n]; [2, 3] –SeO ₂ , Somellet-Haouser, Wittig, Mislow Evan's rearrangements; [3, 3]- Cope, Claisen, Claisen-Cope, Aza-Cope; [5, 5].	25%
4	Pericyclic Reactions-II: Theories of pericyclic reactions: FMO, Woodward-Hoffmann rules, Huckel-Mobius rules. Cycloadditions: [2+2] thermal and photochemical; [4+2]-Diels-Alder reactions, diene and dinophile nature; Inter, intra and hetero cycloaddition reaction with region and stereoselectivity. [3+2]-dipolar cycloaddition, introduction of different dipoles, their reactions dipolarophiles (inter, intra) Cycloadditions reactions of more than six electrons. Group transfer reactions: Ene reactions: Syn β-elimination.	25%

Basic Text & Reference Books:-

1. Colour Chemistry : Synthesis, Properties and applications of Organic dyes and pigments, A. T. Peters, H. S. Freeman
2. The Chemistry of Synthetic dyes and pigments, by H. A. Lubs, Reinhold Publication (1955)
3. The Chemistry of Synthetic dyes, Volume I to IX, Edited by K. Venkataraman, Academic Press (1971)
4. The production and applications of fluorescent Brightening Agents, Milos Zahradnik, John Wiley & Sons. 1982
5. Synthetic dyes, Gurdeep R. Chatwal, 4th revised and enlarged edition, Himalaya Publishing House
6. Handbook of synthetic dyes and pigments, Vol. – 2 (Intermediates), 2nd edition, K. M. Shah, Multi-tech publishing co. Mumbai
7. Handbook of synthetic dyes and pigments, Vol. – 3 (Pigments), 2nd edition, K. M. Shah, Multi-tech publishing co. Mumbai
8. Aspects of organic photochemistry, William M. Horspool, Academic Press
9. Frontier orbitals and organic chemical reactions, Ian Fleming,
10. Molecular Orbitals and Organic Chemical Reactions, Student Edition, Ian Fleming, (2010), Wiley
11. Pericyclic reactions, Ian Fleming, Oxford
12. Advance organic chemistry: part A & B, Francis Carey
13. Photochemistry and pericyclic reactions, Jagdamba Singh, Jaya Singh,
14. Modern methods of organic synthesis, 4th edition, W. Carruthers, Iain Coldham, Cambridge university press,
15. Organic chemistry, 2nd edition, J. Clayden, N. Greeves, S. Warren, Oxford university press
16. Organic chemistry, 7th edition, R. T. Morrison, R. N. Boyd, S. K. Bhattacharjee, Pearson

CVM UNIVERSITY
M. Sc. (Organic Chemistry)
Semester: III

Paper Code: 101330310		Total Credit: 4
Title of Paper: Occupational Practices		
Unit	Description in detail	Weightage
1	<p>Intellectual Property Rights: Introduction to intellectual properties; Need for protection of intellectual properties; Industrial property: patents, trademark, industrial design and geographical indications; Copyright and neighbouring rights; IPR legislations in India, World IP organizations and treaties; Indian patent act; Patentability; Patent applications; Patent registration and filing; Patent cooperation treaty.</p>	25%
2	<p>Validation of analytical methods and processes: General principles of analytical method validation, parameters for method validation: specificity, selectivity, precision, accuracy, linearity and calibration curve, Range, Limit of detection and quantification, Robustness. Introduction to process validation; Regulatory basis for process validation; Pharmaceutical process validation; FDA guidelines; cGMP and GLP: cGMP guidelines viz. ICH/WHO/USFDA/EDQM/Schedule M/NDA/AMDA.</p>	25%
3	<p>Hazards: Classification Hazardous chemical, transportation of Hazardous chemicals, Storage, Handling and control measures for hazardous chemicals. Hazards and controls in Unit process and Unit Operations. Hazards – fire, mechanical, electrical, chemical and pharmaceutical, Monitoring & prevention systems, industrial effluent testing & treatment. Control of environmental pollution.</p>	25%
4	<p>Concept of Industrial Safety: Accidents investigation and Analysis, Statutory provisions, Types of chemical hazards and control, control techniques, process flow chart and its importance for safety inspection, interpretation, use and training of MSDS, UN, HAZCHEM.</p> <p>Safety in chemical industry: General introduction, type of chemical hazards, Safety and risk phrases, Storage hazards and control, Prevention of overflow-pressure-temperature and process flow, Types of guards and valves for the vessel, its inlet and out let, need of remote and auto control valves, Process hazards and controls.</p>	25%

Basic Text & Reference Books:-

1. Intellectual Property Rights under WTO: Tasks Before India, Author: T. Rammappa – New Delhi, Wheeler Publishing, 2000.
2. Intellectual Property Rights: Text & Cases; Author: Dr. S. Balasubhranian Dr. R. Radhakrishnan, Publisher: Excel Books N Delhi, ISBN: 8174466096, ISBN-13: 9788174466099.
3. How to Practice GMPs, Author: P.P. Sharma, Vandana Publications, Agra
4. Pharmaceutical Process Validation, Author: Ira R. Berry and Robert Nash, Publisher: Marcel Decker Inc.(2nd edition).
5. Accident prevention manual for industrial operations, National safety council, Chicago, 10th edition.
6. Safety and Accident prevention in chemical operation, 2 nd edition, Howard H.
7. Handbook of occupational safety and Health by S. Lawrence.
8. MSDS – your guide to chemical safety
9. Engineering design for control of work place hazards, A. Richard
10. Safety managers Handbook, J. J. Keller and Associates Inc, USA.
11. Supervising safety for hazardous Processes, Dr. K. U. Mistry, Safety Health and Environment Association, 1st edition.
12. Fundamental of Industrial safety and health by Dr. K. U. Mistry

CVM UNIVERSITY
M. Sc. (Organic Chemistry)
Semester: III

Paper Code: 101330304	Total Credit: 4
Title Of Paper: Spectral Exercise and Organic Separation Lab	

Description in detail	Weightage (%)
Separation and identification of Ternary Organic Mixture and Spectral Exercise	100%

- A. Separation and identification of Ternary Organic Mixture
Minimum two (02) mixtures should be given from each of the following type
1. Solid + Solid + Solid
 2. Solid + Solid + Solid (one soluble)
 3. Solid + Solid + Liquid
 4. Solid + Liquid + Liquid
 5. Liquid + Liquid + Liquid
- B. Spectral Exercise
- Structure interpretation of organic compounds from spectral data

Basic Text & Reference Books:-

1. Vogel's Textbook of practical organic chemistry, 5th edition, B. S. Furniss, A. J. Hannaford, P. W. G. Smith, A. R. Tatchell (Pearson Education)
2. Comprehensive practical organic chemistry: Qualitative analysis, V. K. Ahluwalia, Sunita Dhingra (Universities Press)
3. Organic structures from spectra, 5th edition, L. D. Field, S. Sternhell, J. R. Kalman (Wiley: A John Wiley & Sons Ltd publication)
4. Elementary Organic Spectroscopy: Principles and Chemical applications (revised edition), Y. R. Sharma (S. Chand Publishing)

CVM UNIVERSITY
M. Sc. (Organic Chemistry)
Semester: III

Paper Code: 101330306	Total Credit: 4
Title of Paper: Synthesis and Application of Dyes and Intermediates Lab	

Description in detail	Weightage (%)
Synthesis and Application of Dyes & Intermediates	100%

- A. Synthesis of Azo dye (including azoic dye, disperse azo dye and acid azo dye) and its dyeing on various fiber. Dyeing of Indigo (Vat dyeing). Also some intermediate use for above dyeing.
- B. Synthesis of dyes, pigments and intermediate
1. o-Cresolphthalein
 2. Phenolphthalein
 3. Fluorescein and its methylation
 4. Quinizarin
 5. 1, 5-Dinitroanthraquinone
 6. Bisazo acid dye
 7. Acetoacetanilide pigment
 8. Indigo dye and its dyeing (Vat dyeing)

Basic Text & Reference Books:-

1. Vogel's Textbook of practical organic chemistry, 5th edition, B. S. Furniss, A. J. Hannaford, P. W. G. Smith, A. R. Tatchell (Pearson Education)
2. Comprehensive practical organic chemistry: Preparation and Quantitative analysis, V. K. Ahluwalia, Renu Aggarwal (Universities Press)

OR

101330305 and 101330307:

* **Project work** (as optional) in place of practicals; to be offered to some of the students, based on their merit, interest and placement with the teachers (Marks : 200). The project shall have to be carried out under the allotted teacher(s) and a dissertation shall be submitted and will be assessed for internal (80 marks) and external (120 marks), in the usual manner.

CVM UNIVERSITY
M. Sc. (Organic Chemistry)
Semester: III

Paper Code: 101330308	Total Credit: 1
Title of Paper: Viva Voce	
Description in detail	Weightage (%)
Viva Voce From the Subjects Studies in Semester – III	100%

CVM UNIVERSITY
M. Sc. (Organic Chemistry)
Semester: IV

Paper Code: 101330401		Total Credit: 4
Title of Paper: Natural Products		
Unit	Description in detail	Weightage
1	Introduction of Natural Products Classification, source and methods of isolation of natural products, General methods for the structure determination of natural products. Vitamins: Structure and synthesis of Vitamin A ₁ , Vitamin B ₁ (Thiamine), Vitamin B (Pyridoxine) and Biotin (Vitamin H). Synthesis of Vitamin C, Vitamin B ₂ (Riboflavin).	25%
2	Alkaloids Introduction of Opium alkaloids, Structure and synthesis of Morphine, Rearrangement in opium alkaloids, synthesis of Reserpine and Tylophorine. Biogenesis of Alkaloids, Structure and synthesis of Cinchonine, Structure and synthesis of Tropine, Synthesis of 2-ethylpyridine, tropinic acid, tropinone and tropilidine from tropine, Synthesis of pimelic acid from tropinic acid	25%
3	Terpenoids and Carotenoids Structure and synthesis of bicyclic sesquiterpenoids Eudesmol and Cadinene, structure and synthesis of β -Carotene, synthesis of Caryophyllene and (-) Khusimone, molecular rearrangement of Caryophyllene and Logifolene. Biogenesis of Terpenoids and Carotenoids.	25%
4	Steroids Structure and synthesis of Cholesterol, Steroid Hormones: Introduction, Androgens: Synthesis of Testosterone, Oestrogens: Total Synthesis of Oestrone, Gestrogens: Synthesis of Progesterone from cholesterol. Synthesis of Cortisone, and Chemistry of bile acids. Biogenesis of Steroids.	25%

Basic Text & Reference Books:-

1. The Chemistry of Natural Products, K. W. Bentley, Vol. I – V (Interscience).
2. Organic Chemistry, Vol. 2, I. L. Finar, 5th Edition (1994) ELBS Publication.
3. Natural Products Chemistry, Vol. I & II K. Nakanishi et al., Academic press publication (1974).
4. The Molecules of Nature, J. B. Hendrickson, W. A. Benjamin Inc. (1965).
5. Selected Organic Synthesis, Ian Fleming John Wiley (1977).

6. Chemistry of Natural Products, N. R. Krishnaswamy, University Press (India) Ltd. (1999).
7. Classical Methods in Structure Elucidation of Natural Products, Reinhard W. Hoffmann by Wiley-VHCA.
8. [https://ndl.iitkgp.ac.in/homestudy/science/ chemistry & biochemistry/chemistry video lecctrures:CEC, Alkaloids-II, Alkaloids-III & Alkaloids-IV](https://ndl.iitkgp.ac.in/homestudy/science/chemistry%20&%20biochemistry/chemistry%20video%20lecctrures:CEC,%20Alkaloids-II,%20Alkaloids-III%20&%20Alkaloids-IV)

CVM UNIVERSITY
M. Sc. (Organic Chemistry)
Semester: IV

Paper Code: 101330402		Total Credit: 4
Title of Paper: Medicinal Chemistry		
Unit	Description in detail	Weightage
1	<p>Introduction to Medicinal Chemistry, Pharmacokinetics: Drug administration, Drug absorption, drug distribution, drug Metabolism (general pathway of drug metabolism: Oxidative, reductive and hydrolytic reactions), Drug excretion. Time course of drug action; First order and zero order, Time course of drug concentration change in plasma, Plateau effect, Some useful points and related examples.</p> <p>Pharmacodynamics: Receptors, Chemical messengers, Binding sites, Receptor types and subtypes (protein receptors, DNA receptors with examples of Agonists and Antagonists).</p>	25%
2	<p>Psychoactive Drugs: Sedative and Hypnotics: Classifications, SAR of Barbituric acid, Synthesis of Glutethimide, Oxazepam and methaqualone. Antianxiety agents: Introduction, Classification, SAR of Benzodiazepine, Mode of action; Synthesis and uses: Diazepam, Nitrazepam, Meprobamate, Hydroxyzine. Antidepressants: Introduction, Classification, Synthesis and uses: Isocarboxazid, Imipramine, Sertraline, Venlafaxine. Cardiovascular Drugs Antianginal and Vasodilators: Introduction and Classifications, Synthesis of Nitroglycerine, Nicorandil, Nifedipine, Bepridil, Minoxidil and Hydralazine and SAR of Dihydropyridines. Antihypertensive drugs: Introduction and Classifications, Synthesis of Captopril, Ramipril.</p>	25%
3	<p>Antineoplastics Agents: Introduction, Classification, synthesis and drug profile. Alkylating agents: Melphalan, cyclophosphamide and dacarbazine. Topoisomerase inhibitors: Doxorubicin etoposide and dactinomycin. Antimetabolites: Mercaptopurine methotrexate and gemcitabine. Tubulin binders: Docetaxel paclitaxel and vincristine. Antiviral Agents: Introduction, Classification of drugs according to its mechanism of action and according to the treatment protocol. Drug profile based on Nucleotide analogues: Acyclovir, Idoxuridine, Rimantadine, Non-Nucleoside RT inhibitors: Nevirapine, Emivirine.</p>	25%

	Nucleoside RT inhibitors: Zalcitabine, Zidovudine. HIV protease inhibitors: Indinavir, Ritonavir.	
4	Antibiotics: General Introduction, Chemical Classification. β -lactam antibiotics: Penicillin, Cephalosporins, β -lactamase inhibitors, Aminoglycosides, Tetracyclines, Chloramphenicol, Quinolone. Synthesis and application of Ciprofloxacin, Pefloxacin, Norfloxacin, Enrofloxacin, Ofloxacin, Levofloxacin, Chloramphenicol, Ampicillin, Amoxicillin, 6-Amino Penicillanic acid, 7-Amino Cephalosporanic acid, 7-Amino-3-Deacetoxy Cephalosporanic acid (Precursors), Oxacillin, Cloxacillin, Dicloxacillin, Flucloxacillin, Ceftriaxone, Cefuroxime. Drug Design: Concepts of drug design, Approaches to lead discovery, SAR, Combinatorial chemistry, Pro-drugs.	25%

Basic Text & Reference Books:-

1. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical, Chemistry, 11th Edition by John H. Block & John M. Beale, Published by Lippincott Williams & Wilkins (2004).
2. Principles of Medicinal Chemistry, 4th Edition by William O-Foye, Thomas L. Lemke and David A. Williams, Published in India by B. I. Waverly Pvt. Ltd. New Delhi (1995).
3. Essential of Medicinal Chemistry, 2nd Edition by Andrejus korolkovas, Published by Wiley-India Edition (1988).
4. Instant Notes: Medicinal Chemistry, Edited by Graham L. Patric, Published by Viva Books Private Ltd. (2002)
5. Textbook of Medicinal Chemistry Vol. I & II by V. Alagarsamy Published by Elsevier (2010).
6. Medicinal Chemistry 3rd Edition by Ashutosh Kar Published by New age international (P) Limited, Publishers (2005).
7. Medicinal Chemistry Edited by Alfred Burger Published by Interscience Publishers, John Wiley & Sons, New York (1951)
8. Burger's Medicinal Chemistry and Drug Discovery Vol. 3: Therapeutic agents Edited by Manfred E. Wolff Published by Interscience Publishers, John Wiley & Sons, New York (1996)
9. Burger's Medicinal Chemistry 4th Edition : Part III Edited By Manfred E. Wolff Published by Interscience Publishers, John Wiley & Sons, New York (1981)
10. Organic Chemistry, Vol. 2, I. L. Finar, 5th Edition (1994) ELBS Publication.
11. Natural Products Chemistry, Vol. I & II K. Nakanishi et al., Academic press publication (1974).
12. The Molecules of Nature, J. B. Hendrickson, W. A. Benjamin Inc. (1965).
13. Selected Organic Synthesis, Ian Fleming John Wiley (1977).
14. Chemistry of Natural Products, N. R. Krishnaswamy, University Press (India) Ltd. (1999).

15. [https://ndl.iitkgp.ac.in/homestudy/science/chemistry & biochemistry/chemistry video lecctrures:CEC, Drugs & Pharmaceuticals](https://ndl.iitkgp.ac.in/homestudy/science/chemistry%20&%20biochemistry/chemistry%20video%20lecctrures:CEC,%20Drugs%20&%20Pharmaceuticals)

CVM UNIVERSITY
M. Sc. (Organic Chemistry)
Semester: IV

Paper Code: 101330403		Total Credit: 4
Title of Paper: Stereochemistry in Organic Compounds		
Unit	Description in detail	Weightage
1	Asymmetric Synthesis Introduction, Chemoselectivity, Regioselectivity, Stereoselectivity; Methodology of Asymmetric Synthesis; Classification of Asymmetric reactions: Substrate controlled, Chiral auxiliary controlled, Chiral reagent controlled and Chiral catalyst controlled; Substrate controlled asymmetric synthesis: Nucleophilic addition to carbonyl compounds; 1,2 – Asymmetric induction, Cram's rule, Prelog's rule and Felkin – Anh model; Asymmetric aldol reaction; Diastereoselective aldol reaction, Chiral auxiliary controlled asymmetric synthesis: α – Alkylation of chiral enolates, oxazoline; Use of chiral auxiliary in Diels – Alder reaction; Chiral reagent controlled asymmetric synthesis: Asymmetric hydroboration using IPC_2BH and IPCBH_2 ; Reduction with CBS reagent. M. P. V. Reduction; Chiral catalyst controlled asymmetric synthesis: Sharpless epoxidation; Asymmetric hydrogenations using chiral Wilkinson bisphosphine.	25%
2	Resolution and Conformational Analysis Resolution: Principle; General methods for resolution; Resolution of (\pm)-2-octanol, (\pm)-phenylethylamine, (\pm)-alanine. Conformational analysis of acyclic compounds.	25%
3	Conformational Analysis Conformational analysis of cyclic, fused, and bridged cyclic ring systems.	25%
4	Dynamic stereochemistry: Selection of substrate for Alkene, Water addition, Nucleophilic attack on cyclic ring, Exo-Endo attack on bridgehead compound, Nucleophilic substitution reaction ($\text{S}_{\text{N}}1$, $\text{S}_{\text{N}}2$, $\text{S}_{\text{N}}\text{i}$, NGP by π -bond and NGP by σ -bond), Elimination reaction (α -elimination, β -elimination, γ -elimination, 1,n-elimination), Regioselectivity of Elimination reaction, Dehalogenation of dihalide compounds, Diol formation, Epoxide formation, Epoxide ring opening.	25%

Basic Text & Reference Books:-

1. Stereochemistry: Conformation and Mechanism, By P.S. Kalsi, 6th edition, New Age International (P) Ltd., Publishers (2005).



2. Stereochemistry and Mechanism through solved problems, By P.S. Kalsi, Wiley Eastern Ltd. (1994).
3. Stereochemistry of organic compounds, By D. Nasipuri, 2nd Edition, New Age International (P) Ltd., Publishers (1994).
4. Stereochemistry of Carbon Compounds, By E.L. Eliel, Tata McGraw-Hill Pub. Co. Ltd. (1962).
5. Organic Chemistry, By J. Clayden, N. Greeves, S. Warren and P. Wothers, Oxford Uni. Press, N.Y. (2001).
6. Dynamic stereochemistry of chiral compounds: Principles and Applications By Christian Wolf, RSC Publishing (2008).
7. Organic Chemistry by J. Clayden, N. Greeves and S. Warren, 2nd edition, Oxford University Press, UK.
8. Modern Methods of Organic Synthesis; W. Carruthers and I. Coldham, 4th edition, Cambridge University Press, UK.

CVM UNIVERSITY
M. Sc. (Organic Chemistry)
Semester: IV

Paper Code: 101330409		Total Credit: 4
Title of Paper: Topics in Organic Chemistry		
Unit	Description in detail	Weightage
1	Organometallic Chemistry Transition metals in Organic reactions; 18-electron rule; Bonding and reactions in transition metal complexes: oxidative addition, reductive elimination, insertion reaction; Role of palladium in homogenous catalysis; Heck reaction; Cross coupling of organometallics and halides: Stille coupling, Suzuki coupling, Sonogashira reaction, Hiyama coupling, Kumada coupling, Zimmerman coupling; Allylic electrophile activation by Pd(0); Pd catalyzed amination of aromatic ring; Nucleophilic attack to Pd(II)-alkene organometallic complexes, Metathesis reactions.	25%
2	Name Reactions and Reagents Sharpless asymmetric hydroxylation, Staudinger reaction, Corey-Fuchs reaction, Ritter reaction, Nef reaction, McMurry reaction, Luche reduction, Wacker oxidation, TEMPO, Noyori asymmetric hydrogenation, Apple reaction, Corey-winter olefin reaction .	25%
3	Sulfur, Silicon and Phosphorous in Organic Chemistry Sulfur and organosulfur compounds; Sulfur stabilized anions; Sulfonium salts; Sulfonium ylids, Reactivity comparison of silicon and carbon; Allyl silanes as nucleophiles; Role of S, Si and P in alkene synthesis; Stereoselective synthesis of alkene; Julia olefination; Peterson reaction, Wittig reaction.	25%
4	Organic Chemistry – Problem Solving in Context to Competitive Examinations Solving problems based on reaction mechanism, reagents, spectroscopy and stereochemistry with special emphasis on current research.	25%

Basic Text & Reference Books:-

1. Organic Chemistry by J. Clayden, N. Greeves and S. Warren, 2nd edition, Oxford University Press, UK.
2. Modern Methods of Organic Synthesis; W. Carruthers and I. Coldham, 4th edition, Cambridge University Press, UK.
3. Name Reaction for Functional Group Transformation, E. J. Corey and Jie Jack Lie, John Wiley and Sons, New Jersey.

4. Name Reactions, Jie Jack Lie, 4th edition, Springer, New York.
5. Selected Organic Synthesis, Ian Fleming, John Wiley & Sons, New Jersey.

CVM UNIVERSITY
M. Sc. (Organic Chemistry)
Semester: IV

Paper Code: 101330410		Total Credit: 4
Title of Paper: Applied Organic Chemistry		
Unit	Description in detail	Weightage
1	Organic Chemistry in Industry Introduction, Process Chemistry <i>versus</i> Research Chemistry, Pharmaceutical Industry: Drug Discovery, Drug development-Preclinical and clinical testing, Medicine, Future Problems and Opportunities. Agrochemical Industry: Herbicides, Fungicides and Insecticides. Dyes Industry: Textile and Food dyes.	25%
2	Organic Chemistry and Environment Introduction, Pesticides, Focus on POPs and VOCs, Endocrine Disruptors, Chlorofluorocarbons and their Replacements, Polycyclic Aromatic Hydrocarbons, Plastics, Green Chemistry and the future.	25%
3	Organic Chemistry in Forensic Science Introduction, Drugs of Abuse: Categories, Presumptive Tests, Instrumental Methods and Designer Drugs, Poisoning, Testing of Blood, Dyes, Inks and Paper, Trace Evidence, Fingerprints Visualization.	25%
4	Organic Reactions Catalysis Introduction, Catalysis by Acids and Bases, Lewis Acid Catalysis, Phase-Transfer Catalysis, Reactions Catalyzed by Metal Surfaces and Transition Metal Complexes, Enzyme and Organocatalysis.	25%

Basic Text & Reference Books:-

1. Organic Chemistry: A Mechanism Approach; Penny Chaloner, CRC Press, Taylor and Francis; Florida.
2. Pharmaceutical Process development: Current Chemical and Engineering Challenges, J. Blacker and M. T. Williams, RSC Cambridge, UK.
3. Fine Chemicals: The Industry and Its Business, P. Pollak, 2nd Edition, Wiley.
4. The Evolution of Drug Discovery: From Traditional Medicines to Modern Drugs, E. Ravina, Wiley.
5. Name Reactions, Jie Jack Lie, Fourth edition, Springer, New York.
6. Catalysis of Organic Reactions, John R. Sowa, Jr., CRC Press, Taylor and Francis, Florida.

CVM UNIVERSITY
M. Sc. (Organic Chemistry)
Semester: IV

Paper Code: 101330404	Total Credit: 4
Title of Paper: Multistep Synthesis of Heterocyclic Compounds Lab	

Description in detail	Weightage (%)
Multistep Synthesis of Heterocyclic Compounds	100%

Multistep Synthesis of Heterocyclic Compounds (Minimum Sixteen (15) exercises)

- To monitor reaction by Thin Layer Chromatography (TLC)
 1. Acridone
 2. Antipyrin
 3. Phenacetin
 4. 2-Methylbenzimidazole
 5. 2-Benzylbenzimidazole
 6. Preparation of heterocyclic azo dye
 7. 5-Chloro-3-methyl-1-phenyl-1*H*-pyrazolone-4-carboxaldehyde
 8. 2-Phenylindole
 9. 5-Nitroanthranilic acid
 10. 2-Methyl-3-benzyl-4-ketoquinazoline
 11. 2,3-Dimethyl-4-ketoquinazoline
 12. Flavone
 13. 2-Chloro-3-formyl-quinolones
 14. 5-Hydroxy-1,3-benzoxathiazolone-2
 15. *p*-Aminobenzene sulfonamide (Sulfa drug),
 16. 2-Chloromethylbenzimidazole
 17. 3-(4-Carbonyl-1-phenylpyrazol-3-yl)chromen-2-one
 18. Miscellaneous

Basic Text & Reference Books:-

5. Vogel's Textbook of practical organic chemistry, 5th edition, B. S. Furniss, A. J. Hannaford, P. W. G. Smith, A. R. Tatchell (Pearson Education)
6. Comprehensive practical organic chemistry: Qualitative analysis, V. K. Ahluwalia, SunitaDhingra (Universities Press)
7. Organic structures from spectra, 5th edition, L. D. Field, S. Sternhell, J. R. Kalman (Wiley: A John Wiley & Sons Ltd publication)
8. Elementary Organic Spectroscopy: Principles and Chemical applications (revised edition), Y. R. Sharma (S. Chand Publishing)

CVM UNIVERSITY
M. Sc. (Organic Chemistry)
Semester: IV

Paper Code: 101330406	Total Credit: 4
Title of Paper: Spectral Analysis & Synthesis of Drugs, Intermediates and Esters Lab	

Description in detail	Weightage (%)
Synthesis of Some Drugs and Intermediates, Synthesis of Various Esters, Demonstration of column chromatography, Spectral Analysis	100%

- A. Synthesis of Some Drugs and Intermediates (08 exercises)
1. Yarayara (2-methoxy naphthalene)
 2. 5,5'-Diphenylhydantoin
 3. Benzimidazole
 4. Benzotriazole
 5. 2-Hydroxy-4-methylquinoline
 6. 2,3-Diphenylquinoxaline
 7. 6-Methyl-4-oxo-1,3,-dihydro-2-thiopyrimidine
 8. Ethyl-6-methyl-2-oxo-4-phenyl-1,3,4-trihydro-5-pyrimidinecarboxylate
- B. Synthesis of Various Esters (07 exercises)
1. Benzocain (Ethyl-p-aminobenzoate)
 2. Dibutyl maleate
 3. Ethyl Cinnamate
 4. Butesin (Butyl-4-aminobenzoate)
 5. Isobutyl phenylacetate
 6. Salol (Phenyl Salicylate)
 7. Ethylphenylacetate
- C. Demonstration of Column Chromatography
- D. Spectral Analysis
Structure interpretation of organic compounds from spectra.
Minimum eight (08) exercises should be given.

Basic Text & Reference Books:-

3. Vogel's Textbook of practical organic chemistry, 5th edition, B. S. Furniss, A. J. Hannaford, P. W. G. Smith, A. R. Tatchell (Pearson Education).



4. Comprehensive practical organic chemistry: Preparation and Quantitative analysis, V. K. Ahluwalia, Renu Agarwal (Universities Press).

OR

101330405 and 101330407

* Project work (as optional) in place of practicals; to be offered to some of the students, based on their merit, interest and placement with the teachers (Marks : 200). The project shall have to be carried out under the allotted teacher(s) and a dissertation shall be submitted and will be assessed for internal (60 marks) and external (140 marks), in the usual manner.

CVM UNIVERSITY
M. Sc. (Organic Chemistry)
Semester: IV

Paper Code: 101330408	Total Credit: 1
Title of Paper: Comprehensive Viva	
Description in detail	Weightage (%)
Viva Voce From the Subjects Studied in Semester – IV	100%