SARDAR PATEL UNIVERSITY
VALLABH VIDYANAGAR

SYLLABUS EFFECTIVE FROM: 2017-18
M.Sc. CHEMISTRY
SEMESTER-II

Proposed syllabus with effect from June 2017
PS02CCHE21: **Quantum Chemistry**

Total Credit: 4

Unit	Description in details	Weightage (%)
Unit-1	***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. ***Translational motion of a particle:*** 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	25%
Unit-2	***Rotational motion of a particle:*** Particle on a sphere; normalization of the wave functions; rotation of a diatomic molecule and problems ***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. ***The hydrogen like atoms:*** The r-dependent part of the wave function; Laguerre and associated Laguerre polynomials; radial eigenfunction for various system; total wave functions of hydrogen like atom.	25%
Unit-3	***Approximation methods:*** Dirac notation; time independent perturbation theory for non-degenerate case; n^{th} -order perturbation energy; first order correction to wavefunction; second order correction to energy of the eigenfunction; first order perturbation theory for a degenerate level; the variation theorem. ***Many-electron atoms & angular momenta:*** The wave functions of many electron systems; the He atom; many electron atom; Hatree-self consistent field methods; angular momenta in many electron atom; communication with Hamiltonian; spin-orbit interaction; energy states of atoms and term symbols; problems.	25%

Unit-4	***Theory of chemical bonding:*** Born Oppenheimer approximation; molecular orbital theory; LCAO approximation; MO theory of bonding in hydrogen molecule ion and hydrogen molecule; Valance bond (VB) theory of bonding in hydrogen molecule ion and hydrogen molecule; LCAOMO treatment of diatomic molecule; VB treatment of diatomic molecule.	25%

Reference books:

- Introductory Quantum Chemistry, Fourth Edition,
  By: A. K. Chandra
  Tata McGraw-Hill Publishing Company Ltd., New Delhi (1994).
- Quantum Chemistry,
  By: R. K. Prasad
  New Age International Publishers (1985).
- Molecular Quantum Mechanics,
  By: P. W. Atkins and R. S. Friedman
  OxfordUniversity Press (1997).
- An Introduction to Quantum Chemistry,
  By: M. Satake, Y. Mido, H. Yasuhisa, S.Taguchi, M.S.Sethi & S.A.Iqbal
  Discovery Publishing House New Delhi (1996).
- Quantum Chemistry
  By: N.Levine, Prentice Hall of India (p) Ltd. New Delhi (1994).
- Quantum Chemistry through problem and solutions
  By: R. K. Prasad
  New Age International Publishers (1997).

M.Sc. CHEMISTRY

SEMESTER-II

PS02CCHE22: **Organic Chemistry-II**

Total Credit: 4

Unit	Description in detail	Weightage (%)
Unit-1	**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	25%
Unit-2	**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.	25%
Unit-3	**Reagents in Organic Synthesis [Oxidation] :** $Cr0_3$, $Mn0_2$, $KMn0_4$, $Se0_2$, $Pb(OAc)_4$, OsO_4, HIO_4, DMSO, H_20_2, Ozone, HgO, NBS, $K_3Fe(CN)_6$, DDQ, $Al(O\text{-}t\text{-}Bu)_3$ **Some Miscellaneous Reagents in Organic Synthesis :** Dess- Martin reagent Trimethylsilylhalide, alkyl lithium, LDA, Sharpless Epoxidation	25%
Unit-4	**Reagents in Organic Synthesis [Reduction] :** $Al(O\text{-}iPr)_3$, Zn/HCl, N_2H_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, Baker's Yeast.	25%

Basic Text & Reference Books:-

- 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)

M.Sc. CHEMISTRY
SEMESTER-II
PS02CCHE23: **Topics in Physical Chemistry-II**

Total Credit: 4

Unit	Description in details	Weightage (%)
Unit-1	**Chemical Kinetics – II :** Complex reactions :- Opposing reactions, Consecutive reactions, Parallelreactions, Reactions in flow systems, Chain reactions, Ionic reactions and salt effect, enzyme catalyzed reactions, kinetics of fast reactions.	25%
Unit-2	**Chemical Dynamics :** Methods of determining rate laws, collision theory of reaction rates, steric factor, activated complex theory, Arrhenius equation and the activated complex theory ; ionic reactions, kinetic salt effects, steady state kinetics, kinetic and thermodynamic control of reactions, treatment of uni-molecular reactions. Dynamic chain (hydrogen-bromine reaction, pyrolysis of acetaldehyde, decomposition of ethane), photochemical (hydrogen-bromine and hydrogen-chlorine reactions) and oscillatory reactions (Belousov-Zhabotinsky reaction).	25%
Unit-3	**Group theory in Chemistry :** *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*, σ, 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.	25%
Unit-4	**Chemical Applications of Group Theory :** 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 and cyclic conjugated polyenes. Group theoretical selection rules for electronic transitions, infrared spectra and Raman spectra, Electronic spectra of carbonyl chromophore.	25%

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, (McGrraw 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)

M.Sc. CHEMISTRY
SEMESTER-II
PS02ECHE21: **Analytical Chemistry**

Total Credit: 4

Unit	Detail Description	Weightage (%)
Unit-1	**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**
Unit-2	**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 statastical analysis	**25**
Unit-3	**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**
Unit-4	**Separation Methods :** Introduction & classification of various separation methods. **Chromatography techniques:** General introduction, Principles 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 Rf Values. **Gas Chromatography**: Principle, Introduction, instrumentation.	**25**

M.Sc. CHEMISTRY
SEMESTER-II

PS02ECHE22 ; Introduction to Biochemistry

Total Credit: 4

Unit	Description in detail	Weighta
Unit-1	**Vitamins:** Classification, introduction, chemistry, absorption, transport, mobilization and biochemical functions of Vitamins: A, D, E, K ,C, B_1, B_2, B_6, B_{12}, H ,CoA, Follic acid, Niacin **Lipids:** Nomenclature, Structure and physical properties of some naturally occurring fatty acids, triacelglycerol and waxes as sources of stored energy , insulation and water repellents, Types of membrane lipids , Introduction to glycerophospho lipids, galacto lipids, sphingo lipids , phospho lipids and sterols.	25%
Unit-2	**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.	25%
Unit-3	**Carbohydrates:** Classification and stereochemistry, Biologically important hexose derivatives, Nomenclatre for disaccharides, structure and role of some Homo and Hetero Polysaccharides, Glycoconjugates : Proteoglycans, Glycoproteins and Glycolipids, Introduction to Glycobiology (The sugar code) **Water:** Interaction among biomolecules in aqueous systems, Buffering against pH changes in biological systems, participation of water in biological reactions	25%
Unit-4	**Enzymes:** Classification Nomenclature & extraction factors affections, catalytic activityand 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, structureand types of RNA.	25%

Basic Text & Reference Books:-

- Lehninger Principles of Biochemisrty, David L. Nelson and Michael M. Cox [Palgrave MacMillan /W.H.Freeman & company, New York]
- Principles of Biochemisrtry, Donald J. Voet , Judith G. Voet , Charlotte W. Pratt [John Wiley &Sons]
- Biochemistery, U. Satyanarayana, Books & Allied (p) Ltd. , Kolkata(India)

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.

M.Sc. CHEMISTRY
SEMESTER-II

PS02CCHE24 & PS02CCHE25 Practicals

Inorganic, Organic& Physical Chemistry

- **INORGANIC CHEMISTRY** **Weightage(33%)**

(Inorganic-I)-Quantitative Analysis:
Sr. No.

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)

Sr. No.

1. 6 – Cation, Anion variable
2. 1 – Rare earth element form the following:
3. Th, Ce, Li, Mo, Se, Te, V, Ti and Zr etc.

References 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
- Chemistry: Inorganic Qualitative Analysis in the Laboratory, Clyde Metz, Elsevier, 2012, ISBN : 978032316104

❖ **ORGANIC CHEMISTRY** **Weightage(33%)**

(Organic-I)- Synthesis
Sr. No.

1. Aspirin from salicylic acid [Acetylation]
2. Acetanilide from aniline
3. *p*-Bromoaniline from aniline [Protection, Bromination and Deprotection]
4. *p*-nitroaniline from aniline [Protection, Nitration and Deprotection]
5. Nitrobenzene from benzene/ *m*-dinitrobenzene from nitrobenzene [Nitration]
6. *p*-nitrobromobenzene from bromobenzene
7. Picric acid from phenol
8. *o*- and *p*-nitrophenol from phenol
9. 2,4,6-tribromophenol/ 2,4,6-tribromoaniline [Bromination]
10. 1,3,5-tribromobenzene from aniline [Bromination and deamination]
11. 1-Phenylazo-β-naphthol [Diazo coupling]
12. Methylorange from sulphanilic acid
13. 2,5-Dimethylbenzenesulfonic acid [Sulphonation]
14. Terphthalic acid from *p*-xylene [Oxidation]
15. *m*-nitroaniline from nitrobenzene [nitration and partial Reduction]
16. Phenol Formaldehyde Resin
17. TLC for separation and R_f value determination of components in a mixture

(Organic-II)- Estimation
Sr. No.

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%)**

Total Credit: 4

(Physical- I)
Sr. No.

1. To determine the rate of acid – catalyst iodination of acetone in presence of excessacid and acetone at room temperature
2. To determine the molecular weight of given liquid by steam distillation method
3. Determination of the Critical micelle concentrations (CMC) and surface active parameters of surfactant by surface tension method.
4. To determine the transition temperature of Glauber's salt by solubility method
5. To determine the partition coefficient of ammonia between $CHCl_3$ and H_2O

(Physical- II)
Sr. No.

1. Determination of strengths of halides in a mixture potentiometrically
2. To determine the rate constant of the saponification of ethyl acetate at different temperatures
3. To verify the law of refraction for given glycol + water mixture
4. To determine the molecular composition of ferric – salicylate complex by Job'smethod
5. To study the inversion of cane sugar by polarimeter

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, (AnjaliPublication, 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)