GUJARAT UNIVERSITY

M.Sc. Chemistry Semester I and II

Revised Syllabus

Design and Structure of Choice Based Credit System

(Effective from 2020-2021)

SEMESTER I					
Course		No. of hours per week			Total credits
Paper Code	Name	Lectures	Practicals	Total	
CHE 401	Inorganic	4	--	4	4
CHE 402	Organic	4	--	4	4
CHE 403	Physical	4	--	4	4
CHE 404	Analytical	4	--	4	4
CHE 405 PR	Practical (Inorganic + Organic)	--	7	7	4
CHE 406 PR	Practical (Physical + Analytical)	--	7	7	4
	Total	**16**	**14**	**30**	**24**
SEMESTER II					
CHE 407	Inorganic	4	--	4	4
CHE 408	Organic	4	--	4	4
CHE 409	Physical	4	--	4	4
CHE 410	Analytical	4	--	4	4
CHE 411 PR	Practical (Inorganic + Organic)	--	7	7	4
CHE 412 PR	Practical (Physical + Analytical)	--	7	7	4
	Total	**16**	**14**	**30**	**24**

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M.SC. SEMESTER I

CHE 401 INORGANIC CHEMISTRY

Unit 1 *Quantum Mechanics-I*

- Commutation Relations: Angular Momentum Operators and their commutation relations; Ladder Operators and their commutation relations; Eigen Functions of the position Operator and Dirac Delta function; Projection Operators.
- Approximation method: Perturbation theory (First order and non-degenerate), application to hydrogen and helium atoms; Variation method and application to hydrogen atom.
- The Concept of tunnelling, Shape of the Barriers of tunneling.

Unit 2 *Group Theory*

- Matrices, Vectors and Operators: Matrix Algebra, Mathematics of matrices, Vectors, Transformation Operators
- Representation of point groups: Unit vectors as the basis for representation, Rotational vectors as the basis for representation, Position vectors as the basis for representation, Wave functions as the basis for representation
- Reducible and irreducible representations: Generated by bond vectors and by various orbitals
- Great Orthogonality Theorem and Character Table: GOT, General rules derived from GOT, Relation between reducible and irreducible representations of a point group, criteria for irreducibility, Construction of character table and notations followed, direct product representations

Unit 3 *Organometallic Compounds*

- Organometallic compounds of transition elements, stability of metal carbon bond in complexes
- Synthesis, uses and structure of organometallic compounds of π bonding organic ligands, 2-electron ligands, olifinic and acetylinic complexes, compound with 3 electron ligand – allylic complexes, compounds. With 4-electron ligands butadiene complexes, n^4 complexes of cyclopentadiene, compounds with 5 electron ligands–cyclopantadionyl, compounds with 6 electron ligands, n^6 complexes of benzene and its derivatives
- Role of organometallic compounds in catalytic reaction

Unit 4 *Electronic Spectroscopy*

- 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 and f^2 configurations

REFERENCES

1. *Introductory Quantum Chemistry, Fourth Edition, By: A. K. Chandra Tata McGraw-Hill Publishing Company Ltd., New Delhi (1994).*
2. *Molecular Quantum Mechanics, By: P. W. Atkins and R. S. Friedman Oxford University Press (1997).*
3. *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).*
4. *Quantum Chemistry By: N. Levine, Prentice Hall of India (p) Ltd. New Delhi (1994).*
5. *Quantum Chemistry through problem and solutions By: R. K. Prasad New Age International Publishers (1997).*
6. *Introduction to Magnetochemistry, By: Alan Earshaw (1968)*
7. *Elements of Magnetochemistry, By: Dutta and Syamal (1993)*
8. *Modern Aspects of Inorganic Chemistry, By: Emeleus and Sharpe (1996)*
9. *Advanced Inorganic Chemistry, By: Cotton, Wilkinson, Murillo and Bochmann (1999)*
10. *Inorganic Chemistry, By: A.G.Sharpe (1981)*
11. *Inorganic Chemistry, By: James E. Huheey, Eilen A. Keiter, Richard L. Keiter Publication: Harper Collins*
12. *Essentials of Coordination Chemistry: A simplified approach with 3d visuals, Vasishta Bhatt, Academic Press, Elsevier London, 2016.*
13. *Inorganic Chemistry, By: Shriver and Atkins*
14. *Inorganic Chemistry, By: Gary Wulfsberg*
15. *Descriptive Inorganic Chemistry (Fourth Edition) By Geoff Rayner- Canham, Tina Overton Publication: Craig Bleyer*
16. *F. A. Cotton, Chemical Applications of Group theory, Wiley Eastern 3rd edition*
17. *George Davidson, Group Theory for Chemists, Macmillan Physical Science, 1991*
18. *Chemical Applications of Molecular Symmetry and Group Theory, B.S. Garg, Macmillan Publisher India Ltd (2012)*
19. *Organometallic Chemistry a Unified Approach by R.C.Mehrotra and A.Singh,*
20. *Organometallic Chemistry of Transition Metals by Robert H.Crabtree.*
21. *Symmetry and Group Theory in Chemistry by Rameshwar Ameta, 2nd edition, New Age International Publishers*
22. *Molecular Structure and Symmetry by K Veera Reddy, 1st edition, New Age International Publishers*

M.SC. SEMESTER I

CHE 402 ORGANIC CHEMISTRY

Unit 1 *Elimination, Nucleophilic and Electrophilic Substitution Reaction*

- Mechanism, Orientation and stereochemistry of E1, E2 and E1CB reaction.
- Reactivity: effects of substrate structures, attacking base, solvent and leaving group
- Mechanism and orientation in pyrolytic *syn* eliminations- Chugaev, Cope elimination, Burgess Dehydration Reaction, Selenoxide Elimination and Grieco Elimination.
- Nucleophilic substitution at the carbonyl (C=O), alcohol and nitrogen: Baeyer-Villiger oxidation and the benzoin condensation, Alcohols: The Mitsunobu reaction, Nitrogen: The von Richter and Smiles rearrangements respectively.
- Neighbouring group Participation in Nucleophilic substitution: O (COO-, -OH), N (NH_2, NHR, NR_2), S (SH, SR), and halogen as Neighbouring group donor.
- Aromatic electrophilic substitution reactions: The arenium ion mechanism, orientation and reactivity: Vilsmeier-Hack reaction and Gattermann-Koch reaction.

Unit 2 (A) *Aromaticity*

- Introduction
- Huckel's rule and concept of aromaticity
- Types of aromaticity- Aromatic, Anti-aromatic, Non-aromatic
- Frost circle diagram for cyclobutadiene, benzene, etc.
- Aromaticity in benzenoid and non-benzenoid compounds and charged rings, annulenes, fulvenes, azulenes, antiaromaticity and homoaromaticity.

(B) *Computer in Chemistry*

- Introduction,
- Software, uses of microsoft office (Word, PPT, Excel),
- Drawing of structure, calculations of properties,
- Computer tools used in chemistry, search engines, Journals, database, literature review

Unit 3 (A) *Reactive Intermediates and Rearrangements*

Discuss stability, structure, generation and fate for mentioned intermediates

- Carbocations
- Carbanions
- Carbenes
- Free radicals
- Nitrene

(B) *Rearrangements*

General mechanistic considerations, nature of migration, migratory aptitude, and memory effects in respect of following rearrangements:

- Carbon to Carbon migration of R, H and Ar
    a) Favorskii rearrangement
    b) Wagner–Meerwein rearrangement
- Carbon to Nitrogen migrations:
    a) Schmidt rearrangement
    b) Lossen rearrangement
- Migration from Nitrogen to Carbon
    a) Stevens rearrangement
- Migration from Oxygen to Carbon
    a) Wittig rearrangement
    b) Fries rearrangement

Unit 4 *Stereochemistry*

Introductory/Pre-requisite [*Identifying stereochemical terms & relationships (Stereochemistry, Enantiomers, Diastereomers, Conformations, Configurations, Epimers, Anomers, Prochiral, Chiral carbon, Chiral molecules, Meso, Optical activity, Specific rotation, Atrop isomerism), 2-D representations (line drawings, Fischer projections, Haworth projections) and Nomenclature (R/S, E/Z, D/L, d/l, Cis/Trans, Threo/Erythreo*)

- Determination of relative/absolute configuration and resolution by Chiral GC, HPLC
- Physical and chemical properties of stereoisomer
- Prochiral environments (enantiotopic, diastereotopic)
- Stereochemistry in SN2 (inversion),
- Stereochemistry in elimination reaction mechanisms (E2, Hoffmann)
- Stereochemistry in additions to alkenes (syn, anti, Diels-Alder)

- Stereochemistry in additions to carbonyls (Cram's rule)
- Chiral drugs,
- Stereospecific and stereoselective reaction

REFERENCES

1. *Advanced Organic Chemistry, Reactions Mechanisms and Structure , J. March, 6th Edition, John Wiley.*
2. *Carbenes, nitrenes and arynes, T.L. Gilchrist and C.W. Rees.*
3. *Reaction Mechanism in Organic Chemistry by S. M. Mukherji and S. P. Singh*
4. *Advanced Organic Chemistry Part A: Structure and Mechanism and Part B:Reaction and synthesis ,Francis A. Carey, Richard J. Sundberg, 5th Edition, Springer .*
5. *Organic Chemistry, Jonathan Clayden, Nick Geeves, Stuart Warren, 1st Edition, Oxford University Press.*
6. *Reaction mechanism by Jagdamba singh.*
7. *Organic chemistry - Reaction mechanism, by P.S. Kalsi, New age international publishers.*
8. *Reagents in Organic Synthesis- Fieser and Fieser, John Wiley.*
9. *Organic Chemistry, T.W. Graham Solomons and Graig B. Frymes, John Wiley and Sons.*
10. *Organic Chemistry, F. A. Carey, McGraw Hill Edition.*
11. *General Organic Chemistry Sachin Kumar Ghose, New Central book agency.*
12. *Organic Chemistry Vol 1-2 I.L. Finar 6th edition ,ELBS.*
13. *Organic Chemistry (3/e) by J. B. Hendrickson, Donald J. Cram and George S. Rammond*
14. *Stereochemistry of organic chemistry D. Nesh, New age publication.*
15. *Basic stereochemistry of organic molecule by Subrata.*
16. *https://www.capterra.com/chemical-software/*
17. *K.V. Raman, Computers in Chemistry, Tata McGraw-Hill Ltd., New Delhi, 1993.*
18. *Gini Courter and Annette Marquis, Microsoft Office 2000, BPB Publications, New Delhi, 1999.*
19. *Julia Kelly, Using Microsoft Excel 2000, Prentice-Hall of India, New Delhi, 1999.*
20. *Robert de Lavie, A spreadsheet workbook for Quantitative chemical analysis, McGraw-Hill, Inc. New Delhi, 1997.*
21. *R.P. Soni, Harshal A. Arolkar, Sonal Jain, Working with Personal Computer Software, 2nd Edition, Wiley India, August 2010. ISN13: 978-81-265-2727-4.*

M.SC. SEMESTER I

CHE 403 PHYSICAL CHEMISTRY

Unit 1 *Chemical Thermodynamics*

- Nernst heat theorem and its applications to gaseous system,
- Third law of thermodynamics and its applications to evaluate absolute entropies of solids, liquids and gases and for calculations of free energy changes and equilibrium constants of reactions,
- Chemical affinity and its applications, methods for determining the chemical affinity of a reaction-Gibbs Helmholtz equation, E.M.F. Method, Van't Hoff equation, Vapour pressure method,
- Partial molar quantities and their determination by direct method, apparent molar properties, method of intercepts,
- Chemical potential and its physical significance, variation of chemical potential with temperature and pressure, chemical potential of idea gases and solutions.

Unit 2 *Chemical Kinetics*

- Introduction, Theories of reaction rates: The collision theory of reaction rates, The transition state theory of reaction rates and its limitations, activated complex theory in terms of thermodynamic terms, elementary reactions in solutions, influence of solvent properties on rate, different types of molecular interactions in solutions, diffusion and activation controlled reactions, transmission coefficient, reaction coordinates, potential energy surfaces, kinetic isotope effect.

Unit 3 *Surface Chemistry*

- Physical and chemical adsorption, Special features of chemisorption-kinetics of chemisorption and heat of chemisorption, BET theory for multilayer adsorption, Experimental methods of determining gas adsorption-Volumetric and gravimetric method, Determination of surface area of adsorbents by HJ method, Benton and white method and BET Method, Gibbs adsorption isotherm equation, Experimental results of the Gibbs equation, verification of the Gibbs equation- Domain and Barker Method The Microtome method of Mcbain, The tracer method.

Unit 4 *Solid State Chemistry*

- Properties of solids – electrical, magnetic, optical, dielectric properties. Band theory of solidsand energy band theory of conductors, semiconductors and insulators, Defects in crystals, calculation of Schottky and Frenkel defects using statistical method, Non stoichiometry, Solid electrolytes, diffusion in solids, electrical conductivity in solids, Super conductivity, perovskites. Determination of lattice parameters of a unit cell of NaCl crystal, Graphical method of indexing, Determination of particle size of crystallites, single crystal and phase determination method

REFERENCES

1. *Textbook of physical chemistry – W.J.Moore*
2. *Textbook of physical chemistry – Glasstone*
3. *Textbook of physical chemistry – P.Atkins*
4. *Advanced physical chemistry – Gurdeep Raj*
5. *Advanced physical chemistry – J.N.Gurtu, A.Gurtu*
6. *Thermodynamics for chemists –Glasstone*
7. *Physical chemistry – S. Castellian*
8. *Thermodynamics of non equilibrium processes- Karapitianeh*
9. *Chemical Kinetics- Laidler*
10. *Chemical Kinetics – Frost and Pearson*
11. *Solid state chemistry – H.Keer*
12. *Solid state chemistry- Hannay*
13. *Chemistry of solids – Azaroff*
14. *Surface chemistry – Adamson*
15. *Surface chemistry – Osipov*

M.SC. SEMESTER I

CHE 404 ANALYTICAL CHEMISTRY

Unit 1 *Concepts and Tools of Analytical Chemistry*

- Introduction, scope of analytical science and its literature, features and classification of analytical methods, basics of classical and instrumental methods of analysis, significant figures, SI units, chemical concentrations (weight %, volume %, weight-to-volume %, molarity, formality, molality, ppm, normality), unit conversions, reference standard, preparation of standard solution and standardization, dilution, stoichiometry calculations, calibration of glass apparatus
- Non-aqueous titrations: Principles, theory, role of solvents and their classification, properties of solvents, titration of acids-bases, standard titration curves, factors affecting non-aqueous titrations, advantages and limitations.

Unit 2 *Data Handling and Statistical Analysis*

- Measurement of uncertainty, Accuracy and precision, types of errors and their causes; Gaussian distribution, control charts, confidence limit, test of significance, rejection of a result- Q-test and Grubb's test. Finding the best straight line-least square regression, calibration curves, correlation coefficient; standard addition technique and use of internal standards, Analysis of variance, GLP-standard operating procedures, quality assurance and quality control, validation of analytical methods.

Unit 3 *pH metry and Conductometry*

- pH measurement with glass electrode, working of glass electrode, mechanism of pH measurement (boundary potential and diffusion potential), calibration of glass electrode, acid and alkaline errors in pH measurement. Fundamental concepts of conductometry, measurement of conductivity, apparatus, and basis of conductometric titrations-acid-base, precipitation and complex formation. High frequency titrations.

Unit 4 *Potentiometry and Ion-selective Electrodes*

- Electrochemical cell, cell potentials, sign convention for electrode potentials, types of reference and indicator electrodes-metallic indicator and membrane indicator electrodes, Classification of membrane electrodes-ion-selective and molecular-selective electrodes, Principle, properties and design of ion-selective electrodes, Crystalline and non-crystalline membrane electrodes, Gas-sensing probes and enzyme substrate electrodes, Applications of potentiometric titrations

REFERENCES

1. *Introductory 1. "Quantitative Chemical Analysis" by Daniel C. Harris, 7th Edition, W.H. Freeman and Company, New York, 2007.*
2. *"Analytical Chemistry" by Gary D. Christian, Purnendu K. (Sandy) Dasgupta and Kevin A. Schug, 7th Edition, John Wiley and Sons Inc. New Jersey, 2014.*
3. *"Fundamental of Analytical Chemistry" by Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch, 8rd Edition, Thomson, Brookes/Cole, 2004.*
4. *"Modern Analytical Chemistry" by David Harvey, McGraw Hill, New York, 2001.*

M.SC. SEMESTER I PRACTICALS

CHE 405 PR INORGANIC CHEMISTRY

(Minimum 9)

- Semi-micro qualitative analysis of 15 mixtures, each having six radicals plus one less familiar elements and one insoluble compounds.

REFERENCES

1. *Vogel's Qualitative Inorganic Analysis by G. Svehla, 7th Edition, Pearson*
2. *Inorganic Qualitative Analysis in the Laboratory, Clyde Metz, Elsevier, 2012, ISBN : 978032316104*

M.SC. SEMESTER I PRACTICALS

CHE 405 PR ORGANIC CHEMISTRY
(Minimum 9)

- One step preparation of organic compounds and study of principle, general reaction mechanism, mole ratio calculation, purification, M.P/B.P and TLC.
- Distribution of Marks as per University exam: Principle and reaction mechanism (05 marks), Mole ratio and other calculation (05 marks), Crude and Crystal (10 marks), Purification, and M.P/B.P (05 marks), TLC (05 marks) and Viva (05 marks), Total 35 marks
- List of Preparations

1. Nitration
   a) *m*-dinitro benzene from nitro benzene
   b) *p*-Nitro acetanilide from Acetanilide
2. Bromination
   a) *p*-bromo acetanilide
   b) 2,4,6-tribromo aniline
3. Acylation
   a) Acetanilide from aniline
   b) Resacetophenone from resorcinol
4. Reduction
   a) Preparation of *m*-nitro aniline from *m*-dinitro benzene
   b) Preparation of *m*-phenylenediamine from *m*-dinitrobenzene
5. Oxidation
   a) Preparation of benzoic acid from benzaldehyde
   b) Preparation of *p*-nitrobenzoic acid from p-nitro toluene (Continued…….)
6. Condensation reaction
   a) Preparation of dibenzal acetone from benzaldehyde
   b) Preparation of 7-hydroxy 4-methylcoumarin
7. Diazotization reaction
   a) Preparation methyl orange
   b) Preparation of methyl red
8. Friedl-Craft's reaction
   a) 4-methyl benzophenone (Friedal Craft reaction)
   b) Preparation of aspirin

REFERENCES

1. *A text book of practical organic chemistry – A. I. Vogel*
2. *Practical organic Chemistry – Mann and Saunders*

M.SC. SEMESTER I PRACTICALS

CHE 406 PR PHYSICAL CHEMISTRY

(Minimum 9)

- **Conductometry**
  1. To determine the thermodynamic dissociation constant of a weak acid.
  2. Verification of Ostwald's dilution law and determination of the dissociation constant of a weak monobasic acid conductometrically.
  3. To estimate conductometrically the quantities of HCl and NH_4 Cl in a given mixture.
- **Potentiometry**
  1. To determine the standard redox potential and the number of electrons involved in Fe^{+2}/ Fe^{+3} system.
  2. To determine the dissociation constant of a diabasic acids oxalic acid or malonic acid.
  3. To determine the solubility product of sparingly soluble salts e.g. AgCl, AgBr and AgI
- **pH metry**
  1. To determine the dissociation constant of a polybasic acid e.g. phosphoric acid.
  2. To determine the % purity of Na_2CO_3 and $NaHCO_3$ in the given mixture.
- **Chemical Kinetics and Adsorption**
  1. To study the effect of ionic strength of ions on the kinetics of the reaction $S_2O_8^{-2} + 2I^- \_\_\_\_\_ 2SO_4^{-2} + I_2$
  2. To determine the temperature coefficient and energy of activation of reaction between $K_2S_2O_8$ + KI.
  3. To determine the order of reaction between $K_2S_2O_8$ + KI by fractional change method.
  4. To determine the temperature coefficient and energy of activation of hydrolysis of methyl acetate catalyzed by HCl.
  5. To determine the partial molar volume and the excess volume of the binary mixtures of ethanol-water system.

REFERENCES

1. *Practical physical chemistry –J.B.Yadav*
2. *Practicals in physical chemistry – P.S.Sindhu*
3. *Experimental physical chemistry – R.C.Das, B.Behera*
4. *Experiments in physical chemistry- P.H.Parsania, F. Karia*
5. *Experimental physical chemistry – V.D. Athawale, ParulMathur*
6. *Advanced physical chemistry experiments – Gurtu-and Gurtu*

M.SC. SEMESTER I PRACTICALS

CHE 406 PR ANALYTICAL CHEMISTRY
(Minimum 10)

1. Calibration of glass wares, balance, pH meter, conductometer, potentiometer and spectrophotometer.
2. Preparation of stock solutions and their standardization (HCl with NaOH, and NaOH with KHP)
3. Determination of nicotine in tobacco (non-aqueous titration).
4. Determination of available chlorine in bleaching powder.
5. Determination of vitamin C in orange juice/amla.
6. Determination of acetic acid in vinegar.
7. Determination of sodium carbonate and sodium bicarbonate in washing soda.
8. Determination of ascorbic acid in vitamin C tablets.
9. Determination of calcium and magnesium in water sample.
10. Determination of total dissolved solids in water samples.
11. Determination of sulphate in water sample.
12. Determination of chloride in water sample.
13. To determine the % of nitrogen in urea by Kjeldahl's method.
14. To determine % purity of given alcohol sample by iodometric titration.
15. Determination of fat content of milk sample.

REFERENCES

1. *Analytical Chemistry: Practice, Second Edition, John H. Kennedy, Saunders College Publishing.*
2. *Vogel's Textbook of Quantitative Chemical Analysis, Fifth edition, Longman Scientific and Technical and John Wiley & Sons, Inc., New York.*

M.SC. SEMESTER II

CHE 407 INORGANIC CHEMISTRY

Unit 1 *Theories of Bonding*

- VSEPR, Walsh diagram for tri-atomic molecules, Bent rule and energies of hybridization, VSIP.
- Simple Huckel theory of linear conjugated systems, cyclic conjugated systems aromaticity.
- Many electron atoms and angular momenta: The Wave function of many electron systems, application to helium atom, Hartree Self-Consistent field method. Pariser-Parr-Pople appoximation.

Unit 2 *Applications of Symmetry*

- Molecular spectroscopy and Vibrational spectroscopy: Reducible representation using 3N vectors as the basis, symmetry selection rules for IR and Raman spectroscopy,
- Classification of vibrational modes using internal coordinates as the basis and assignment of frequency to fundamentals.
- Molecular symmetry and chemical bonding: hybrid orbitals for σ-bonding and π-bonding in ABn type of molecules.
- Symmetry Adopted Linear Combination of Atomic orbitals: Projection operator for finding SALC, Bond vectors as the basis for formation of SALC, Orbital functions as the basis for obtaining SALC.

Unit 3 *Bioinorganic Chemistry*

- Hemoglobin and Myoglobin; Cytochromes of the electron transport chain, Cytochrome P-450 enzymes, Coenzyme B12, Zinc Enzymes exploiting acid catalysis: Carbonic anhydrase, Carboxy peptidases, Biological Nitrogen Fixation, The elements of living system: The biological roles of metal ions
- **Metals in medicine:** Chelation Therapy, gold in Rheumatoid antiarthritis drugs, Metallocenes, Anticancer agents- Platinum complexes , mechanism of action, aspects of Pt binding to DNA, Metal complexes as radiodiagnostic agents, Magnetic resonance imaging
- **Metal-nucleic acid interactions:** Coordination, Non-covalent interactions - intercalation and hydrogen bonding, hydrophobic interactions, DNA strand cleavage, Biological fluorophores, Application of fluorescence quenching in drug-DNA binding studies. DNA binding and mechanistic possibility

Unit 4 *Metal-Ligand Equilibria*

- Types of Complex Equilibria in Solution and Equilibrium Constants: Basic principles, Mathematical functions and their interrelationship. Statistical considerations. Factors affecting the stability constants of Metal complexes. Mixed-ligand complexes.
- **Experimental Methods for the Determination of Stability Constants:** Ion exchange methods, Polarographic methods. Solubility methods and Least square method for computing stability constant.

REFERENCES

1. *Introductory Quantum Chemistry, Fourth Edition, By: A. K. Chandra Tata McGraw-Hill Publishing Company Ltd., New Delhi (1994).*
2. *Molecular Quantum Mechanics, By: P. W. Atkins and R. S. Friedman Oxford University Press (1997).*
3. *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).*
4. *Quantum Chemistry By: N. Levine, Prentice Hall of India (p) Ltd. New Delhi (1994).*
5. *Quantum Chemistry through problem and solutions By: R. K. Prasad New Age International Publishers (1997).*
6. *Introduction to Magnetochemistry, By: Alan Earshaw (1968)*
7. *Elements of Magnetochemistry, By: Dutta and Syamal (1993)*
8. *Modern Aspects of Inorganic Chemistry, By: Emeleus and Sharpe (1996)*
9. *Advanced Inorganic Chemistry, By: Cotton, Wilkinson, Murillo and Bochmann (1999)*
10. *Inorganic Chemistry, By: A.G.Sharpe (1981)*
11. *Inorganic Chemistry, By: James E. Huheey, Eilen A. Keiter, Richard L. Keiter Publication: Harper Collins*
12. *Essentials of Coordination Chemistry: A simplified approach with 3d visuals, Vasishta Bhatt, Academic Press, Elsevier London, 2016.*
13. *Inorganic Chemistry, By: Shriver and Atkins*
14. *Inorganic Chemistry, By: Gary Wulfsberg*
15. *Descriptive Inorganic Chemistry (Fourth Edition) By Geoff Rayner- Canham, Tina Overton Publication: Craig Bleyer*
16. *F. A. Cotton, Chemical Applications of Group theory, Wiley Eastern 2nd Edn.1992*
17. *George Davidson, Group Theory for Chemists, Macmillan Physical Science, 1991*
18. *Chemical Applications of Molecular Symmetry and Group Theory, B.S. Garg,Macmillan Publisher India Ltd (2012)*
19. *Symmetry and Group Theory in Chemistry by Rameshwar Ameta, 2nd edition, New Age International Publishers*
20. *Molecular Structure and Symmetry by K Veera Reddy, 1st edition, New Age International Publishers*

M.SC. SEMESTER II

CHE 408 ORGANIC CHEMISTRY

Unit 1 *Photochemistry*

1. Mechanism, Photochemical reactions: Principles of energy transfer, electronic excitation
2. Characteristics of photochemical reactions
3. Jablonski diagram
4. Chemiluminescence, Bioluminescence
5. Photosensitization
6. Photochemistry of carbonyl compounds: Representation of excited states of ketones
7. Photoreduction
8. Norrish type I & II reactions, Reactions of cyclic Ketone and acylic Ketone
9. Oxetane formation (Paterno-Buchi reaction)
10. Di-π methane rearrangement
11. cis-trans isomerisation
12. Photo-Fries rearrangement
13. Applications of photochemistry

Unit 2 *Heterocyclic Compounds*

1. Introduction
2. Nomenclature of Heterocyclic compounds
3. Pyridine conceptually derived from Benzene, replacing CH with N
4. Pyrrole derived from benzene, replacing CH=CH with N
5. Reactions of Pyridine and its derivatives
6. Reactions of Pyrrole and its derivatives
7. Comparison of Pyrrole with furan and thiophene
8. Chemistry of Imidazole, Triazoles, Tettrazole
9. Fused rings: indole, quinoline, isoquinoline, and indolizine
10. Chemistry of Oxazole, Thiazole, Isoxazole, Isothiazole
11. Importance of heterocyclic compounds in medicinal chemistry

Unit 3 *Name Reactions*

- Total 10 name reactions and their principle, general reaction, mechanism, synthetic application, advantages, disadvantages and modification-scope of reaction,

1. Suzuki reaction
2. Sonogarshira coupling
3. Bhuchwald -Hartwig reaction
4. Knoevanagel reaction
5. Shapiro reaction
6. Ugi reaction
7. Biginelli reaction
8. Nazerov cyclization
9. Ullmann reaction.
10. Baylis Hilman

Unit 4 *Reagents in organic synthesis*

- Total 10 reagents, mechanism, selectivity and utility of following reagents:

1. HATU
2. Lithium diisopropylamide (LDA)
3. Dicyclohexyl carbodiimide (DCC)
4. 1,3 – Dithiane (Umpolung reagent)
5. Dess- Martin periodinane
6. Diisobutylauminium hydride(DIBAL –H)
7. Sodium cyanoborohydride (NaBH3(CN))
8. DDQ
9. n-Butyl lithium
10. Phase transfer catalysis : Quaternary ammonium and phosphonium salts, crown ethers.

REFERENCES

1. *Advanced Spectrometric Identification of Organic Compounds by Robert M. Silverstein, 7th Edition*
2. *Introductory Photochemistry, A.Cox and T.Camp, McGraw Hill.*
3. *Photochemistry, R.P. Kundall and A. Gilbert, Thomson Nelson.*
4. *Organic Photochemistry, J. Coxon and B. Halton, 2nd Edition , Cambridge University Press.*
5. *Stategic Applications of Named Reactions in Organic Synthesis, Laszlo Kurti and Barbara Czak, 1st Edition ,Acedemic Press.*
6. *Name Reactions and Reagents in Organic Synthesis, Bradford P. Mundy, Michael G. Ellerd , Frank G. Favaloro, 2nd Edition, Wiley – Interscience.*
7. *Name Reactions. A Collection of Detailed Reaction Mechanisms., Jie Jack Li, 3rd Edition , Springer.*
8. *Heterocyclic Chemistry, volume 1-3, R.R. Gupta, M. Kumar and V. Gupta, Springer-Verlag.*
9. *Heterocyclic Chemistry, J.A. Joule, K.Mills, and G.F. Smith, 3rd Edition, Chapman and Hall.*

10. *Heterocyclic Chemistry, T.L. Gilchrist, Longman Scientific Technical.*
11. *Contemporary Heterocyclic Chemistry, G.R. Nikome and W.W. Poudler, Wiley.*
12. *Comprehensive Heterocyclic Chemistry, A.R. Kartizky, and C.W. Rees.*
13. *Encyclopedia of Reagents for Organic Synthesis, Leo A. Paquette, David Crich and Phillip L. Fuchs, John Wiley and Sons Inc.*
14. *Organic Chemistry, T.W. Graham Solomons and Graig B. Frymes, John Wiley and Sons.*
15. *Organic Chemistry, F. A. Carey, McGraw Hill Edition.*
16. *General Organic Chemistry Sachin Kumar Ghose, New Central book agency.*
17. *Guidebook to Mechanism in Organic Chemistry by Peter Sykes, 6th Edition, Prentice Hall.*
18. *Advanced Organic Chemistry Part A: Structure and Mechanism and Part B:Reaction and synthesis , Francis A. Carey, Richard J. Sundberg, 5th Edition, Springer .*
19. *Organic Chemistry Vol 1-2 I.L.Finar 6th edition,ELBS.*
20. *Name Reactions and Reagents in Organic Synthesis By Bradford P. Mundy, Michael G. Ellerd, Frank G. Favaloro.*
21. *Organic Syntheses Based on Name Reactions: By Alfred Hassner, Irishi Namboothiri.*

M.SC. SEMESTER II

CHE 409 PHYSICAL CHEMISTRY

Unit 1 *Statistical Thermodynamics*

- Concepts of distribution of molecules, thermodynamic probability, permutations and combinations, The Boltzmann distribution law, relationship between molecular partition function and thermodynamic function thermodynamic properties in terms of molar partition function Partition function - translational, vibrational, rotational, electronic nuclear partition functions separation of partition function of polyatomic molecules. Bose-Einstein statistics, Fermi-Dirac statistics.

Unit 2 *Polymer Chemistry*

- Introduction, mechanism and kinetics of polymer processes, criteria of polymer solubility, thermodynamic of polymer solution, F-H theory, polymer analysis and characterization- identification, physical testing method – thermal and chemical , characterization-molecular weight distribution, determination of molecular weight of polymers, glass transition temperature, factors affecting glass transition temperature, glass transition temperature and molecular weight, Importance of glass transition temperature.

Unit 3 *Nuclear and Radio Chemistry*

- Nuclear properties-nuclear radius, coulombic and nuclear potential radius, nuclear binding energy, nuclear models-shell model, liquid drop model, radioactive decay nuclear reactions, evaporation, spallation, fragmentation, fission and fusion reactions, Reaction cross section, Use of radioisotopes as tracers: Reaction mechanism, Structure determination, Isotope dilution analysis: (i) Direct Isotope dilution analysis (DIDA), (ii) Inverse Isotope Dilution Analysis (IIDA), and (iii) Sub stoichiometric isotope dilution analysis, Dating 14C, Medical applications.

Unit 4 *Electrochemistry*

- Basic concepts: Determination of dissociation constant of monobasic acids by conductometry, Determination of dissociation constants of monobasic and polybasic acids by potentiometry, The electrical double layer, the rate of charge transfer, Determination of activities of solutes from activities of solvent, Dependence of electrolyte activity on hydration number, Bjerrum's theory of ion association in electrolyte solutions, Determination of interfacial tension of mercury as a function of potential across the interface.

REFERENCES

1. *Textbook of physical chemistry – W.J.Moore*
2. *Textbook of physical chemistry – Glasstone*
3. *Textbook of physical chemistry – P.Atkins*
4. *Advanced physical chemistry – Surdeep Raj*
5. *Advanced physical chemistry – J.N.Gurtu, A.Gurtu*
6. *Statistical thermodynamics – M.C.Gupta*
7. *Polymer chemistry – Gowariker*
8. *Polymer chemistry – Billmayer*
9. *Principles of polymer science – Bahadur & Sastry*
10. *Polymer science & technology – Fried*
11. *Polymer chemistry- Malcolm P. Stevens*
12. *Nuclear chemistry – Arniker*
13. *Nuclear and radio chemistry – J.W. Kannedy, G.Friedlander*
14. *Electrochemistry – Bockris and Reddy*

M.SC. SEMESTER II

CHE 410 ANALYTICAL CHEMISTRY

Unit 1 *Sampling and Sample Preparation Techniques*

- Sampling and sample preparation, general steps in chemical analysis, Liquid-liquid extraction/solvent extraction-partition coefficient, distribution ratio and percent extraction. Solvent extraction of metal ions-ion association complexes and metal chelates, multiple batch extraction, Craig's counter-current distribution, Cloud point extraction, Accelerated and Microwave assisted extraction, protein precipitation and solid phase extraction (SPE), Hybrid SPE and solid phase micro extraction (SPME).

Unit 2 *Chromatographic Methods*

- Principles of chromatography, classification of chromatographic techniques based on mechanism of retention, configuration, mobile and stationary phase, Efficiency of separation- plate theory (theoretical plate concept) and rate theory (Van Deemter equation), Principles and applications of thin layer chromatography (TLC), high performance thin layer chromatography (HPTLC), ion exchange chromatography, and ion-chromatography and high performance liquid chromatography (HPLC).

Unit 3 *Spectrophotometry*

- Properties of light, absorption of light, interaction of light with matter and origin of spectra, The spectrophotometer- calibration, sources of light, monochromators and detectors, Beer's law in chemical analysis, photometric accuracy- Ringbom Plot, derivative spectrophotometry (first and second order), optical rotatory dispersion and circular dichroism. Analysis of mixture-resolved and unresolved spectra, measurement of equilibrium constant: Scatchard Plot; Stoichiometry-method of continuous variation- the Jobs plot, Photometric titrations.

Unit 4 *Fluorescence and Phosphorescence Spectrometry*

- Introduction, physical and chemical principles, relaxation processes, Jalonski diagram, fluorescence, phosphorescence and structure, quantum yield, effect of structural rigidity, temperature, concentration and solvents, instrumentation, interferences (additive and multiplicative) and application for quantitative measurements.

REFERENCES

1. *"Quantitative Chemical Analysis" by Daniel C. Harris, 7th Edition, W.H. Freeman and Company, New York, 2007.*
2. *"Analytical Chemistry" by Gary D. Christian, Purnendu K. (Sandy) Dasgupta and Kevin A. Schug, 7th Edition, John Wiley and Sons Inc. New Jersey, 2014.*
3. *"Fundamental of Analytical Chemistry" by Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch, 8rd Edition, Thomson, Brookes/Cole, 2004.*
4. *"Modern Analytical Chemistry" by David Harvey, McGraw Hill, New York, 2001.*

M.SC. SEMESTER II PRACTICALS

CHE 411 PR INORGANIC CHEMISTRY

(Minimum 9)

- Synthesis of metal complexes and salts;
  1. Ferrous ammonium sulphate.
  2. Tris-acetylacetonato Manganese(III) chloride.
  3. Potassium trioxalato ferrate
  4. Potassium trioxalato Chromate
  5. Prussian blue
  6. Cis – trans- bis oxalate, diaquo chromate(III)
  7. Synthesis of penta amminechlorocobalt (III) chloride
  8. Preparation of tris -acetylacetonato iron(III)
  9. Preparation of manganese dioxide nano-particles
  10. Preparation of bis-chloro bis-triphenyl phosphine nickel (II)
  11. Synthesis of hexaammine cobalt(III) chloride
  12. Preparation of tetra-butylammoniumhexa molybdate (VI)

REFERENCES

1. *Practical Inorganic Chemistry: Preparations, reactions and instrumental methods, G.Pass, ISBN: 978-94-017-2744-0, Springer.*
2. *Experimental Inorganic/Physical chemistry, M.A. Malati, 978-1-898563-47-1 Woodhead Publishing Ltd., Cambridge, UK.*
3. *Some Experiments for M. Sc in Inorganic Chemistry, Prof. J B Baruah, IIT, Gauahati.*

M.SC. SEMESTER II PRACTICALS

CHE 411 PR ORGANIC CHEMISTRY
(Minimum 9)

- One step preparation of organic compounds and study of general reaction, mechanism, mole ratio calculation, TLC, purification, IR and ^{1}HNMR (Theoretical)
- Distribution of Marks as per University exam: Principle and reaction mechanism (05 marks), Mole ratio and other calculation (05 marks), Crude and Crystal (10 marks), Purification, spectral data and M.P/B.P (05 marks), TLC (05 marks) and Viva (05 marks), Total 35 marks
- List of Preparations

1. Sandmeyer reaction:
   a. Preparation of *p*-chlorotoluene
   b. Preparation of Iodo nitro benzene
2. Beckmann rearrangement: Preparation benzanilide
3. Cannizzaro reaction
   a. Preparation of Benzoic acid
   b. Preparation of Benzyl alchohol
4. Coupling reaction: Preparation of benzapinacol
5. Dyes
   a. Preparation of Florescence
   b. Preparation of Eosin
6. Fischer Indole synthesis: 2-phenyl indole
7. Polymerization: Preaparatoin of bakelite
8. Reimer-Tiemann reaction: Preparation of β-hydroxynapthaldehyde
9. Skraup synthesis: Preparation of quinoline
10. Preparation of paracetamol
11. Green reactions: Preparation of *p*-Bromo acetanilide from acetanilide

REFERENCES

1. *A text book of practical organic chemistry – A. I. Vogel*
2. *Practical organic Chemistry – Mann and Saunders*

M.SC. SEMESTER II PRACTICALS

CHE 412 PR PHYSICAL CHEMISTRY
(Minimum 9)

- **Conductometry**
  1. To examine the validity of the Debye-Huckel-Onsagar (D.H.O) equation for strong electrolytes
  2. To determine the hydrolysis constant of a salt of strong acid and weak base e.g. aniline hydrochloride.
  3. To determine ion association constants (ion pair formation) of KCl in dioxane-water mixture.
- **Potentiometry**
  1. To find the stability constant of Ag-NH_3 complex.
  2. To determine the heat of reaction, entropy change and equilibrium constant for the reaction between metallic Zinc and copper ions.
- **pH metry**
  1. To determine the solubility and dissociation constant of salicylic acid in ethanol-water mixture.
  2. To determine the dissociation constant of a monobasic acid $ClCH_2COOH$ and benzoic acid.
- **Chemical Kinetics and Adsorption**
  1. To study the reaction between acetone and iodine in presence of acids.
  2. To study the autocatalytic reaction between $KMnO_4$ and $H_2C_2O_4$.
  3. To determine the surface area of the given powdered catalyst sample by means of B.E.T. adsorption isotherm.
  4. To study the adsorption of aqueous oxalic acid solution by activated charcoal and examine the validity of Freundlich and Langmuir's adsorption isotherms.

REFERENCES

1. *Practical physical chemistry –J.B.Yadav*
2. *Practicals in physical chemistry – P.S.Sindhu*
3. *Experimental physical chemistry – R.C.Das, B.Behera*
4. *Experiments in physical chemistry- P.H.Parsania, F. Karia*
5. *Experimental physical chemistry – V.D. Athawale, ParulMathur*
6. *Advanced physical chemistry experiments – Gurtu-and Gurtu*

M.SC. SEMESTER II PRACTICALS

CHE 412 PR ANALYTICAL CHEMISTRY

(Minimum 10)

1. Determination of saponification value of oil.
2. Determination of iodine value of oil.
3. Determination of acid value of oil.
4. Determination of dissolved oxygen.
5. Determination of chemical oxygen demand.
6. Determination of iron in iron tablets.
7. Simultaneous estimation of chromium (III) and iron (III) by EDTA titration.
8. Simultaneous estimation of calcium (II) and zinc (II) by EDTA titration.
9. Simultaneous estimation of lead (II) and magnesium (II) by EDTA titration.
10. Separation of amino acids by TLC.
11. Separation of drugs by TLC.
12. Separation of dyes by TLC.
13. To determine Ca in Ginger sample.
14. Extraction of caffeine from dry tea leaves and its quantitative determination.

REFERENCES

1. *Analytical Chemistry: Practice, Second Edition, John H. Kennedy, Saunders College Publishing.*
2. *Vogel's Textbook of Quantitative Chemical Analysis, Fifth edition, Longman Scientific and Technical and John Wiley & Sons, Inc., New York.*

GUJARAT UNIVERSITY
MSc Semester I and II Organic Chemistry Practicals
Revised Syllabus
Design and Structure of Choice Based Credit System
(Effective from June 2023)

CHE 405 PR ORGANIC CHEMISTRY

(Minimum 8)

 One step preparation of organic compounds and study of principle, general reaction mechanism, mole ratio calculation, purification, M.P/B.P

 Distribution of Marks as per university exam:

Principle and reaction mechanism (05 marks), Mole ratio and other calculation (05 marks), Crude and Crystal (10 marks), Purification & M.P/B.P (05 marks), Journal (05 Marks), and Viva (05 marks): Total 35 marks.

List of preparation

- **Nitration**
  1. *m*-dinitro benzene from nitro benzene
  2. *p*-Nitro acetanilide from Acetanilide
- **Hydrolysis**
  3. P-nitroaniline from p-nitro acetanilide.
- **Reduction**
  4. Preparation of *m*-nitro aniline from *m*-dinitro benzene.
- **Acylation**
  5. Acetanilide from aniline.
- **Bromination**
  6. 2,4,6-tribromo aniline from aniline.
- **Oxidation**
  7. Preparation of Anthraquinone
- **Condensation reaction.**
  8. Preparation of 7-hydroxy 4-methylcoumarin.
- **Diazotization reaction**
  9. Preparation methyl orange.
- **Polymerization**
  10. Preparation of Bakelite from Phenol.

References Books.

1. *A text book of practical organic chemistry – A. I. Vogel*
2. *Practical organic Chemistry – Mann and Saunders*

M.Sc.-II CHE 411 PR ORGANIC CHEMISTRY

(Minimum 9)

- One step preparation of organic compounds and study of general reaction, mechanism, mole ratio calculation, purification, IR and ^{1}HNMR (Theoretical).
- Distribution of Marks as per university exam:
  Principle and reaction mechanism (05 marks), Mole ratio and other calculation (05 marks), Crude and Crystal (10 marks), Spectral data (IR & 1H NMR) (5 marks), Journal (05 marks) and Viva (05 marks), Total 35 marks.

List of Preparations

- **Sandmeyer reaction:**
  1. Preparation of p-iodo nitro benzene.
  2. Preparation of phenylazo-2-naphthol from aniline & 2-Naphthol
- **Hoffman-Bromide reaction**
  3. Preparation of Anthranilic acid
- **Cannizzaro reaction**
  4. Preparation of Benzoic acid.
- **Condensation reaction:**
  5. Preparation of Dibenzalacetone.
- **Dyes**
  6. Preparation of Methyl red.
- **Fischer Indole synthesis**
  7. 2-phenyl indole.
- **Reimer-Tiemann reaction:**
  8. Preparation of 2-hydroxy naphthaldehyde.
- **Skraup synthesis:**
  9. Preparation of quinoline.
- **Green reaction:**
  10 . Preparation of *p*-bromo acetanilide from acetanilide.

References Books.

1. *A textbook of practical organic chemistry – A. I. Vogel*
2. *Practical organic Chemistry – Mann and Saunders*

GUJARAT UNIVERSITY
MSc Organic Chemistry Semester III and IV
Revised Syllabus
Design and Structure of Choice Based Credit System

(Effective from June 2023)

MSc Semester III						
Course		No. of hours per week (12 h for each unit and 48 h for each paper/course)			Total credits	Marks
Paper Code	Type	Lectures	Labs	Total		
CHE (O) 501	Core Paper	4	--	4	4	100
CHE (O) 502	Core Paper	4	--	4	4	100
CHE (O) 503	Core Paper	4	--	4	4	100
CHE (EO) 504	Elective Paper	4	--	4	4	100
CHE (O) 505 PR	Lab Course 1	--	6	6	4	100
CHE (O) 506 PR	Lab Course 2	--	6	6	4	100
	Total	16	12	28	24	600
MSc Semester IV						
Course		No. of hours per week (12 h for each unit and 48 h for each paper/course)			Total credits	Marks
Paper Code	Type	Lectures/ Discussion	DISS/PW/ IT/Lab course	Total		
CHE (O) 507	Core Paper (Scientific Writing)	4	--	4	4	100
CHE (O) 508	Core Paper (Report Writing)	4	--	4	4	100
CHE (O) 509	Core paper (Industrial Training and Industrial Visit)	--	4	4	4	100
CHE (O) 510	Core Paper [Professional Chemistry Test (Last 5 Years NET questions)]	4	--	4	4	100
CHE (O) 511	Dissertation (DISS)/Project Work (PW) OR Lab Course	--	12	12	08	200
		12	16	28	24	600

For each paper 30 % weightage is given to internal assessment and 70 % for external assessment.

CHE(O) 501 Natural Products and Bio molecules

Learning objective:

1. To understand the concept of biomolecules and natural product.
2. To understand the natural and synthetic pathways of the biomolecules and natural product.

Learning Outcomes

1. Learner can understand different types of steroids and hormones.
2. From Protein and peptides students will learn the topic and understand the importance of the same.
3. Study of different types of carbohydrates and their structures.
4. Students will learn the importance of nucleic acid in the DNA, RNA and proteins.

Unit I: Steroids and hormones

Introduction, Biogenesis of Steroids, Chemistry of cholesterol and ergosterol (no synthesis), Chemistry and synthesis of sex hormones (Testosterone, Oestrone, Progesterone) from cholesterol, Partial synthesis of Cortisone, Chemistry of bile acids, Plant hormones (auxins, heteroauxins, gibberellins)

Unit – II -Protein and peptides

Introduction of protein, Stereoisomerism in α-amino acid, Acid-base properties of amino acid, Isoelectric Points and Electrophoresis, Reductive Amination, Structure and nomenclature of peptides, Classification of amino acids, Disulfide linkages in peptides, Amino acids sequence determination in polypeptide, Modern synthetic approach for end group analysis, Solution-phase peptide synthesis, Solid-phase peptide synthesis

Unit – III-Carbohydrates

Introduction & definition, Classification, Types of glycosidic linkage, Chemistry of cellulose, Chemistry of starch, Chemistry of glycogen, Configuration of monosaccharides, Ring structure of monosaccharides, Disaccharides, Derivatives of polysaccharides

Unit – IV -Nucleic acid and Fatty acid

Compounds of nucleic acids, nomenclature of nucleotides, nucleosides, structure of DNA, proteins, structure of RNA, Chemistry of

polymerase chain reaction, DNA sequencing: Sanger's di-deoxy method, Fatty acids, saturated fatty acids, unsaturated fatty acids, essentials fatty acids

Reference books:

1. Organic chemistry vol. I & II (sixth edition) I. L. Finar
2. Organic chemistry of natural products (Volume-1), Gurdeep R. Chatwal, Himalaya Publishing House
3. Chemistry of Natural products vol I & II by O.P.Agrawal
4. Chemistry of vitamins-S. F. Dyke
5. Chemistry of natural products by Bantely, Vol 1-10
6. Organic chemistry, L. J. Wade Jr., Prentice nall, England cliffs, 1987

CHE(O) 502 Advanced organic synthesis

Learning objective:

3. To understand the reaction mechanism of a chemical reaction, the path and the feasibility of a reaction.
4. To suggest synthetic route for complex organic compounds with stereochemistry.
5. To understand the techniques involved in the determination of mechanism of reacted ions and to propose methods to determine the mechanism of reaction.
6. To make the students understand and appreciate the concept of Stereochemistry and reaction mechanism.

Learning Outcomes

5. Learner can understand deep aspects of retrosynthesis and oxidation-reduction reaction.
6. Learner can understand synthesis of the important organic molecule.
7. Learner can be able to design new molecules of interest.
8. PCR and Conformational analysis can give understanding of how the reactions take place by bond shifting and geometry.
9. Protection groups concept is important to synthesized desired compounds to avoid side reaction/products during organic synthesis.

Unit-I- **PCR and Conformational analysis**

Introduction & classification, Electrocyclic reactions - introduction, definition and classification, Woodward-Hoffmann rules for electrocyclic reactions, Cycloaddition reactions, Woodward- Hoffmann rules for cycloaddition reactions, Sigmatropic rearrangements - examples, Conformation and Configuration, Barriers to rotation, Conformation of ethane, propane, butane, Ring strain, Ring inversion of cyclohexane, Substituted cyclohexane, Decalins

Unit-II- Protecting groups

Role of protecting group in organic synthesis, principle of protection of hydroxyl (alcohol and phenol), amino [amine – (primary, secondary) and amide], carbonyl (ketone and aldehyde), carboxylic acid with different (minimum 5) reagents and their deprotection, synthetic equivalent groups (application of protection & deprotection approach with proper organic reaction).

Unit-III Retrosynthesis

Introduction and terminology, guidelines for disconnections, functional group inter- conversions, Amine synthesis, the importance of the order of events in organic synthesis, chemo selectivity, one group C-X and two group C-X (1,1 & 1,2 and 1,3) disconnections, umpolung (epoxide, Haloketones and esters, 1,3 dithiane, cyanide, Nitro, alkynes)

C-C disconnection: one group C-C disconnections (1,1 & 1,2 and 1,3) in Alcohols, and carbonyl compounds, regioselectivity, alkene and Diene synthesis, use of aliphatic nitro compounds in organic synthesis, two group C-C disconnections-1,3-Difunctionalized compounds.

Unit IV: Oxidation-Reduction

Oxidation: Oxidation of aldehydes and ketones: with H_2O_2 (Dakin reaction), with peracid (Baeyer-Villiger oxidation). Dehydrogenation/ oxidation of alcohols to aldehydes and ketones: chromium reagents such as $K_2Cr_2O_7/H_2SO_4$ (Jones reagent), CrO_3-pyridine (Collin's reagent), PCC (Corey's reagent), MnO_2 and PDC, hypervalent iodine reagents (IBX,

Dess-Martin periodinane). DMSO based reagents (Swern oxidation) and Oppenauer oxidation. Oxidation involving C-C bonds cleavage: Glycols using HIO_4; cycloalkanones using CrO_3; carbon-carbon double bond (aliphatic & aromatic) using ozone, $KMnO_4$, CrO_3, $NaIO_4$ and OsO_4; aromatic rings using RuO_4 and $NaIO_4$. Oxidation involving replacement of hydrogen by oxygen: oxidation of CH_2 to CO by SeO_2, Oxidation of aryl methanes by CrO_2Cl_2 (Etard oxidation).

Reduction: Reduction of CO to CH_2 in aldehydes and ketones - Clemmensen reduction, Wolff-Kishner reduction and Huang-Minlon modification. Ra-Ni desulfurization of thioketal. Metal hydride reduction: Boron reagents ($NaBH_4$, $NaCNBH_3$, $NaBH(OAc)_3$), aluminium reagents ($LiAlH_4$, DIBALH, Red Al,), NH_2NH_2 (diimide reduction). Dissolving metal reductions: using Zn, Li, Na, and Mg under neutral and acidic conditions, Li/Na-liquid NH_3 mediated reduction (Birch reduction) of aromatic compounds and acetylenes. Reduction of amides, nitriles, epoxide, aromatic nitro, nitroso, azo and oximes compound.

Reference:

1. T. W. Greens, P. G. M. Wuts. Protective groups in Organic synthesis, 3rd / 4th Ed. John Wiley & Sons, INC
2. Organic chemistry- Clayden, Greeves, Warren and Wothers
3. Advance organic chemistry by Jerry March
4. Advance organic chemistry by Carey and Sundberg,
5. Advance organic chemistry by Francis A. carey
6. Designing Organic Synthesis, S. Warren, Wiley.
7. Organic Synthesis- Concept, Methods and Starting Materials, J. Fuhrhop and G. Penzillin, Verlage VCH.
8. Some Modern Methods of Organic Synthesis, W. Carruthers, Cambridge Univ. Press.
9. Handbook of Reagents for Organic Synthesis - Oxidizing and Reducing Agents Burke, Steven D., Danheiser, Rick L. (Eds.)

CHE(O) 503 Organic spectroscopy

Course Objectives:

1. To familiarize students with the most used spectroscopic techniques.
2. Introduce basic and essential requirements to solve or understand the spectral problem.
3. Develop basic skills to interpret spectra using spectroscopic data.
4. To understand the basic spectroscopy of organic chemistry.
5. To understand the process and techniques of spectroscopy.
6. To learn the advancement of spectroscopy.
7. To understand the various techniques with advantages, disadvantages/limitations, and application of spectroscopy in industrial aspects.

Learning Outcome:

1. The students will understand the concept, importance and scope of UV-Visible spectroscopy.
2. Evaluate the utility of UV/Vis spectroscopy as a qualitative and quantitative method.
3. The students will understand the concept and importance of IR spectroscopy.
4. The students will understand the role of infrared spectroscopy in the study of structure of organic compounds.
5. The student will understand the concept and application of NMR (^{1}HNMR and ^{13}CNMR) in organic synthesis as well as medicinal chemistry.
6. Students will learn fragmentation patterns by Mass spectroscopy.
7. To be able to analyze and interpret the spectral data collected from different spectroscopic techniques.
8. To be able to solve problems related to the structure, purity, and concentration of chemicals.
9. To gain valuable insight into the types of molecular interactions by choosing suitable spectroscopic methods and interpreting the obtained data.

Unit – I UV-Visible & IR Spectroscopy

UV-Visible Spectroscopy

Introduction, Principle, Selection rules for electronic transition, Electronic transitions, Solvent effects, Chromophore and auxochrome, Different

shifts, Instrumentation, Applications, Problems based on dienes, enones, benzoyl derivatives

IR Spectroscopy

Introduction, Principle, Selection rule, Important group frequencies, Modes of vibration, Degree of freedom, Different peaks, Preparation method for samples, Instrumentation

Unit-II 1H NMR and 13C NMR

1H NMR: Introduction, chemical shift, magnetic equivalence, factors affecting chemical shift, Spin-spin splitting: coupling constants (J), geminal, vicinal, long- range coupling, simplification of the complex spectra (1) Use of shift reagents, (2) Spin-spin decoupling (Double resonance), (3) Nuclear Over Hauser Effect (NOE), Spectra analysis of types of functional group and compounds. 2D NMR Spectroscopy (COSY & NOESY), Applications of NMR.

13 CNMR: Introduction, Chemical shifts and shift calculation, Chemical classes and chemical shifts (Hydrocarbons, aromatic & heteroaromatic compounds, different functional groups), Common methods of recording 13C Spectra, Advance 13C NMR techniques: 13C DEPT & 2D NMR spectroscopy (HETCOR)

Unit-III Mass spectrometry

Introduction, Determination of molecular weight and formulae, Parent peak, Base peak, Molecular ion peak, metastable peak, Ionization techniques (CI, FD, FAB, ESI, MALDI), Fundamental fragmentation process, Fragmentation patterns of organic functional groups, Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.

Unit-IV Problems/interpretation structure/structure determination based on UV, IR, 1H NMR, 13C NMR, Mass spectrometry.

Spectral Problems Based on Combined Spectroscopy - DBE rules, Problems based on UV-Visible spectroscopy, Problems based on IR spectroscopy, Problems based on Mass spectrometry, Problems based on 1H NMR and 13C NMR spectroscopy.

Reference:

1. Spectrometric identification of organic compounds, T. C. Morril, R. M. Silverstein and G. Bassler, 6th edition, John Wiley and sons.
2. Introduction to spectroscopy, D. L. Pavia, G. M. Lampman and G. S. Kriz, 3rd Ed., Harcourt college publishers.
3. Organic spectroscopy by W.Kemp.
4. Spectroscopic methods in organic chemistry, D. H. Williams and Ian Fleming
5. Organic spectroscopy by P.S. Kalsi

CHE(EO) 504 ELECTIVE-1

Medicinal & Industrial Chemistry

Learning objectives:

1. Students will about the medicinal and industrial chemistry.
2. Learns will get knowledge of Drug design.
3. Learns can understand how to synthesis various drugs.
4. Learns can understand how to purify various products at Research (R & D) labs and industrial scale.

Learning outcomes:

1. Drug design is the important task since the discovery of drug and in future drugs are the need of the society. Learns will understand the concepts of how to develop drug.
2. Learners will understand what antibiotics are and where/when to use them.
3. The chemist (learns) should know how to synthesis the drugs by best route of synthesis.
4. For any chemical products the raw materials are required. The learns will learn how to synthesize the raw materials by green chemistry aspects.
5. Learns will learn that how to isolate and purify the products at chemical industries.

Unit – I -Drug Design, Antibiotics and antimalarial (with SAR, MOA)

Drug Design

Introduction, naming of organic medicinal compounds, development of new drugs, procedure (conventional and recent/modern) followed in drug design, concept of lead compound and lead modification, pro drugs, soft drugs and hard drugs, phase I, II and III clinical trials, structure activity relationship, theories of drug activity: occupational theory, rate theory, induced fit theory, quantitative structure activity relationship. Concept of drug receptors, elementary treatment of drug receptor interactions, physio chemical parameters lipophilicity, partition coefficient, electronic ionization constant. Introduction to drug discovery by CADD - Structure and property, ADME-rules, concept of QSAR & 3-D QSAR, Pharmacophore, Enzymes/proteins structures/docking. Software used in drug design.

Antibiotics and antimalarial (with SAR and MOA)

Introduction, general classification, structural variations, synthesis and medicinal uses of the following: Antibiotics: Penicillin, tetracycline, chloramphenicol. Antimalarial: Antimalarial agents based on 4-amino and 8-amino.

Unit –II –Organic synthesis of imp drugs (psychoactive, cardiovascular, hypoglycemic, anti-TB, antimalarial)

Psychoactive drugs

Thiopental, amobarbital, diazepam, chlorozepan, alprazolam, glutethimide, nikethamide, procaine, lidocaine and dibucaine, Ibuprofin, meclofenate sodium, novalgin, pethidine

Cardiovascular, diuretics and hypoglycemic drugs

Synthesis of amyl nitrate, diltiazim, atenolol, methyl dopa, tolbutamide, chloropropamide, glibenclamide, acetazolamide, chlorothiazide, furosemic and ethacrycnic acid

Antimalarial drugs

Mefloquines, chloroquine, primaquine and daraprim

Antituberculosis drugs

Isoniazid (INH), Ethionamide, Ethambutol, DDS (Dapsone)

Unit – III- Basic principle and unit process (by Convention and Green chemistry aspects) in organic chemistry/industry

Basic principle at chemical industry

Basic chemical data (including MSDS), flow charts, chemical process selection, batch versus continuous operation. Safety – general safety, safety during handling of chemicals, fire safety. Hazardous - toxic chemical materials (Solid, liquid and gas), precaution and action taken during accident by chemicals. Patents and its importance in Research and development/chemical industry. Good manufacturing practice (GMP) and Good laboratory practice (GLP).

Unit process (in organic chemistry) at chemical industry

Nitration, Halogenation, Sulphonation and Amination methods and industrial chemicals derived from benzene, naphthalene using unit process by Convention and Green chemistry aspects (Green catalyst, Name reactions associated with green chemistry, one pot reaction, MCR, use of MW, ultrasonic/sound) for each unit process with suitable examples.

Unit – IV - Separation (chromatography & Unit operations) Techniques and Applications in organic chemistry

Chromatography Techniques

TLC, HPTLC, GC, HPLC/LC, SFC, Column Chromatography, Combi Flash -…

Unit operations in organic chemistry –

Filtration – Different types of filtration techniques, filter aid and filter media.

Distillation - Different types of distillations with their pros and cons.

Extraction – Solid from solids and liquid from liquids using suitable reagents.

Drying – Using ovens, spray tower, plate and frame dryer

Reference:

1. Burger's medicinal chemistry and drug design (5/e) 1997, vol 1 to 5 edited by Manfred E.Woltt (John wiley and sons Mc. New york)
2. Principles of medicinal chemistry by William A. Foye (ied), lea and febiys (Philadelphia)
3. Principles of medicinal chemistry vol I & II (5/e) F.S.kadam, K.R. Mahadic ad K.G.Bohra (Nirali publication)
4. Medicinal chemistry by ashutosh kar
5. The organic chemistry of drug synthesis vol I, II and III (1980) ed by D. lednicer and L.A. mitscher (Johyn wiley and sons, New york)
6. Wilson and Gisvold text book of organic medicinal and pharmaceutical chemistry (5/e,1982) by Robert Doerge (J.B. lippincoff company, phaladophia/ Toppan co.Ltd, Tokyo)
7. Topics in medicinal chemistry vol I & II by rabinowitz Myerson (interscience 1968)
8. The pharmaceutical basis of therapeutics by Geoman and Gilman (Mcmillan co.)
9. Unit processes in organic synthesis by P. H. Groggins
10. Industrial Chemical process by R. N. Shreve
11. Riegels handlook of industrial chemistry by James and Kent
12. Dryden's outlines of chemical Technology M. Gopal Rao

CHE(EO) 504 ELECTIVE-2

ESSENTIALS OF OXIDATION, REDUCTION AND C-C BOND FORMATION. APPLICATION IN ORGANIC SYNTHESIS

https://nptel.ac.in/courses/104/101/104101127/#

COURSE PLAN:

Week 1: Introduction to organic synthesis, importance of selectivity and basics of oxidation of alcohols and development of sulfur-based oxidations: Swern oxidation and related concepts; Continuation of Swern oxidation and the utility

of intermediates derived from Swern oxidation including Pummerer intermediates; Oxidations using selenium compounds such as SeO2 and organoselenium compounds

Week 2: Dess-Martin, IBX and related hypervalent iodine-based oxidations; Silver carbonate/celite, Prevost reactions and its modern variation. Microbial oxidations such as Pseudomonas Putida etc. Week 3: Oxidations with RuO4 and other Transition metal catalysed oxidations; Tamao-Fleming Oxidation; Oxidations with Dimethyl dioxirane (DMDO) and 2-sulfonyloxaziridines and chiral versions; Oxidations at unfunctionalized carbons, Photosensitized oxidations

Week 4: Reduction of Carbonyl compounds with Boron and Aluminium based reagents such as Luche Reduction, NaCN(BH3), DIBAL, Red-Al, L-and K-Selectrides, Superhydrides and associated selectivities.

Week 5: Low Valent Titanium species and Microbial reductions (NADH model etc.); Dissolving Metal Reductions; Reduction with Silanes

Week 6: Sharpless epoxidation and synthetic utility of the chiral epoxy alcohols; Katsuki-Jacobsen epoxidation and mechanistic details; OsO4 based and related Sharpless Asymmetric Dihydroxylation

Week 7: Coreys oxazaborilidines in asymmetric reductions; Noyoris Ruthenium catalysed reduction of ketones; Asymmetric Hydrogenations with BINAP

Week 8: C-C Bond formation via Carbanions alpha to electron withdrawing groups; Boron and Silicon Enolates: Formation and Use in C-C Bond Formation; Imines in C-C Bond Formation; Simmons-Smith Cyclopropanation in Organic Synthesis

Week 9: Use of Allyl Boron, Allyl and Vinyl Silanes and Allyl Tin compounds in C-C Bond Formation

Week 10: Introduction to SAMP and RAMP chiral ligands for asymmetric C-C bond formation; Introduction to Oppolzers Sultam based chiral ligands and their reactions for organic synthesis; Evans Oxazolidinone for asymmetric synthesis

Week 11: Synthesis of selected natural products using above discussed methods of oxidation, reduction and C-C Bond formations

Week 12: Synthesis of selected natural products using above discussed methods of oxidation, reduction and C-C Bond formations

CHE(O) ELECTIVE-3

REAGENTS IN ORGANIC SYNTHESIS

https://nptel.ac.in/courses/104/103/104103111/

COURSE PLAN:

Week 1: Oxidizing Agents in Organic Transformations-Part-I

Week 2: Oxidizing Agents in Organic Transformations-Part-II

Week 3: Reducing Agents in Organic Transformations-Part-I

Week 4: Reducing Agents in Organic Transformations-Part-II

Week 5: Organic Transformations-Using Non-Transition Metals Part-I

Week 6: Organic Transformations-Using Non-Transition Metals Part-II

Week 7: Organic Transformations-Using Non-Transition Metals Part-III

Week 8: Organic Transformations-Using Transition Metals Part-I

Week 9: Organic Transformations-Using Transition Metals Part-II

Week 10: Organic Transformations-Using Transition Metals Part-III

Week 11: Organic Transformations-Using Transition Metals Part-IV

Week 12: Organic Transformations-Using Lanthanides Reagents

CHE(O) 505 PR & CHE(O) 506 PR

Preparation of Organic compounds and study of reaction, mechanism, mole ratio calculation, TLC, purification, confirmation by chemical method, UV, IR, Mass and NMR value of compound (Theoretical)

CHE(O) 505 PR (Two step/multi step reactions)

Reaction & mechanism-15 Marks, IR,1HNMR, 13 C NMR, Mass spectra-20 Marks, Crude & crystal-20 Marks, mole ratio and other calculations-05 marks, confirmation test/derivative of functional group/compound-10 Marks=70 Marks.

Total marks 100 = 70 (External) + 30 (Internal)

1. Preparation of p-chlorotoluene from Toludine.
2. Preparation of eosin from resorcinol
3. Preparation of p-amino azobenzene from aniline
4. Preparation of sym-tribromo benzene from aniline
5. Preparation of m-nitro phenol from m-nitro aniline
6. Preparation of 4-nitrobenzoic acid from 4-nitrotoluene
7. Preparation of 2-chlorobenzoic acid from anthranilic acid
8. Preparation of acridone from 2-chlorobenzoic acid.
9. Preparation of 2-phenylindole from phenylhydrazine
10. Preparation of benzidine from nitrobenzene
11. preparation of congo red from benzidine.
12. preparation of benzylamine from phthalimide.

Reference:

1. Small scale preparations: A.I.Vogel
2. Practical organic Chemistry: Mann and Saunders 4th edition.
3. http://orgsyn.org

CHE(O) 506 PR

Reaction & mechanism-15 Marks, Short question & answers-15 Marks, Identification of unknown compound from IR,1HNMR,13 CNMR, Mass spectra-20 Marks, Viva 20 Marks=70 Marks.

Total marks 100 = 70 (External) + 30 (Internal)

1. Reaction mechanisms of all 12 preparations of CHE (O) 505 PR
2. Question-answers on all 12 preparations.
3. Data interpretation (UV, IR, 1H & 13 C NMR, Mass spectra) of unknown compounds.

Sem. IV

CHE(O) 507 Scientific Writing

- Writing of Research Article/Review Article/Commentary Article/Case Study/ Monograph/Book Chapter/Book Review/Research Proposal or any other scientific article type.
- The student can select any one scientific writing type or research proposal and submit a copy (hard and soft) of the same for internal and external evaluation.
- Evaluation shall be centered around on novelty, relevance, significance, and impact.
- Additional weightage will be given for submission/publishing of any article type in any journal (University journal or a journal that is indexed in the UGC CARE list/Web of Science/ SCOPUS/SCI/SCIE etc.) or a research proposal.

Guidelines for Scientific Writing

Research Article

Presents a full report with new results on a specific topic. Complete experimental details with proper justification. Generally not limited in length, with figures, tables, and references. Format…Title, Authors, Abstract, introduction, experimental, results, discussion, conclusion, acknowledgment, references

Review Articles/Commentary Article

Gives an overview of research in a particular field. It can be on one's own research or any other topic of general and current interest. Organized differently from communications or research articles as it does not have primary experimental data. Data of existing literature can be presented in a tabular format, graphs, diagrams, figures, charts etc. Should be referenced as thoroughly as possible. Format…Title, Authors, Abstract, introduction, discussion, conclusion, acknowledgment, references

Case Study

This study represents person, group, or situation that has been studied over time. Format depends upon the type of study.

Monograph

Title, Author, Introduction: Reason to select a topic; History, timeline, and Scientific/social significance; Benefits to the scientific community, teaching, and research, Development: Exposition of ideas into paragraphs or chapters.
"Quote that authors endorse these ideas." Conclusion: Status and future perspectives, References: Should be referenced as thoroughly as possible

Book Chapter

Title, Authors, Abstract, Introduction/Background on the topic, Discussion (with subdivisions): Text with tables, figures, charts etc., Summary/Conclusion: Status and future perspectives, References

Book Review

A book review is a thorough description, critical analysis, and/or evaluation of the quality, meaning, and significance of a book, often written in relation to prior research on the topic.
Scope/Purpose/Content, Note the Method/Methodology of writing, Critically Evaluate the Contents, Examine the Front Matter and Back Matter, Summarize and Comment.

Research Proposal

Title, Research Problem/Problem Statement, Rational/Purpose of the Study Review of the Literature, Proposed Research Framework, Research Questions/Proposed Hypothesis, Significance, Proposed Methods and Procedures, Deliverables/Expected Outcomes, Execution timelines, year wise breakup, financial aspects, References

References

1 *"A Manual for Writers of Research Papers, Theses, and Dissertations",* Kate Turabian, University of Chicago Press, 8th Edition, 2013.
2 "*Concise Guide to Writing Research Papers (Perfect Phrases Series)",*Carol Ellison**,** McGraw-Hill Education; 1st Edition, 2010.

CHE(O) 508 Report Writing

- Report Writing for Participation and/or presentation (Poster/Oral/Invited talk as applicable) in University/State level/National/International Seminar/ Conference/Webinar/ Symposium/Workshop/Hands-on training /Software learning of at least 5 days. The sessions must be a minimum of 6 hours per day, in case of seminar/ webinar/ conference/workshop, it is mandatory to participate more than 30 hours in such events. In the case of one day seminar/ webinar/ conference/workshop, it is mandatory to participate in two such events.

- Evaluation will be based on detailed technical report prepared on the conference/seminar/workshop participated and for Poster/Oral presentation, as applicable.
- Additional weightage will be given for Poster/Oral presentations.

Guidelines for Report Writing

It aims to summarise the most important talks/research presented. It is not usually feasible to attempt comprehensive coverage of the conference. More focus should be on those presentations that are most topical, interesting, or thought-provoking.

Points to consider when writing the report:

- Name of Institute/Department/University that organized the conference.
- Title and theme of the conference
- Information regarding number of attendees, where and when it was held (date), name of the convener, organizing secretary etc.
- Include a copy of the brochure.
- A brief about the Inaugural Session
- Details of all the technical sessions
- List of main speakers, their position/designation, topic, expertise, and their institutional affiliation
- Highlight research paper(s) or work with major significance and impact.
- A brief about the Concluding/Valedictory Session
- Embed the text with photographs wherever possible.
- The outcome/summary: Your learning

References

1 *"Writing for Conferences: A Handbook for Graduate Students and Faculty",* Leo Mallette, Clare Berger, Greenwood; Illustrated Edition, 2011.

2 *"The Creative Writing Handbook",* John Singleton (Editor), Mary Luckhurst (Editor), Red Globe Press; 2nd Edition, 1999.

CHE(O) 509 Industrial Training and Industry Visit

Guidelines

1. Each student must undergo a minimum of 1-week industrial training under the supervision of a faculty from the concerned department.
2. The industry may be in Ahmedabad, Gujarat or anywhere in India.
3. The training may be obtained at any R&D, QA, QC, Production or any other relevant department on different instrumental techniques or other laboratory equipment.
4. The students must submit a report on the training obtained from the industry which may include (a) introduction about the industry (b) various activities of the industry (c) the process which are used in the industry (d) the products of the industry and (e) summary and conclusion.
5. The report submitted by each student would be assessed by the branch in-charge and the supervising teacher.
6. The student must discuss/present the details of the training through a power point presentation.
7. The industry tour/visit must be of minimum of two days anywhere in India. The industrial tour certificate will be issued by in charge faculty/Head/Principal, while the visit certificate can be from the industry. Report writing and presentation will be similar to Industrial Training.

CHE(O) 510 Professional Chemistry Test (PCT)

Guidelines for PCT

1. Prepare questions from the last five years of CSIR-NET Examinations.
2. Preparation should be as per sections A, B, and C from the paper format.
3. Examination will be based on MCQ based exam will be conducted.
   (Part A maximum 10 out of 15 questions, Part B maximum 13 out of 20 questions and Part C maximum 6 out of 16 questions. If more than the specified number of questions are answered then the first 10, 13 and 16, respectively will be considered for assessment.)
4. No negative marks for wrong answers.

CHE(O) 511 Dissertation/Project Work

Guidelines for Dissertation/Project Work

1. Each student must carry out a project for a minimum of 30 days under the supervision of a faculty from the concerned department.
2. The project can be carried out either in the department or in any other industry, institute or organizations located in Ahmedabad, Gujarat or anywhere in India.
3. The topics of the dissertation can be selected from any of the four branches of chemistry i.e., Organic, Inorganic, Physical or Analytical. The topic can be related to (a)synthesis, purification, characterization, application of organic compounds or (b)metal complexes preparation and applications or (c)physical studies of various systems (d) method development and validation (e) green chemistry (f) nanomaterials preparation and applications (g) functionalized supramolecules (h) electro analytical methods (i)environmental analysis and decontamination or any other related to the subject.
4. Each student must submit a dissertation on the topic of their study comprising of (a) an introduction on the topic along with literature survey and justification for the selection of the topic (b) materials and methods (c) methodology (d) results and discussion and (e) summary and conclusion along with the references.
5. Each student must give monthly report and a midterm presentation of their work at the department.
6. The student must discuss/present the details of dissertation through a power point presentation.
7. Dissertation would be examined by the supervising teacher and external examiner.

CHE (O) 511 PR (Lab Course)

(Two step/multi step reactions)

PART-A

Reaction & mechanism-15 Marks, IR,1HNMR, 13 C NMR, Mass spectra-20 Marks, Crude & crystal-20 Marks, mole ratio and other calculations-05 marks, confirmation test/derivative of functional group/compound-10 Marks=70 Marks.

Total marks 100 = 70 (External) + 30 (Internal)

1. Preparation of benzanilide from benzophenone.
2. Preparation of p-nitroaniline from acetanilide.
3. Preparation of p-nitrophenylhydrazine from p-nitroaniline
4. Preparation of p-nitrobenzoic acid from toluene
5. Preparation of p-ethoxyacetanilide from p-aminophenol.
6. Preparation of 2 -hydroxy-5-methylbenzophenone from p- cresol
7. Preparation of benzamidazole from o-nitroaniline
8. Preparation of anthrone from anthracene.
9. Preparation of 4-benzylidene-2-phenyloxazol-5-one from glycine.
10. Preparation of 1,2,4-triacetoxy benzene from hydroquinone
11. Biginelli reaction from benzaldehyde, EAA and urea/thiourea
12. Preparations of Zinc oxide Nano particles via Chemical reduction.

Reference:

1. Small scale preparations: A.I. Vogel
2. Practical organic Chemistry: Mann and Saunders 4th edition.
3. http://orgsyn.org
1. Nano Particle Technology Handbook, 3rd Edition, Makio Naito, Toyokazu Yokoyama, Kouhei Hosokawa, Kiyoshi Nogi.

PART-B

Reaction & mechanism-15 Marks, Short question & answers-15 Marks, Identification of unknown compound from IR,1HNMR,13 CNMR, Mass spectra-20 Marks, Viva 20 Marks=70 Marks.

Total marks 100 = 70 (External) + 30 (Internal)

1. Reaction mechanisms of all 12 synthesis of PART A
2. Question-answer preparations of all 12 synthesis.
3. Data interpretation (UV, IR, 1H 713 C NMR, Mass spectra) of unknown compounds.