# C. U. SHAH UNIVERSITY

# FACULTY OF SCIENCE

## DEPARTMENT OF CHEMISTRY

**COURSE: M.Sc.** **SEMESTER: II**

**SUBJECT NAME: INORGANIC CHEMISTRY** **SUBJECT CODE: MSCCHC201**

## Teaching & Evaluation Scheme:-

| Teaching Scheme(hrs) | | | | Evaluation Scheme | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory | | | | | Practical (Marks) | | | |
| Th | Semianr | Pr | Total | Sessional Exam | | University Exam | | Total | External | Internal | Total | Total |
| | | | | Marks | Hrs | Marks | Hrs | | | | | |
| 3 | 0 | 0 | 3 | 30 | 1.5 | 70 | 3 | 100 | -- | -- | -- | 100 |

### Objectives:-

- To get the idea about the influence of structure and bonding on the physical properties and reactivity of inorganic molecules.
- To study several various concepts of bonding, their advantages and disadvantages.
- To be able to recognize symmetry elements in molecules and assign molecules to the appropriate point group. Later in your coursework, this will be used to explain bonding and spectroscopic properties.
- To learn how structures are determined for inorganic molecules and to learn about the thermodynamics of crystal lattice formation.
- To gain an appreciation for how inorganic chemistry influences your everyday life.

## Course outline:-

| Sr. No. | Course Contents |
|---|---|
| 1 | **Organometallic Compounds:** Introduction, Nature of bonding in organometallic compounds of transition metals. σ-bonded organometallic compounds: Introduction, general characteristics, chemical reactions, bonding and structure. π-bonded organometallic compounds: Introduction and Classification of π-bonded organometallic compounds (a)η2-alkene complexes: Preparative methods, physical properties, chemical properties, bonding of structure. (b) η3allyl (or enyl) complexes preparation, physical of chemical properties. |
| 2 | **Fundaments of Bioinorganic Chemistry:** Introduction, Complexes of Ia and IIa group cations in Biological chemistry. Ferredoxin, iron-sulphur proteins and their relevance.<br>Di-nitrogen complexes: their structure, binding and relevance in biology, Biological Nitrogen fixation. Di-oxygen complexes: their structure, binding relevance in biology |
| 3 | **Electron spin resonance:**Theory of ESR, ESR applications for the structure determination of metal complexes, Applications of ESR for understanding metal complexes relevant to biology. Interaction between nuclear spin and electron spin. |
| 4 | **Ion-Exchangers:** Introduction, classification of ionexchangers and their applications in the separation of following: 1. Zinc and Magnesium, 2. Chloride and bromide, 3. Cobalt and Nickel, 4. Cadmium and Zinc. |

## Learning Outcomes:-

After the successful completion of the course, students will be able to

- Gain knowledge of organometallic compounds,organo-transitions, chemical reactions, bonding and structure.
- The can be aware about role of inorganic chemistry in biological system.
- Students can get idea about spin resonance and its applications.
- They can learn separation techniques by ion exchangers.

## Books Recommended:-

1. Metal ions in Bio-Inorganic Chemistry, P.K. Bhattacharya, Narosa Publishing House.
2. Vogel's Text book of Quantitative Inorganic Analysis, ELBS Press.
3. Organometallic Chemistry, R.C. Mehrotra and A. Singh, New Age International.
4. Advanced Inorganic Chemistry, Cotton Wilkinson, W S E Wiley.
5. Physical Methods in Chemistry, R.S.Drago, Saunders College.
6. The Inorganic Chemistry of Biological Processes, M.N.Hughes, John Wiley & Sons.

7. The Organometallic Chemistry of the Transition Metals, R.H. Crabtree, John Wiley.
8. Metallo-Organic Chemistry, A.J. Pearson, Wiley.

## E-Resources:-

1. http://pubs.acs.org/journal/inocaj
2. http://www.chemlin.de/chemistry/inorganic_chemistry.htm
3. http://www.anorg.chem.uu.nl/home/index.html
4. http://www.springer.com/chemistry/inorganic+chemistry/journal/11502
5. http://libguides.stanford.edu/content.php?pid=149720&sid=1271547
6. http://www.science.uwaterloo.ca/~cchieh/cact/applychem/inorganic.html
7. http://pubs.rsc.org/en/journals/journalissues/ic#!recentarticles&all
8. http://www.chem.umass.edu/~samal/orginorgsites.html
9. http://www.sciencedirect.com/science/book/9780123851109
10. http://www.chemistryviews.org/details/event/1442119/2nd_EuCheMS_Inorganic_Chemistry_Conference.html
11. http://store.elsevier.com/Comprehensive-Inorganic-Chemistry-II/isbn-9780080977744/
12. http://chemistry.about.com/cs/generalchemistry/a/aa072103a.htm
13. http://www.ox.ac.uk/admissions/postgraduate_courses/course_guide/chemistry_1.html
14. http://www.researchgate.net/journal/0260-3594_Comments_on_Inorganic_Chemistry
15. http://www.cecam.org/workshop-671.html

# C. U. SHAH UNIVERSITY

# FACULTY OF PURE SCIENCE

## DEPARTMENT OF CHEMISTRY

**COURSE: M.Sc.** **SEMESTER: II**

**SUBJECT NAME: ORGANIC CHEMISTRY** **SUBJECT CODE: MSCCHC202**

## Teaching & Evaluation Scheme:-

| Teaching Scheme(hrs) | | | | Evaluation Scheme | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory | | | | | Practical (Marks) | | | |
| Th | Semianr | Pr | Total | Sessional Exam | | University Exam | | Total | External | Internal | Total | Total |
| | | | | Marks | Hrs | Marks | Hrs | | | | | |
| 3 | 0 | 0 | 3 | 30 | 1.5 | 70 | 3 | 100 | -- | -- | -- | 100 |

### Objectives:-

- To understand organic chemistry reaction pathways and reaction mechanism.
- To learn theories and principles related to organic chemistry.
- To learn and understand various nucleophilic and electrophilic reactions in organic chemistry.
- To create interest in students in learning organic chemistry.

### Prerequisites:-

Before studying organic chemistry, all students have basic knowledge of inorganic and organic compounds, molecular structure, Molecular orbital theories and knowledge related to UG level chemistry.

### Course outline:-

| Sr. No. | Course Contents |
|---|---|
| 1 | **Photochemical Reactions:** Interaction of electromagnetic radiation with matter, types of excitations, fate of excited molecule, quantum yield, transfer of excitation energy, actinometry. |

| | |
|---|---|
| 2 | **Determination of Reaction Mechanism :**<br>Classification, rate constant and life times of reactive energy state – determination of rate constant of reactions Effects of light intensity on the rate of photochemical reactions.<br>Types of photochemical reaction – photo-dissociation, gas phase photolysis. |
| 3 | **Photochemistry of Alkenes:**<br>Intramolecular reaction of the olefinic-bond –geometrical isomerism, cyclisation reactions, rearrangement of 1,4- and 1, -dinenes. |
| 4 | 1. **Photochemistry of Carbonyl Compound :**<br>Intramolecular reaction of the Carbonyl Compound cyclic and acyclic,-saturated, and α,β-unsaturated compounds, Cyclohexadienones. Intramolecularcycloaddition reaction-dimerisation and oxetane formation.<br>2. **Photochemistry of Aromatic Compounds:**<br>Isomersations, addition and substitutions reactions.<br>3. **Miscellaneous Photochemical Reactions:**<br>Photo-Fries reactions of anilides. Photo-Fries rearrangement. Barton reaction. Singlet molecular oxygen reactions. Photochemical formation of smog, Photo degradation of polymers. |
| 5 | **Pericyclic Reaction:**<br>Cycloaddition reaction, sigmatropic rearrangements, Frontier orbitals of ethylene, 1,3 – butadiene, 1,3,5– hexatriene and allyl system. Classification of pericyclic reactions. Woodward– Hoffmann correlation diagrams. FMO and PMO approach. Electrocyclic reaction – conrotatory and disrotatory motions, 4n and 4n+2 and allyl systems. |
| 6 | **Aromaticity:**<br>Concepts of armomaticity, non aromaticity and anti aromaticityNon-benzene aromatic compounds, azulenes, Tropolener (4n+2), Huckel'sreule and its applications. |

## Learning Outcomes:-

After the successful completion of the course, students will be able to

- Understand photochemical reactions.
- Determine reaction mechanism, photo chemistry, aromaticity etc.

## Books Recommended:-


1. A Text Book of Organic Chemistry – R.K.Bansal, New Age International (P) ltd. 4th edition (2003).
2. Advanced Organic Chemistry (IV edition) – Jerry March.
3. Reaction Mechanism and Reagents in Organic Chemistry – Gurdeep R. Chatwal.
4. Organic Chemistry by G. Marc. Loudon, Oxford University Press (2002).
5. Principles of Organic Synthesis by R.O.C Norman, J.M. Coxon, CRC Press, (3rd edition) (2009).
6. Organic Reaction Mechanism (II edition) – V.K. Ahluwalia, R.K. Parasar.
7. Organic Chemistry – I.L.Finar 6th edition (low price), Pearson Education (2003).

8. Organic Chemistry by J. Clayden, N. Greeves, S. Warren, P. Wothers, Oxford University Press (2000).

**E-Resources:**

1. http://www.organic-chemistry.org/
2. http://www.organicdivision.org/?nd=p_organic_web_links
3. http://www.masterorganicchemistry.com/resource-guide/
4. http://orgchem.iisc.ernet.in/chemlink.html
5. http://www.mpcfaculty.net/ron_rinehart/organic.htm
6. http://web.usca.edu/chemistry/NewStudentInfo/helpful-websites-for-studying-organic-chemistry.dot
7. http://pubs.rsc.org/en/journals/journalissues/oc#!recentarticles&all
8. http://www.chem.ox.ac.uk/vrchemistry/iom/#
9. http://ocw.mit.edu/courses/#chemistry
10. http://www.stolaf.edu/depts/chemistry/courses/toolkits/247/
11. http://iverson.cm.utexas.edu/courses/310M/MainPagesSp06/GoldenRules.html
12. http://www.abdn.ac.uk/curly-arrows/index.html%20(click%20the%20Tutorials%20button)
13. www.wikipedia.org/organic

# C. U. SHAH UNIVERSITY

# FACULTY OF PURE SCIENCE

## DEPARTMENT OF CHEMISTRY

**COURSE: M.Sc.** **SEMESTER: II**

**SUBJECT NAME: MACROMOLECULAR PHYSICAL CHEMISTRY-I**

**SUBJECT CODE: MSCCHC203**

## Teaching & Evaluation Scheme:-

| Teaching Scheme(hrs) | | | | Evaluation Scheme | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory | | | | | Practical (Marks) | | | |
| Th | Seminar | Pr | Total | Sessional Exam | | University Exam | | Total | External | Internal | Total | Total |
| | | | | Marks | Hrs | Marks | Hrs | | | | | |
| 3 | 0 | 0 | 3 | 30 | 1.5 | 70 | 3 | 100 | -- | -- | -- | 100 |

### Objectives:-

- To know the concepts of polymer chemistry.
- To get the idea about kinetics of chemical reactions.
- To understand applications of physical chemistry in everyday life.

### Prerequisites:-

Before learning Physical chemistry, student should aware about basic principles and theories of physical chemistry, thermodynamics, electrode potential, chemical reactions and other UG level chemistry.

### Course outline:-

| Sr. No. | Course Contents |
|---|---|
| 1 | **Basics of polymer chemistry**: Classification of polymers. Polymer nomenclature. Types of polymer chains. Synthesis of monomers. Stereo regular polymers. Functionality and polymerization concepts. |

| | |
|---|---|
| **2** | **Chain polymerization:** Kinetics of free radical polymerization and chain transfer reactions. Chain transfer reactions. Factor affecting radical polymerization and properties of the resulting polymer. Free radical polymerization: Methods of initiating free radical polymerization.<br>**Cationic and Anionic polymerization:** Kinetics of cationic and anionic polymerization. Evaluation of reactivity ratios. Coordination polymerization. Molecular weight distribution. Copolymerization and its kinetics.<br>**Free radical polymerization:** Emulsion polymerization Bulk polymerization, solution polymerization, and solid phase polymerization. Poly- recombination. Problems. |
| **3** | **Polycondensation**: Kinetics of polycondensation reaction. Molecular weight control in polycondensation. Reaction route of polyfunctional compounds. Nonlinear polycondensation. Statistics of linear polycondensation. Effect of monomer concentration and temperature on direction of polycondensation reaction. Polycondensation equilibrium and molecular weight of polymer. Factors affecting the rate of polycondensation and molecular weight of the polymer. Method of polycondensation: Melt, interfacial, solution and solid phase polycondensation, Problems. |
| **4** | **Stepwise polymerization and ring scission polymerization**: Thermodynamics of ring transformation to a linear polymer. Effect of temperature and monomer concentration on ring-polymer equilibrium. Kinetics and mechanism of ring scission polymerization. Effect of activator concentration and temperature on ring scission polymerization and molecular weight of the polymer. |
| **5** | Physico-chemical degradation reactions. Cross-linking and reactions of functional groups. |

## Learning Outcomes:-

After the successful completion of the course, students will be able to

- Understand concept of polymer chemistry, chain polymerization.
- Polymerization and its application, cross linking etc.

## Learning Outcomes:-

After the successful completion of the course, students will be able to

- Understand Thermodynamics and its applications.
- Concept of fugacity and its determination.
- Understand about solutions, its properties and vapor pressure curves.
- They can be able to apply basics into their experiment as well as their routine life.

## Books Recommended:-


1. Polymer Science, V. R. Gowariker, N. V. Vishwanathan and J. Shreedhar, Willey Eastern Ltd., New Delhi.
2. Organic Polymer Chemistry, K. J. Saundars.
3. Text-book of Polymer Science, F. W. Billmeyer, Willey Interscience.
4. Polymer Chemistry, Bruno Vollmert. Springer, New York.
5. Polymer materials Science, Technology and Developments, Vol.I, SukumarMaity, AnusandhanPrakasan, Midnapore
6. Principles of Polymer Systems, F. Rodriguez, McGraw Hill.
7. A First Course in Polymer Chemistry, Mir Publishers, Moscow.
8. Physical Chemistry of Macromolecules, D. D. Deshpande, IIT, Bombay
9. Polymer Chemistry An Introduction, Malcolm P. Stevens, Addition-Wesley Publishing Company, Inc.
10. Macromolecular Physical Chemistry, P. H. Parsania
11. Principles of Polymer Chemistry, A. Ravve, Kluwer Academic/Plenum Publisher, New York.


## E-Resources:-

1. http://ukcatalogue.oup.com/product/9780199543373.do#.UhOsGtI3Bsk
2. http://web.mit.edu/speclab/www/links.html
3. http://library.duke.edu/research/subject/guides/chemistry/
4. http://www.chem.ox.ac.uk/cheminfo/internet.html
5. http://www.science.fau.edu/chemistry/links.htm
6. http://pubs.rsc.org/en/journals/journalissues/cp#!recentarticles&all
7. http://www.rsc.org/ConferencesandEvents/ISACS/PhysicalChemistryandNanoscience/index.asp
8. http://pubs.acs.org/loi/jpchax
9. http://www.csulb.edu/~lhenriqu/chem.htm
10. http://libguides.stanford.edu/content.php?pid=114712&sid=991132
11. http://simple.wikipedia.org/wiki/Physical_chemistry
12. http://chemistry.olivet.edu/chemistry_library.htm
13. http://as.wiley.com/WileyCDA/WileyTitle/productCd-EHEP000800.html
14. http://www.chemsoc.dk/KFlinks.htm
15. http://www.library.auckland.ac.nz/subject-guides/chem/chemmeta.htm
16. http://www.tandfonline.com/toc/trpc20/current#.UhOsT9I3Bsk

# C. U. SHAH UNIVERSITY

# FACULTY OF PURE SCIENCES

## DEPARTMENT OF CHEMISTRY

**COURSE: M.Sc.** **SEMESTER: II**

**SUBJECT NAME: ANALYTICAL CHEMISTRY** **SUBJECT CODE: MSCCHC204**

## Teaching & Evaluation Scheme:-

| Teaching Scheme(hrs) | | | | Evaluation Scheme | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory | | | | | Practical (Marks) | | | |
| Th | Semianr | Pr | Total | Sessional Exam | | University Exam | | Total | External | Internal | Total | Total |
| | | | | Marks | Hrs | Marks | Hrs | | | | | |
| 3 | 0 | 0 | 3 | 30 | 1.5 | 70 | 3 | 100 | -- | -- | -- | 100 |

### Objectives:-

- To learn about analytical instrumentation and their applications in analytical chemistry.
- To understand fundamentals of analytical chemistry and its laboratory applications.
- To get awareness regarding environmental chemistry.
- To conceptualize green chemistry approach.

### Prerequisites:-

- Before learning analytical chemistry, student should aware about basic principles and theories of analytical chemistry, instrumental methods of analysis and other UG level chemistry.

## Course outline:-

| Sr. No. | Course Contents |
|---|---|
| 1 | **Basics of Environmental Chemistry:**<br>Definitions, types of classifications, energy balance between earth-atmospheric systems, particulates organic particulates, particulate collection techniques, importance of particulates, photolytic cycle, photochemical smog chemistry. Principles of water analysis their parameters, sampling and preservation techniques. |
| 2 | **Fundamentals of Electrometric Analysis**<br>**a.** Types of error<br>**b.** Accuracy and precision<br>**c.** Data processing<br>**d.** Confidence limit and interval<br>**e.** Test of significance<br>**f.** t-test and F-test<br>**g.** Rejection of data<br>**h.** Control charts<br>**i.** Least square analysis<br>**j.** Problems |
| 3 | **Green Chemistry**<br>Concepts of green chemistry, 12 principles of green chemistry, current trends of synthesis and techniques of green approach. |

## Learning Outcomes:-

After the successful completion of the course, students will be able to

- Concepts of environmental chemistry and its applications.
- Understanding of electrometric analysis.
- Aware with the Green chemistry approach.

## Books Recommended:-

1. Environmental Guidelines and Standards in Indian. P. K. Goel& K. P. Sharma.
2. An Introduction to air pollution. R. K. Trivedi and P. K. Goel.
3. Principles of Environmental Chemistry. H. Kolhandaraman and GeethaSwaminathan.
4. Atmospheric Pollution. Black W. (McGrow Hill Company) New York.

5. A Textbook of Environmental Chemistry and Pollution Control. S. S. Dara (S. Chanda& Co.) New Delhi.
6. Ecology of Polluted water and Toxicology. K. D. Mishra.
7. Environmental Chemistry. A. K. De.
8. Industry, Environment and Pollution. Arvind Kumar and P. K. Goel.
11. Basic concepts of Environmental Chemistry. Des W. Connel.
12. Manual on Water and Wastewater analysis. Dr. B. B. Sundarsan.
13. Liquid waste of Industry: Theories Practices and Treatment. Nelson L. Nemerow.
14. Statistics in Chemistry. P. H. Parsanaia
15. W. Horwitz, Official Methods of Analysis, 11th edition (1970), Association of Official Analytical Chemists, Washington DC.

## E-Resources:-

1. http://ukcatalogue.oup.com/product/9780199543373.do#.UhOsGtI3Bsk
2. http://web.mit.edu/speclab/www/links.html
3. http://library.duke.edu/research/subject/guides/chemistry/
4. http://www.chem.ox.ac.uk/cheminfo/internet.html
5. http://www.science.fau.edu/chemistry/links.htm
6. http://pubs.rsc.org/en/journals/journalissues/cp#!recentarticles&all
7. http://www.rsc.org/ConferencesandEvents/ISACS/PhysicalChemistryandNanoscience/index.asp
8. http://pubs.acs.org/loi/jpchax
9. http://www.csulb.edu/~lhenriqu/chem.htm
10. http://libguides.stanford.edu/content.php?pid=114712&sid=991132
11. http://simple.wikipedia.org/wiki/Physical_chemistry
12. http://chemistry.olivet.edu/chemistry_library.htm
13. http://as.wiley.com/WileyCDA/WileyTitle/productCd-EHEP000800.html
14. http://www.chemsoc.dk/KFlinks.htm
15. http://www.library.auckland.ac.nz/subject-guides/chem/chemmeta.htm
16. http://www.tandfonline.com/toc/trpc20/current#.UhOsT9I3Bsk

# C. U. SHAH UNIVERSITY

# FACULTY OF PURE SCIENCE

## DEPARTMENT OF CHEMISTRY

**COURSE: M.Sc.** **SEMESTER: II**

**SUBJECT NAME: PRACTICALS** **SUBJECT CODE: MSCCHC205**

## Teaching & Evaluation Scheme:-

| Teaching Scheme(hrs) | | | | Evaluation Scheme | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory | | | | | Practical (Marks) | | | |
| Th | Seminar | Pr | Total | Sessional Exam | | University Exam | | Total | External | Internal | Total | Total |
| | | | | Marks | Hrs | Marks | Hrs | | | | | |
| 0 | 0 | 15 | 15 | -- | -- | -- | -- | -- | 150 | 50 | 200 | 200 |

## Course outline:-

| Sr. No. | Course Contents |
|---|---|
| 1 | **Organic Chemistry:**<br>**a.** **Organic preparation(05):**One & Two stage preparation.<br>**b.** Identification of Organic compounds containing more than one functional groups **(10)** |
| 2 | **Inorganic Chemistry:**<br>**a.** **Qualitative Analysis:** Analysis of a mixture containing six radicals, including one rare metal ions: W, Tl, Ti, Mo,Se, Zr, Th, Ce,V, Li.<br>**b.** **Synthesis and estimation of metal complexes:**Synthesis of selected inorganic metal complexes(08) and their estimation by usual volumetric /gravimetric /colorimetric techniques to determine the percentage purity of the complexes prepared: |
| 3 | **Physical Chemistry:**<br>**(i) Instrumental exercises:**<br>**a.** Conductometry: Mono and biprotic acids, mixtures of acids against strong/weak bases, argentometric, complexometric, replacement titrations, verification of Onsagar's equation, dissociation of weak acids.<br>**b.** Potentiometry: acid-base, redox and argentometric titrations.<br>**c.** pHmetry: acid-base titration, pKa of acids and E0QH2.<br>**d.** Ultrasonics: Acoustical parameters of liquids.<br>**e.** Refractometry: Binary mixtures and solids. |

| | |
|---|---|
| | **f.** Polarimetry: Optically active compounds.<br>**g.** Spectrophotometry: Lambert-Beers Law, binary mixture, kinetics of iodination, etc.<br>**(ii) Physicochemical exercises**:<br>**a. Reaction dynamics**: Zero, first and second order reactions.<br>**b. Partition coefficient**: Dimerization of acids, $I^-$-$I_2$ system, $Cu^{2+}$ - $NH_3$ complexes.<br>**c. Thermodynamics**: Heat of solution, partial molar volume, etc.<br>**d. Steam distillation**: Molecular weight determination. |
| **4** | **Analytical Chemistry**:<br>**a. Practicals based on food analysis**: Honey, oil, tea-leaves, turmeric powder, etc.<br>**b. Drug analysis**: aspirin, Benzyl benzoate, etc.<br>**c. Volumetric and gravimetric exercises**: Ester, peroxides, other ions, etc.<br>**d. Industrial products**: Estimation for purity and assay. |