



B.M.S. COLLEGE OF ENGINEERING, BANGALORE-19

(Autonomous College under VTU)

Course Code	15CY3DCCEM	Course Name	Technical Chemistry
Credits	04	L-T-P-S	3-0-1-0

MODIFIED COURSE OUTCOMES – Technical Chemistry (15CY3DCCEM)

CO 1	Learn Principles of Organic Chemistry to understand the concepts of bonding, reaction mechanisms, organic transformations, spectroscopic analysis, insecticides, pharmaceuticals, dyes, soaps and detergents
CO 2	Ability to describe and apply the learnt knowledge to predict the reaction products in the given organic transformations, structure elucidations and end products of a reaction
CO 3	Apply the knowledge gained to conduct experiments in synthesizing simple organic compounds and analyze their purity and quantification through volumetric analysis

UNIT-1. REACTION MECHANISMS

Introduction to Chemical bonds, Reactivity of organic compounds and electronic effects in molecules. Reactive intermediates-Carbon based-formation, structure and stability of Carbocation, Carbanion and Carbon free radicals with examples. Nucleophilic aliphatic substitution: Mechanism, Rate law and stereochemistry of the S_N1 , S_N2 and S_Ni reactions with examples. Elimination: Mechanism, Rate Law and stereochemistry of the E_1 , E_2 and E_1cB reactions with examples. Electrophilic aromatic substitution: Directing effect of substitutions (ortho/meta/para) in benzene with examples. **[08 hours]**

UNIT-2. ORGANIC TRANSFORMATIONS

Conversion of alkenes to alcohols: Oxymercuration (Markovnikov) and demercuration / Hydroboration and oxidation (Anti-Markovnikov). Oxidations: Definition, examples of Chromium, Peroxides, Sulfoxide based reagents and transformations. Mechanism and application of Collins reagent in the oxidation of primary and secondary alcohols. Reduction: Definition, Dissolving metal reduction. Metal Hydride reductions involving- metal borohydrides and metal catalyzed reduction. Organometallic Reagents: Definition, synthesis and applications of Grignard reagent, and organolithium agents. Industrial production of methanol, methyl-tert-butyl-ether (MTBE) and ethylene glycol. **[08 hours]**

UNIT-3. BASICS OF ORGANIC ABSORPTION SPECTROSCOPY

Electromagnetic radiation: Franck-Condon Principle, UV Spectroscopy - Definition, Electronic transitions - $\sigma\text{-}\sigma^*$, $n\text{-}\sigma^*$, $\pi\text{-}\pi^*$, $n\text{-}\sigma^*$. Applications in the diagnosis of conjugated and non-conjugated alkenes, Effect of alkyl substituents on the absorption maximum. Problems related to calculation of λ_{max} and energy

IR Spectroscopy - Basics, IR absorption and chemical structure, Wavenumber, Factors determining IR absorption peak position and intensity, Hooke's law, Identification of organic functional groups. Application of IR in determination of green house gases and automobile pollutants.

NMR Spectroscopy- Introduction, Nuclear spin, magnetogyric ratio, spin state, chemical shift, integration, relationship between chemical shift and structure, spin-spin splitting, n+1 rule, use of deuterium in NMR, ^1H NMR of selected aliphatic and aromatic alkanes, alkenes and alcohols. [08 hours]

UNIT-4. PHARMACEUTICALS AND INSECTICIDES

PHARMACEUTICALS: Introduction, General Classification, drug-design-objectives and governed factors. Therapeutic action and application of analgesics (Ibuprofen from isobutyl benzene).

INSECTICIDES: Introduction, General classification - natural (Botanical and Bio-rational formulations) and synthetic (Inorganic and Organic) pesticides - synthesis, governing factors, uses, limitations of organophosphate (malathion), N-methyl carbonate (Carbaryl), Neo-nicotinoid (Imidacloprid) and Cyclopentadienes (Dieldrin). [08 hours]

UNIT-5. DYES, SOAPS & DETERGENTS

DYES: Classification - structure and method of application, colour and constitution-chromophore, auxochrome theory, origin of colour, Synthesis and applications of Anionic dye (Methyl orange from Aniline), Diazo dye (Congo red from nitrobenzene), Triarylmethane dye (Malachite green from benzaldehyde) and Vat dye (Indigotin from o-nitrotoluene).

SOAPS AND DETERGENTS: Introduction to oils and fats, properties and uses, vegetable oils examples analysis of oil - Acid value, saponification value and iodine value and their importance. Soaps-definition, types of manufacture of soap, Hydrolyzer process. Detergents-definition, various constituents of a detergent, Surfactants-anionic, cationic, zwitterionic and non-ionic. Cleansing action of detergent, advantages of detergents over soaps. [08 hours]

Text books:

1. A text book of Organic Chemistry by Arun Bahl and B. S. Bahl, 18th revised edition, S Chand, 2006
2. Organic chemistry by Graham Solomons, T. W. and Craig B. Fryhle, (WSE) 10th edition, Wiley India, 2010.

Reference books:

1. Organic Chemistry by Robert Thornton Morrison, Robert Neilson Boyd and S.K. Bhattacharjee, 7th edition, Pearson Prentice Hall, 2011
2. Advanced Organic Chemistry: Reactions, Mechanisms and Structure by Michael B. Smith and Jerry March, (WSE) 4th edition, Wiley, 2008
3. Organic Chemistry by Marc G. Loudon, 4th Edition, 2009

e-books:

- (1) Basic Principles of Organic Chemistry by John D. Roberts, Marjorie C. Caserio, 2nd edition, Addison-Wesley, 1977
- (2) Virtual Textbook of Organic Chemistry by William Reusch, Michigan State University, 1999

MOOCs List:

- (1) nptel.ac.in/courses.php?disciplineId=104
- (2) <http://ocw.mit.edu/courses/audio-video-courses/#chemistry>
- (3) <https://legacy.saylor.org/chem103/Intro/>

LIST OF EXPERIMENTS

1. Nitration of nitrobenzene to m-dinitrobenzene
2. Preparation of benzoic acid from benzaldehyde
3. Bromination of acetanilide to p-bromoacetanilide
4. Synthesis of acetyl salicylic acid (Aspirin) from salicylic acid
5. Preparation of α -phenylazo- β -naphthol (Sudan Yellow) from aniline
6. Study of geometrical isomerism - Maleic acid into fumaric acid using UV-Vis (demo)
7. Estimation of phenol by bromination
8. Estimation of a keto group by iodination
9. Estimation of esters by hydrolysis
10. Estimation of saponification value of an oil or fat
11. Estimation of carboxylic acid by iodometric titration

Reference books:

1. Technical Chemistry Lab Manual, written by faculty, Dept. of Chemistry, BMSCE, Bangalore.
2. Laboratory manual of Organic Chemistry by Raj K. Bansal, 5th revised edition, New Age International, 2013.

Course Outcomes:

After the completion of the course, students will have:

1. Ability to define, describe and solve different mechanisms of organic transformations
2. Ability to understand organic functionalization and application to oxidation and reduction reactions
3. Ability to analyze and interpret an organic structure based on its absorption spectrum
4. Ability to understand functional group dynamics and their usefulness in pharmaceuticals and pesticides
5. Ability to identify, interpret colour based on structure and validate by modern spectroscopic tool
6. Ability to conduct experiments and write mechanisms of electrophilic substitution reaction - nitration and halogenation, Oxidation of aldehydes and their application to synthesis of pharma product - aspirin and dye - sudan yellow. They shall survey and estimate various organic functional groups using environmentally benign organic reagents.