Engineering Chemistry

Syllabus

(With effect from the year 2018-2019)

Department of Chemistry

Sri Chandrasekharendra Saraswathi Viswa Mahavidyalaya

(University established under sec 3 of UGC Act 1956)

(Accredited with "A" by NAAC)

Enathur, Kanchipuram – 631 561.Tamilnadu,

I B.E./ B.Tech Engineering Chemistry Syllabus (with effect from 2018-19 onwards)

Semester	Part	Sub. Code	Title of the Paper	L	P	T	Credits
I / II		CBSCH18T20	Engineering Chemistry (Chemistry – I)	3	0	1	4

Aim: *Making the students to realize the importance and utility of chemistry in various fields*

Objective:

- *To learn the basics of atomic structure, bonding, analytical methods and various types of reactions in organic chemistry.*

Outcome:

The students will be able to

- Analyze microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
- Rationalize bulk properties and processes using thermodynamic considerations
- Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques.
- Rationalize periodic properties.
- List major chemical reactions that are used in the synthesis of various organic molecules.

Unit I: Atomic structure (15 Lectures)

Comparison between Rutherford's model of atom and Bohr's model - Bohr-Sommerfeld model (Concepts only)-its limitations - de Broglie theory-Heisenberg's uncertainty principle - Schrodinger's wave equation (derivation not needed)-significance of Ψ and Ψ^2 – shapes of different orbital's –Aufbau principle-Pauli Exclusion Principle- Hund's rule. Electronic configuration of atoms- Mosley's law – Modern periodic table - periodic properties: atomic size- ionization energies- electron affinity- electro negativity.

Unit II: Chemical Bonding **(**15 Lectures)

Types of bonds – ionic - covalent – coordinate bond - Molecular Orbital Theory –types of molecular orbitals- energy level diagrams- e^-ns filling in MO – bond order – MO diagrams of H_2, He_2, N_2, O_2, CO and HF molecules**–**Metallic bond – band theory of solids (primitive treatment only) and the role of doping on band structures - Hybridization – definition - geometry of the molecules- CH_4, C_2H_4, C_2H_2 - Molecular forces-Ionic, dipolar, van der waals interactions.

Unit III: Thermal and electrochemical equilibria (15 Lectures)

Thermodynamic functions: State functions, Path functions, Internal energy, enthalpy, entropy and free energy-Gibbs Helmholtz equation and its applications. Feasibility of reaction - Ellingham diagrams.

Types of electrodes- Standard electrodes-Standard hydrogen electrode, standard calomel electrode, Single electrode potential , electrochemical series - galvanic cell - emf - Nernst equation and its applications - Glass electrode, Potentiometric acid base titrations and Solubility equilibria-Corrosion-types-Chemical corrosion-electrochemical corrosion-factors influencing and control measures.

Unit IV: Spectroscopic techniques and applications (15 Lectures)

Electromagnetic radiations – wavelength – frequency – energy of a radiation – electromagnetic spectrum – changes brought about by the radiations– components of a spectrometer – rotational spectra of

diatomic molecules – rigid and non-rigid rotor models (energy expressions only)- selection rule– schematic instrumentation – types of vibrations in molecules (CO_2, H_2O) – vibrational spectra (primitive treatment) – selection rule- instrumentation and applications – electronic transitions – electronic spectra — Beer-Lambert's law- instrumentation and applications – NMR – principle – chemical shift - instrumentation – NMR spectra of CH_4 – CH_3OH – xylene isomers – MRI (Introduction only)

Unit V: Stereochemistry & Organic Reactions (15 Lectures)

Stereochemistry - Representation of 3D structures - Fisher projection, Newman and Sawhorse projection formulae – Ethane, 3-bromo-2-butanol Conformation of Ethane, Butane & Ethylene glycol, , Symmetry and Chirality - Stereo isomers, Enantiomers, Diastereomers. Configuration - R-S system. Optical activity - Lactic acid, Tartaric acid- Geometrical isomerism – *cis-trans* & E-Z notations.

Organic Reactions – Substitution - S_N^1 & S_N^2 (simple examples, mechanism not expected) – electrophilic substitutions – Friedel Crafts alkylations - Additions – 1,2-addition **–** types- addition of HX - Elimination – E^1 & E^2 (Examples only, mechanism not expected) - Oxidations – *cis*-hydroxylation with OsO_4, Reductions – Clemmensen & wolff-Kishner reductions, Cyclization – Diels Alder, Ring-Opening – Nylon-6 from caprolactum.

Synthesis of most commonly used drugs – Aspirin, Paracetamol.

Text Books

1. Textbook of Inorganic Chemistry, P.L.Soni, Sultan Chand & Sons, Delhi, 2013. (For units I and II)
2. Principles of Physical Chemistry, B.R. Puri, L.R. Sharma and Madan S. Pathania, Shoban Lal Nagin Chand & Co., Jalandhar, 2000. (For units III and IV)
3. Advanced Organic Chemistry, B. S. Bahl and Arun Bahl, S.Chand, Delhi, 2012. (For unitV).

Reference Books

1. Engineering Chemistry, P.C. Jain and Monika Jain, Dhanpat Rai Publishing Co Pvt. Ltd., New Delhi, 2008.
2. Applied Chemistry, K. Sivakumar, Anuradha Publications, Chennai, 2009.
3. Textbook of Engineering Chemistry, S.S.Dara & S.S. Umare, S.Chand, Delhi, 2004.
4. Fundamentals of Molecular Spectroscopy, C.N.Banwell and Elaine.M.McCash, 4th Edition, McGraw Hill Education, 2017.
5. Physical Chemistry, P. W. Atkins and Julio De Paula, 10th Edition, Oxford University Press,2014.

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Semester	Part	Sub. Code	Title of the Paper	L	P	T	Credits
I / II		CBSCH18P60	Chemistry Lab	0	3	0	1.5

Aim: *To make the students familiar with the way of systematic experimenting in the laboratory*

Objective:

- *To learn the basics and perform experiments involving volumetric analysis, colligative properties, simple synthesis and other instrumental techniques.*

.***Outcome:***

After the course the students will be able to

- Estimate rate constants of reactions from concentration of reactants/products as a function of time .
- Measure molecular/system properties such as surface tension, viscosity, Conductance of solutions, redox potentials, chloride content of water.
- Synthesize a small drug molecule
- Analyze a salt sample

Any ten experiments of the following

1. Determination of surface tension and viscosity of a liquid or a solution
2. Thin layer chromatography / Paper chromatography for separation of a mixture.
3. Ion exchange column for removal of hardness of water
4. Determination of chloride content of water by volumetry.
5. Determination of M.wt of a non-volatile solute by Rast's method.
6. Determination of the rate constant of the reaction between $K_2S_2O_8$ and KI – Clock reaction method.
7. Conductometry -Verification of Debye-Huckel-Onsager equation for a strong electrolyte.
8. Potentiometry - Determination of formal redox potential of Fe^{3+}/Fe^{2+} couple
9. Synthesis of Nylon 66 by interfacial polymerization method.
10. Determination of Saponification/acid value of oil.
11. Systematic qualitative analysis of a salt
12. Lattice structures and packing of spheres
13. Models of potential energy surfaces – computational experiment.
14. Chemical oscillations- Potentiometric study of the oscillations of Belousov-Zhabotinsky reaction
15. Determination of the partition coefficient of I_2 between water and CCl_4
16. Verification of Freundlich isotherm for adsorption of acetic acid / oxalic acid by charcoal.
17. Determination of isoelectric point of Gelatin sols by using capillary viscosmeter.

Text Books

1. Advanced Practical Physical Chemistry, J.B.Yadhav, Krishna Prakasan Media, 2016.
2. Experiments in Applied Chemistry, Sunita Rattan, S.K. Kataria& Sons, 2012.

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