

Department of Chemistry

B.Sc III- Year Semester VI Syllabus & Pattern of Chemistry

(Effective from session 2013-14)

B.Sc-III-Sem-VI

Total Lectures: 84 Marks: 80

Note: Figures to the right hand side indicate number of lectures.

Unit I

14L

A] Kinetic Aspects of Metal Complexes :

Thermodynamic and kinetic stability of the complexes, factors affecting stability of complexes. Brief idea about substitution reactions, SN1-dissociative and SN2-associative mechanism. Labile and inert complexes. Factors affecting lability of complexes namely arrangement of d-electrons (on the basis of VB theory), size of central metal ion, charge of central metal ion, geometry of complexes. Substitution reactions in square planar complexes mechanism.

B] Analytical Chemistry :

1) Spectrophotometry and Colorimetry :- Concept of ϵ_{max} , Beer-Lambert's law (Only statement and final equation, no derivation). Calibration curve and its importance. Validity and limitations of Beer-Lambert's law. Verification of Beer's law. Block diagram of colorimeter and spectrophotometer with brief description of each component and its function. Difference between colorimetric and spectrophotometric technique for determination of concentration of metal ion (Example of determination of Cu(II)).

2) Paper Chromatography :- Definition and classification of chromatographic techniques. Principle of differential migration. Principle and technique of paper chromatography -ascending, descending and circular, R_f value and factors affecting R_f value.

Unit II

14L

A] Organometallic Chemistry : Definition, nomenclature and classification of organometallic compounds. Metal carbonyls- definition and classification. Preparation, properties, structure and bonding in $\text{Ni}(\text{CO})_4$, $\text{Fe}(\text{CO})_5$, $\text{Cr}(\text{CO})_6$. Nature of M-C bond in metal carbonyls.

B] Inorganic Polymers: Definition and classification. Silicones: preparation, properties structure and bonding and applications. Phosphonitrile halides polymers- preparation, properties, structure and bonding in cyclic polymers.

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C] Bio-inorganic Chemistry: Essential and trace elements in biological processes. Biological role of Na^+ , K^+ , Ca^{2+} and Mg^{2+} ions. Metalloporphyrins-Haemoglobin and Myoglobin and their role in oxygen transport.

Unit III

14L

A] Electronic spectroscopy: Introduction, theory, instrumentation, types of electronic transitions, presentation of electronic spectrum, terms used- chromophore, auxochrome, bathochromic shift, hypsochromic shift, hyperchromic effect and hypochromic effect, Applications in the structure determination of dienes, α,β -unsaturated aldehydes and ketones, aromatic compounds.

B] Infrared spectroscopy: Introduction, Types of molecular vibrations- stretching and bending, Calculation of vibrational modes, force constant, instrumentation, interpretation of IR, H-stretching, triple bond, double bond and Finger print regions, IR spectra of H_2O , CO_2 , $\text{C}_2\text{H}_5\text{OH}$, CH_3CHO , CH_3COOH and CH_3CONH_2 .

Unit IV

14L

A] NMR spectroscopy: Introduction, spin quantum number, instrumentation, Aspects of NMR- number of signals (equivalent and non-equivalent protons), positions of signals (chemical shift), intensities of signals, splitting of signals (spin-spin coupling), coupling constant, applications.

B] Mass spectroscopy: Introduction, theory, instrumentation- (ion sources), Mass spectra of neopentane and methanol, molecular ion peak, base peak, metastable peak, Rules of fragmentation, applications.

Unit V-

14L

Elementary Quantum Mechanics

(i) Limitations of classical mechanics. Plank's quantum theory (postulates only). Photoelectric effect - Experiments, observation and Einstein's explanation. Compton effect and its explanation. (ii) de Broglie hypothesis of matter waves. de Broglie's equation. Heisenberg's uncertainty principle. (iii) Classical wave equation, derivation of time independent Schrodinger's wave equation in one-dimension and its extension to a three-dimensional space. Well behaved wave function, physical significance of wave function (Born interpretation). (iv) Application of Schrodinger wave equation to a particle in one dimensional box and its extension to a three-dimensional box. Concept of atomic orbital. (v) Numericals.

Unit VI

14L

A] Electrochemistry: (i) Types of electrode - Standard hydrogen electrode, Calomel electrode, Quinhydrone electrode and Glass electrode. Principle of Potentiometric titration. Study of acid-base, redox and precipitation titration. (ii) pH of a solution and pH scale. Determination of pH of a solution using hydrogen, quinhydrone and glass electrodes. Advantage and disadvantage of these electrodes. pH-metric titrations. Determination of pK_a of a weak acid by pH-metric

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measurement. (iii) Concentration cells - Types of concentration cells, concentration cell without transfer and determination of its emf. (iv) Numericals.

B] Nuclear Chemistry: (i) Shell model of a nucleus - Assumptions, evidences for existence of magic numbers, advantages and limitations. (ii) Liquid drop model of a nucleus - Assumptions, similarities between nucleus and liquid drop, advantages and limitations, explanation of nuclear fission reaction on the basis of liquid drop model. (iii) Nuclear force and its explanation on the basis of Meson theory. (iv) Characteristics of nuclear reaction, difference between nuclear and chemical reactions. Calculation of Q value of a nuclear reaction. (v) Characteristics of nuclear fission reaction, fission yield. Fission reaction as an alternative source of energy. (vi) Nuclear fusion reaction - Characteristic of a nuclear fusion reaction. Thermonuclear reactions as a source of energy of sun and other stars. Fusion reactions as a potential future source of energy. (vii) Applications of radio isotopes in industry, agriculture, medicines and bio-sciences with two examples each. (viii) Numericals.

Semester- VI 6S Chemistry Practicals

Total Laboratory sessions: 26 Marks: 50

Exercise I: Organic Chemistry Experiments: 16 Laboratory sessions

1. Estimation of formaldehyde.
2. Estimation of glycine.
3. Estimation of ascorbic acid (vitamine C).
4. Estimation of phenol by bromination method.
5. Estimation of aniline by bromination method.
6. Estimation of urea by hypobromite method.
7. Estimation of unsaturation by bromination method.
8. Determination of iodine value of oil.
9. Determination of equivalent weight of an ester by saponification.
10. Separation of a mixture of methyl orange and methylene blue by thinlayer chromatography (using benzene).
- 21 22
11. Separation of a mixture of 2,4-dinitro phenyls of acetaldehyde and benzaldehyde by thin layer chromatography (using benzene : petroleum ether = 3:1).
12. Separation of a mixture of dyes by thin layer chromatography (using cyclohexane:ethyl acetate = 8.5:1.5).
13. Separation of a mixture of 2,4-dinitro phenyls of acetaldehyde and benzaldehyde by thin layer chromatography (using toluene: petroleum ether).

Exercise II: Physical Chemistry experiments 10 Laboratory sessions

1. To determine dissociation constant of weak acid by conductometry.
2. To determine dissociation constant of weak acid by potentiometry.
3. To study potentiometric titration of KCl and AgNO₃.
4. To determine dissociation constant of dibasic acid by pH-metry.

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5. To verify Beer's Lambert's law using $\text{KMnO}_4/\text{K}_2\text{Cr}_2\text{O}_7$.
6. To determine pH of a soil sample by pH-meter.
7. To determine solubility and solubility product of sparingly soluble salts conductometrically.
8. To study strong acid and strong base titration by pH-metry.

Distribution of Marks for Practical Examination

Time: 6 hours (One Day Examination) Marks: 50

Exercise-I 18

Exercise-II 18

Viva-Voce 07

Record 07

Total: 50

Books Recommended: (Common for Semester V and Semester VI)

1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia- S. Naginchand & Co., Delhi.
2. Text book of Inorganic Chemistry by A.K. De, Wiley East Ltd.
3. Selected Topics in Inorganic Chemistry by Malik, Tuli and Madan- S. Chand & Co.
4. Modern Inorganic Chemistry by R.C. Agrawal, Kitab Mahal.
5. Instrumental Methods of analysis by Chatwal and Anand, Himalaya Publishing House.
6. Concise Inorganic Chemistry by J.D. Lee, ELBS.
7. Inorganic Chemistry by J.E. Huheey- Harper & Row.
8. Fundamental concepts of Inorganic Chemistry by E.S. Gilreath, McGraw Hill book Co.
9. Modern Inorganic Chemistry by W.L. Jolly, McGraw Hill Int.
10. Chemistry Facts, Patterns & Principles by Kneen, Rogers and Simpson, ELBS.
- Theoretical Principles of Inorganic Chemistry by G.S. Manku, Tata McGraw Hill.
12. Inorganic complex compounds by Murmann, Chapman & Hall.
13. Text book of Inorganic Chemistry by K.N. Upadhyaya, Vikas Publishing House, Delhi.
14. Advanced Practical Inorganic Chemistry by Gurdeep Raj, Goel Publishing House, Meerut.
15. Co-ordination Chemistry by D. Banerjee, TMH Publication.
16. Text book of Inorganic Chemistry by B.J. Joshi, P.J. Bahad, P.R. Mandlik, R.M. Kedar, C.B. Deshpande, V.V. Parhate published by Amravati University Chemistry Teachers Association with Bokey Prakashan, Amravati.
17. Text book of Inorganic Chemistry by Bhadange, Pagariya, Deshmukh, Joshi, Bombatkar, Mandlik, Bokey Prakashan, Amravati.

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18. Organic Chemistry by R.T. Morrison & R.T. Boyd, 6th edition, PHI.
19. Organic Chemistry by Pine, 5th edition.
20. Organic Chemistry Vol. I, II and III by Mukharjee, Singh and Kapoor- Wiley Eastern.
21. Organic Chemistry by S.K. Ghosh.
22. Reaction Mechanism in Organic Chemistry by S.M. Mukharjee and S.P. Singh.
23. Spectroscopy of Organic Compounds by P.S. Kalsi.
24. Stereochemistry and mechanism through solved problems by P.S. Kalsi.
25. Organic Chemistry by TWG Solomons, 4th edition, John Wiley.
26. Hand Book of Organic Analysis by H.J. Clarke, Arnold Heinmen.
27. Text book of Practical Organic Chemistry by A. I. Vogel.
28. Text book of Organic Chemistry by P.R. Rajput, S.N. Bhosale, Y.K. Meshram, V.G. Thakre, Dr. S.P. Deshmukh, A.R. Mankar, published by Amravati University Chemistry Teachers Association with Bokey Prakashan, Amravati.
29. Text book of Organic Chemistry by P.S. Kalsi published by Macmillan India Ltd., 1999, Delhi.
30. Practical Organic Chemistry by F.G. Mann, B.C. Saunders, Orient Longman.
31. Comparative Practical Organic Chemistry (Qualitative Analysis) by V.K. Ahluwalia and Sunita Dhingra, Orient Longman.
32. Comprehensive Practical Organic Chemistry (Preparation and Qualitative Analysis) by V.K. Ahluwalia and Renu Agrawal, Orient Longman.
33. Physical Chemistry: Walter, J. Moore, 5th edn., New Delhi.
34. Physical Chemistry: G.M. Barrow, McGraw Hill, Indian Edn.
35. Principles of Physical Chemistry: Maron and Prutton.
36. Principles of Physical Chemistry: Puri, Sharma and Pathaniya.
37. Physical Chemistry: P.W. Atkins, 4th Edn.
38. Text book of Physical Chemistry: P.L. Sony, O.P. Dharma.
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39. Physical Chemistry: Levine.
40. Practical Physical Chemistry: Palit and De.
41. Practical Physical Chemistry: Yadao.
42. Practical Physical Chemistry: Khosla.
43. Laboratory Mannual of Physical Chemistry: W.J. Popiel.
44. Practical Chemistry: Dr. S.B. Lohiya, Bajaj publication, Amravati.
45. Text book of Physical Chemistry by S.B. Phadke, G.N. Chaudhari, S.S. Kabra, R.G. Bhangale, A.B. Patil, S.K. Rithe published by Amravati University Chemistry Teachers Association with Bokey Prakashan, Amravati.

List of equipments/apparatus required for the Chemistry Practicals for B.Sc.

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1. Abbe's Refractometer 02 nos./batch
2. Viscometer 10 nos./batch
3. Stalagmometer 10 nos./batch
4. Melting Point Apparatus 10 nos./batch
5. Thermometer 0-360oC 20 nos./batch
6. Thermometer 0-110oC 20 nos./batch
7. Analytical balance 15 nos./batch
8. Weight box 15 nos./batch
9. Density Bottles 20 nos./batch
10. Kipp's Apparatus 02 nos./batch
11. Quick fit Distillation Assembly/Multipurpose assembly 10 nos./batch
12. Sintered Glass Crucible 20 nos./batch
13. Silica Crucible 20 nos./batch
14. Vacuum Suction Pump 02 nos./lab.
15. Potentiometer 02 nos./batch
16. Metzer Electronic one pan balance 01 nos./lab.
17. Filtration flask with Buckner Funnes 100ml 10 nos./batch
250ml 05 nos./batch
500ml 02 nos./batch
18. Desiccators 10 nos./batch
19. Magnetic Stirrer 10 nos./batch
20. Water Suction 10 nos./batch
21. Conductometer with Conductivity Cell 04 nos./batch
22. Colorimeter 02 nos./batch
23. pH Meter 02 nos./batch
24. Chromatographic Jar 05 nos./batch
25. Separating funnels 250ml, 500ml 05 nos./batch
26. Hot Air Oven 02 nos./lab.
27. Hot-Cold Air Blower 01 no./lab.
28. Centrifuge machine (Electrically Operated) 02 nos./lab.
29. Deioniser/ Water Still (Electrically Operated) 01 no./lab.
30. Hot Plate/ Heating Mantle 05 nos./batch
31. Models of Elements
(Seven Crystal types and their symmetry) 01 no./batch
32. Flame Photometer 02 nos./batch
33. Spectrophotometer 02 nos./batch
34. Shaking Machine 01 no./batch
35. Polarimeter 02 nos./batch