Academic year 2023-24
Semester: III
Department of Chemistry
Basirhat College

Lesson Plan for Course: PHYSICAL CHEMISTRY-II Code: CEMACOR05T Credit: 4

- Course coordinator: **Dr. Bidyut Debnath**
- Course Outcome
- CO1: Transport properties of liquid like viscosity, conductance and transport number are discussed in detail. Application of conductance measurement, conductometric titrations is also discussed.
- CO2: Different thermodynamic properties like partial properties and chemical potential, thermodynamic conditions for equilibrium, nernst's distribution law, thermodynamic properties of ideal substances- pure and mixtures etc. are discussed.
- CO3: Some fundamentals of Quantum Mechanics like black body radiation, wave function, concepts of operators, particle in a box, simple harmonic oscillations are discussed.
- CO4: They will about numerical knowledge.
- CO5: Here different derivations have been discussed.

Course planner

Sl	Course Topic	Teacher	Class-hrs	Remarks
				Class starts from 21.09.2023
Sep	Transport processes: Fick's law: Flux, force, phenomenological coefficients & their inter-relationship (general form), different examples of transport properties. Transport processes: Viscosity:General features of fluid flow (streamline flow and turbulent flow); Newton's equation, viscosity coefficient; Poiseuille's equation; principle of determination of viscosity coefficient of liquids by falling sphere method; Temperature variation of viscosity of liquids and comparison with that of gases	BD	7 hrs	
	Transport processes: Conductance and transport number: Ion conductance; Conductance and measurement of conductance, cell constant, specific conductance, equivalent conductance and molar conductance; Variation of specific and equivalent conductance with dilution for strong and weak electrolytes; Kohlrausch's law of independent migration of ions; Equivalent and molar conductance at infinite dilution and their determination for strong and weak 16 electrolytes; Debye –Huckel theory of Ion atmosphere (qualitative)-asymmetric effect, relaxation effect and electrophoretic effect; Ostwald's dilution law; Ionic mobility; Application of conductance measurement (determination of solubility product and ionic product of water); Conductometric titrations	MS	5 hrs	
	Transport processes: Transport number, Principles of Hittorf's and Moving-boundary method; Wien effect, Debye-Falkenhagen effect, Walden's rule	SM	3 hrs	
	Applications of Thermodynamics – I:Partial properties and Chemical potential: Chemical potential and activity, partial molar quantities, relation	BD	7hrs	

Oct	between Chemical potential and Gibbs‟ free energy and other thermodynamic state functions; variation of Chemical potential (μ) with temperature and pressure; Gibbs-Duhem equation; fugacity and fugacity coefficient; Variation of thermodynamic functions for systems with variable composition; Equations of states for these systems, Change in G, S, H and V during mixing for binary solutions.			
	Applications of Thermodynamics – I: Chemical Equilibrium: Thermodynamic conditions for equilibrium, degree of advancement; van't Hoff's reaction isotherm (deduction from chemical potential); Variation of free energy with degree of advancement; Equilibrium constant and standard Gibbs' free energy change.	SM	4hrs	
	Applications of Thermodynamics – I: Definitions of KP, KC and KX; van't Hoff's reaction isobar and isochore from different standard states; Shifting of equilibrium due to change in external parameters e.g. temperature and pressure; variation of equilibrium constant with addition to inert gas; Le Chatelier's principle and its derivation.	MS	4 hrs	
Nov	Nernst's distribution law; Application- (finding out Keq using Nernst dist law for KI+I2 = KI3 and dimerization of benzene) Foundation of Quantum Mechanics: Beginning of Quantum Mechanics: Black-body radiation and Planck's theory of radiation; Light as particles: photoelectric and Compton effects; electrons as waves; Wave-particle duality: de Broglie hypothesis, Uncertainty relations (without proof)	BD	5hrs	
	Chemical potential and other properties of ideal substances- pure and mixtures: a) Pure ideal gas-its Chemical potential and other thermodynamic functions and their changes during a change of Thermodynamic parameters of mixing; Chemical potential of an ideal gas in an ideal gas mixture; Concept of standard states and choice of standard states of ideal gases. Foundation of Quantum Mechanics: Wave function: Schrödinger time-independent equation; nature of the equation, acceptability conditions imposed on the wave functions and probability interpretations of wave function; Orthogonal and normal functions; Schmidt's orthogonalization	MS	7hrs	
	b) Condensed Phase – Chemical potential of pure solid and pure liquids, Ideal solution – Definition, Raoult's law; Mixing properties of ideal solutions, chemical potential of a component in an ideal solution; Choice of standard states of solids and liquids. Foundation of Quantum Mechanics: Concept of Operators: Elementary concepts of operators, eigenfunctions and eigenvalues; Linear operators; Commutation of operators, commutator and uncertainty relation; Expectation value; Hermitian operator; Postulates of Quantum Mechanics; General structure of Schrodinger equation (S.E.) and time dependency; Stationary state	SM	6hrs	
Dec	Foundation of Quantum Mechanics: Particle in a box: Setting up of S.E. for one-dimensional well and its solution; Comparison with free particle eigenfunctions and eigenvalues. Properties of PB wave functions (normalisation, orthogonality, probability distribution);	BD	4hrs	

	Foundation of Quantum Mechanics: Expectation values of x, x2, px and px2 and their significance in relation to the uncertainty principle; Extension of the problem to two and three dimensions and the concept of degenerate energy levels; Accidental degeneracy	MS	4hrs	
Jan	Foundation of Quantum Mechanics: Simple Harmonic Oscillator: setting up of the Schrodinger stationary equation, energy expression (without derivation), expression of wave function for n = 0 and n = 1 (without derivation) and their characteristic features.	SM	4hrs	
Jan	Assessment: End-term Test		Total: 60Hrs	

Resources :

Books:

1. Atkins, P. W. & Paula, J. de *Atkins', Physical Chemistry*, Oxford University Press
2. Castellan, G. W. *Physical Chemistry*, Narosa
3. McQuarrie, D. A. & Simons, J. D. *Physical Chemistry: A Molecular Approach*, Viva Press
4. Levine, I. N. *Physical Chemistry*, Tata McGraw-Hill
5. Rakshit, P.C., *Physical Chemistry*, Sarat Book House
6. Moore, W. J. *Physical Chemistry*, Orient Longman
7. Mortimer, R. G. *Physical Chemistry*, Elsevier
8. Denbigh, K. *The Principles of Chemical Equilibrium* Cambridge University Press
9. Engel, T. & Reid, P. *Physical Chemistry*, Pearson
10. Levine, I. N. *Quantum Chemistry*, PHI
11. Atkins, P. W. *Molecular Quantum Mechanics*, Oxford
12. Zemansky, M. W. &Dittman, R.H. *Heat and Thermodynamics*, Tata-McGraw-Hill
13. Rastogi, R. P. &Misra, R.R. *An Introduction to Chemical Thermodynamics*, Vikas
14. Klotz, I.M., Rosenberg, R. M. *Chemical Thermodynamics:Basic Concepts and Methods* Wiley
15. Glasstone, S. *An Introduction to Electrochemistry*, East-West Press

1. Other resources :

*Remarks will specify

- The nature of the class-topic (viz. Theoretical, Practical, and Tutorial).
- Methodology of teaching (whether using ICT, engaging students in group discussion, quiz etc. etc.)
- Different modes of assessment. (Please check UGC evaluation reforms).

Semester: III
Department of Chemistry

Lesson Plan for Course: PHYSICAL CHEMISTRY-II LabCode: CEMACOR05P Credit: 2

- Course coordinator: Dr. Monojit sarkar
- Course Outcome
- CO1: Study of viscosity, partition coefficient, conductometric titration, verification of ostwald,s dilution law etc. are to be done.
- CO2: students will learn about various types of titrations.

Course planner

Sl	Course Topic	Teacher	Class-hrs	Remarks
Jul Aug				Class starts from 21.09.2023
Sep	Experiment 1: Study of viscosity of unknown liquid (glycerol, sugar) with respect to water	MS+SK	10hrs	
	Experiment 2: Determination of partition coefficient for the distribution of I2 between water and CCl4	MS+SK	5hrs	
Oct	Experiment 2: Determination of partition coefficient for the distribution of I2 between water and CCl4	BD+SM	5hrs	
	Experiment 3: Determination of Keq for KI + I2 = KI3, using partition coefficient between water and CCl4	BD+SM	10hrs	
Nov	Experiment 4: Conductometric titration of an acid (strong, weak/ monobasic, dibasic) against base strong	BD+MS	10hrs	
	Experiment 5: Study of saponification reaction conductometrically	SM+SK	10hrs	
Dec	Experiment 6: Verification of Ostwald‟s dilution law and determination of Ka of weak acid	BD+MS	10hrs	
Jan	Assessment: End-term Test		Total: 60Hrs	

Resources :

Books:

1. Viswanathan, B., Raghavan, P.S. *Practical Physical Chemistry* Viva Books (2009)
2. Mendham, J., A. I. Vogel‟s Quantitative Chemical Analysis 6th Ed., Pearson
3. Harris, D. C. *Quantitative Chemical Analysis*. 6th Ed., Freeman (2007)
4. Palit, S.R., De, S. K. *Practical Physical Chemistry* Science Book Agency
5. *University Hand Book of Undergraduate Chemistry Experiments*, edited by Mukherjee, G. N., University of Calcutta
6. Levitt, B. P. edited *Findlay's Practical Physical Chemistry* Longman Group Ltd.
7. Gurtu, J. N., Kapoor, R., *Advanced Experimental Chemistry* S. Chand & Co. Ltd.

2. Other resources :

*Remarks will specify

- The nature of the class-topic (viz. Theoretical, Practical, and Tutorial).
- Methodology of teaching (whether using ICT, engaging students in group discussion, quiz etc. etc.) Different modes of assessment. (Please check UGC evaluation reforms).

Semester: III
Department of Chemistry
Basirhat College

Lesson Plan for Course: Inorganic chemistry-II. Code: CEMACOR06T Credit: 4

- Course coordinator: dr. Suman Mandal
- Course Outcome
- CO1: General characteristics of ions and ionic bonds and covalent bonds are discussed in general.
- CO2: Lattice energy Concept is revealed.
- CO3: In the second part molecular orbital concepts of bonding, qualitative idea of valence bond and band theories, different weak chemical forces in molecules are discussed.
- CO4: H-bonding concept is discussed.
- CO5: Theories of radioactivity and uses of radioactive elements are discussed.

Course planner

Sl	Course Topic	Teacher	Class-hrs	Remarks
Jul Aug				Class starts from 21.09.2023
Sep	Chemical Bonding-I: *Ionic bond:* General characteristics, types of ions, size effects, radius ratio rule and its application and limitations. Packing of ions in crystals. Born-Landé equation with derivation and importance of Kapustinskii expression for lattice energy.	BD	6hrs	
	Chemical Bonding-I: Madelung constant, Born-Haber cycle and its application, Solvation energy. Defects in solids (elememtary idea). Solubility energetics of dissolution process	MS	6hrs	
	Chemical Bonding-I: *Covalent bond:* Polarizing power and polarizability, ionic potential,Fazan's rules.	SM	3 hrs	
Oct	Chemical Bonding-I: Lewis structures, formal charge. Valence Bond Theory. The hydrogen molecule (Heitler-London approach), directional character of covalent bonds, hybridizations, equivalent and non-equivalent hybrid orbitals, Bent's rule, Dipole moments.	SM	5hrs	
	Chemical Bonding-I: VSEPR theory, shapes of 19 molecules and ions containing lone pairs and bond pairs (examples from main groups chemistry) and multiple bonding (ζ and π bond approach).	BD	4hrs	
	Chemical Bonding-II: Molecular orbital concept of bonding (The approximations of the theory, Linear combination of atomic orbitals (LCAO)) (elementary pictorial approach): sigma and pibonds and delta interaction, multiple bonding. Orbital designations: *gerade, ungerade,* HOMO, LUMO. Orbital mixing.	MS	6hrs	
Nov	Chemical Bonding-II: MO diagrams of H_2, Li_2, Be_2, B_2, C_2, N_2, O_2, F_2, and their ions wherever possible; Heteronuclear molecular orbitals: CO, NO, NO^+, CN^-, HF, BeH_2, CO_2 and H_2O. Bond properties: bond orders, bond lengths.	BD	4hrs	
	Chemical Bonding-II: *Metallic Bond:* Qualitative idea of valence bond and band theories. Semiconductors and insulators, defects in solids.	MS	4hrs	

	Chemical Bonding-II: *Weak Chemical Forces:* van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces, Intermolecular forces: Hydrogen bonding (theories of hydrogen bonding, valence bond treatment), receptor-guest interactions, Halogen bonds. Effects of chemical force, melting and boiling points.	SM	10hrs	
Dec	Radioactivity: Nuclear stability and nuclear binding energy. Nuclear forces: meson exchange theory. Nuclear models (elementary idea):. Nuclear energy and power generation.	BD	4hrs	
	Radioactivity: Concept of nuclear quantum number, magic numbers. Nuclear Reactions: Artificial radioactivity, transmutation of elements, fission, fusion and spallation.	MS	4hrs	
	Radioactivity: . Separation and uses of isotopes. Radio chemical methods: principles of determination of age of rocks and minerals, radio carbon dating, hazards of radiation and safety measures.	SM	4hrs	
Jan	Assessment: End-term Test		Total: 60Hrs	

Resources :

Books:

1. Lee, J. D. *Concise Inorganic Chemistry, 5thEd.,*Wiley India Pvt. Ltd., 2008.
2. Huheey, J. E.; Keiter, E.A. &Keiter, R.L. *Inorganic Chemistry, Principles ofStructure and Reactivity 4th Ed.,* Harper Collins 1993, Pearson, 2006.
3. Douglas, B.E. and McDaniel, D.H. *Concepts & Models of Inorganic Chemistry* Oxford, 1970.
4. Porterfield, H. W., *Inorganic Chemistry,* Second Edition, Academic Press, 2005.
5. Purecell, K.F. and Kotz, J.C., *An Introduction toInorganic Chemistry*, Saunders: Philadelphia, 1980.
6. Cotton, F.A., Wilkinson, G., &Gaus, P.L. *Basic Inorganic Chemistry 3rdEd.;*Wiley India.
7. Gillespie, R. J. and Hargittai, I., The VSEPR Model of Molecular Geometry, Prentice Hall (1992).
8. Albright, T., *Orbital interactions in chemistry,* John Wiley and Sons (2005).
9. Mingos, D.M.P., *Essential trends in inorganic chemistry*. Oxford University Press (1998).
10. Miessler, G. L., Fischer, P. J., Tarr, D. A., *Inorganic Chemistry,* Pearson, 5th Edition.
11. Kaplan, I., *Nuclear Physics,* Addison-Wesley Publishing Company Inc. London, 1964.
12. Friedlander, G., Kennedy, J. W., Macias, E. S. And Miller, J. M., *Nuclear and Radiochemistry*, Wiley, 1981.

3. Other resources :

*Remarks will specify

- The nature of the class-topic (viz. Theoretical, Practical, and Tutorial).
- Methodology of teaching (whether using ICT, engaging students in group discussion, quiz etc. etc.)
- Different modes of assessment. (Please check UGC evaluation reforms).

Semester: III
Department of Chemistry
Basirhat College

Lesson Plan for Course: INORGANIC CHEMISTRY-II LAB. Code: CEMACOR06P Credit: 2

- Course coordinator: **Dr. Suman Mandal**
- Course Outcome
- CO1: Iodometric titrations for estimations of metal ions, vitamin C and available chlorine in bleaching powder are to be done. Estimation of metals in brass, steel and cement are also to be done.

- CO2: Students will the fundamental ideas about metal estimations.

Course planner

Sl	Course Topic	Teacher	Class-hrs	Remarks
Jul Aug				Class starts from 21.09.2023
Sep	Iodimetric Titrations: Estimation of Cu(II)	MS+SK	8hrs	
	Iodimetric Titrations: Estimation of Vitamin C	MS+SK	8hrs	
Oct	Iodimetric Titrations: Estimation of (i) arsenite and (ii) antimony in tartar-emetic iodimetrically	BD+SM	10hrs	
	Iodimetric Titrations: Estimation of available chlorine in bleaching powder	BD+SM	8hrs	
Nov	Estimation of metal content: Estimation of Cu in brass.	BD+MS	8hrs	
	Estimation of metal content:Estimation of Cr and Mn in Steel.	SM+SK	8hrs	
Dec	Estimation of metal content:Estimation of Fe in cement.	BD+MS	10hrs	
Jan	Assessment: End-term Test		Total: 60Hrs	

Resources :

Books:

1.Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis* 6th Ed., Pearson, 2009.

4. Other resources :

*Remarks will specify

- The nature of the class-topic (viz. Theoretical, Practical, and Tutorial).
- Methodology of teaching (whether using ICT, engaging students in group discussion, quiz etc. etc.)
- Different modes of assessment. (Please check UGC evaluation reforms).

Semester: III
Department of Chemistry
Basirhat College

Lesson Plan for Course: ORGANIC CHEMISTRY-IIICode: CEMACOR07T Credit: 4

- Course coordinator: **Dr. Swastik Karmakar**
- Course Outcome
- CO1: Students will learn about addition reaction to alkenes and alkynes.

- CO2: Electrophilic aromatic substitution and nucleophilic aromatic substitution will be discussed elaborately.
-
- CO3: They will know clearly about various reactions of carbonyl compounds and will get elementary ideas of green chemistry including various green syntheses. Some specific mechanisms *B*AC2, *A*AC2, *A*AC1, *A*AL1 will be discussed with evidence in connection to hydrolysis of esters.
- CO4: Elaborative discussion will be made onorganometallic reagents which includesGrignard reagent, Organolithiums, Gilman cuprates etc.
- CO5: They will learn briefly about Grignard reagent.

Course planner

Sl	Course Topic	Teacher	Class-hrs	Remarks
Jul Aug				Class starts from 21.09.2023
Sep	**Chemistry of alkenes and alkynes :***Addition to C=C:* mechanism (with evidence wherever applicable), reactivity, regioselectivity (Markownikoff and anti-Markownikoff additions) and stereoselectivity.	SK	3hrs	
	Chemistry of alkenes and alkynes :reactions: hydrogenation, halogenations, iodolactonisation, hydrohalogenation, hydration, oxymercuration-demercuration, hydroboration-oxidation, epoxidation, *syn*and *anti*-hydroxylation, ozonolysis.	BD	3 hrs	
	Chemistry of alkenes and alkynes : Addition of singlet and triplet carbenes; electrophilic addition to diene (conjugated dienes and allene); radical addition: HBr addition; mechanism of allylic and benzylicbromination in competition with brominations across C=C; use of NBS; Birch reduction of benzenoid aromatics; interconversion of *E* - and *Z* - alkenes; contra-thermodynamic isomerization of internal alkenes.	MS	3 hrs	
	Chemistry of alkenes and alkynes : *Addition to C≡C (in comparison to C=C):* mechanism, reactivity, regioselectivity (Markownikoff and anti-Markownikoff addition) and stereoselectivity;	PD	3hrs	
	Chemistry of alkenes and alkynes : Reactions: hydrogenation, halogenations, hydrohalogenation, hydration, oxymercurationdemercuration, hydroboration-oxidation, dissolving metal reduction of alkynes (Birch); reactions of terminal alkynes by exploring its acidity; interconversion of terminal and non-terminal alkynes.	SM	3 hrs	
Oct	**Aromatic Substitution:***Electrophilic aromatic substitution:*mechanisms and evidences in favour of it; orientation and reactivity;	MS	3hrs	

	Aromatic Substitution:reactions: nitration, nitrosation, sulfonation, halogenation, Friedel-Crafts reaction; one-carbon electrophiles (reactions: chloromethylation, Gatterman-Koch, Gatterman, Houben-Hoesch, Vilsmeier-Haack, Reimer-Tiemann, Kolbe-Schmidt); *Ipso* substitituion.	SK	4hrs	
	Aromatic Substitution:*Nucleophilic aromatic substitution:* addition-elimination mechanism and evidences in favour of it; S_N1 mechanism; cine substitution (benzyne mechanism), structure of benzyne.	MS	3hrs	
	Carbonyl and Related Compounds:*Addition to C=O:* structure, reactivity and preparation of carbonyl compounds; mechanism (with evidence), reactivity, equilibrium and kinetic control; Burgi-Dunitz trajectory in nucleophilic additions;	SM	3 hrs	
	Carbonyl and Related Compounds: Formation of hydrates, cyanohydrins and bisulphite adduct; nucleophilic addition-elimination reactions with alcohols, thiols and nitrogen- based nucleophiles; reactions: benzoin condensation, Cannizzaro and Tischenko reactions, reactions with ylides: Wittig and Corey-Chaykovsky reaction; Rupe rearrangement, oxidations and reductions: Clemmensen, Wolff-Kishner, $LiAlH_4$, $NaBH_4$, MPV, Oppenauer, Bouveault-Blanc, acyloin condensation; oxidation of alcohols with PDC and PCC; periodic acid and lead tetraacetate oxidation of 1,2-diols.	PD	3 hrs	
Oct	**Carbonyl and Related Compounds:** *Exploitation of acidity of α-H of C=O:* formation of enols and enolates; kinetic and thermodynamic enolates.	SK	3hrs	
Nov	**Carbonyl and Related Compounds:** Reactions (mechanism with evidence): halogenation of carbonyl compounds under acidic and basic conditions, Hell-Volhard-Zelinsky (H. V. Z.) reaction, nitrosation, SeO_2 (Riley) oxidation; condensations (mechanism with evidence).	SK	4hrs	
	Carbonyl and Related Compounds: Aldol, Tollens', Knoevenagel, Claisen-Schmidt, Claisen ester including Dieckmann, Stobbe; Mannich reaction, Perkin reaction, Favorskii rearrangement; alkylation of active methylene compounds.	MS	3hrs	
	Carbonyl and Related Compounds: Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate; specific enol equivalents (lithium enolates, enamines, aza-enolates and silylenol ethers) in connection with alkylation, acylation and aldol type reaction.	BD	3 hrs	
	Elementary ideas of Green Chemistry: Twelve (12) principles of green chemistry; planning of green synthesis; common organic reactions and their counterparts: reactions: 22 Aldol, Friedel-Crafts, Michael, Knoevenagel, Cannizzaro, benzoin condensation and Dieckmann condensation.	SM	3hrs	
	Nucleophilic addition to α,β-unsaturated carbonyl system: general principle and mechanism (with evidence); direct and conjugate addition, addition of enolates (Michael reaction), Stetter reaction, Robinson annulation.	PD	4hrs	

Dec	*Substitution at sp2 carbon (C=O system):* mechanism (with evidence): *B*AC2, *A*AC2, *A*AC1, *A*AL1 (in connection to acid and ester); acid derivatives: amides, anhydrides & acyl halides (formation and hydrolysis including comparison).	BD	4hrs	
	Organometallics: *Grignard reagent; Organolithiums; Gilman cuprates:* preparation and reactions (mechanism with evidence); addition of Grignard and organolithium to carbonyl compounds; substitution on -COX; directed orthometalation of arenes using organolithiums, conjugate addition by Gilman cuprates; Corey-House synthesis; abnormal behavior of Grignard reagents; comparison of reactivity among Grignard,	SK	3hrs	
Jan	**Organometallics:** Organolithiums and organocopper reagents; Reformatsky reaction; Blaise reaction; concept of *umpolung*and base-nucleophile dichotomy in case of organometallic reagents.	SM	2hrs	
Jan	Assessment: End-term Test		Total: 60 Hrs	

Resources :

Books:

1. Clayden, J., Greeves, N., Warren, S. *Organic Chemistry*, Second edition, Oxford University Press 2012.
2. Sykes, P., *A guidebook to Mechanism in Organic Chemistry*, Pearson Education, 2003.
3. Smith, J. G. *Organic Chemistry*, Tata McGraw-Hill Publishing Company Limited.
4. Carey, F. A., Guiliano, R. M. *Organic Chemistry*, Eighth edition, McGraw Hill Education, 2012.
5. Loudon, G. M. *Organic Chemistry*, Fourth edition, Oxford University Press, 2008.
6. Norman, R.O. C., Coxon, J. M. *Principles of Organic Synthesis*, Third Edition, Nelson Thornes, 2003.
7. Morrison, R. N. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
8. Finar, I. L. *Organic Chemistry (Volume 1),* Pearson Education.
9. Graham Solomons, T.W., Fryhle, C. B. *Organic Chemistry*, John Wiley & Sons, Inc.
10. March, J. *Advanced Organic Chemistry*, Fourth edition, Wiley.
11. Jenkins, P. R., *Organometallic Reagents in Synthesis*, Oxford Chemistry Primer, Oxford University Press.
12. Ward, R. S., *Bifunctional Compounds*, Oxford Chemistry Primer, Oxford University Press.
13. Ahluwalia, V. K. *Strategies for Green Organic Synthesis*, ANE Books Pvt. Ltd.

5. Other resources :

*Remarks will specify

- The nature of the class-topic (viz. Theoretical, Practical, and Tutorial).
- Methodology of teaching (whether using ICT, engaging students in group discussion, quiz etc. etc.)
- Different modes of assessment. (Please check UGC evaluation reforms).

Semester: III

Department of Chemistry

Basirhat College

Lesson Plan for Course: ORGANIC CHEMISTRY-III LAB. Code: CEMACOR07P Credit: 2

- Course coordinator: **Mr. Prasanta Das**

- Course Outcome
- CO1: Qualitative Analysis of Single Solid Organic Compounds like elemental detection, solubility and classification, functional group, melting points and derivative preparations are to be done.
- CO2: Students will learn about organic sample separation.

Course planner

Sl	Course Topic	Teacher	Class -hrs	Remarks
Jul Aug				Class starts from 21.09.2023
Sep	Detection of special elements (N, S, Cl, Br) by Lassaigne's test. Detection of the following functional groups: aromatic amino (-NH_2), aromatic nitro (-NO_2)	BD+SM	8hrs	
	Solubility and classification (solvents: H_2O, 5% HCl, 5% NaOH and 5% $NaHCO_3$) Detection of the following functional groups: amido (-$CONH_2$, including imide), phenolic –OH	MS+SK	8hrs	
Oct	Detection of the following functional groups: carboxylic acid (-COOH), carbonyl (-CHO and >C=O) Melting point of the given compound .	BD+SM	6hrs	
	Preparation, purification and melting point determination of a crystalline derivative of the given compound . Identification of the compound through literature survey.	MS+SK	10hrs	
Nov	Identification of **known (at leastsix)**organic compounds. through qualitative chemical tests for all the special elements and the functional groups with relevant derivatisation	BD+MS	10hrs	
	Identification of unknown (**at leastsix)**organic compounds. through qualitative chemical tests for all the special elements and the functional groups with relevant derivatisation	SM+SK	6hrs	
Dec	Identification of unknown (**at leastsix)**organic compounds. through qualitative chemical tests for all the special elements and the functional groups with relevant derivatisation	BD+MS	12hrs	
Jan	Assessment: End-term Test		Total: 60Hrs	

Resources :

Books:

1. Vogel, A. I. *Elementary Practical Organic Chemistry,* Part 2: *Qualitative Organic Analysis,* CBS Publishers and Distributors.
2. *University Hand Book of Undergraduate Chemistry Experiments*, edited by Mukherjee, G. N. University of Calcutta, 2003.
3. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry,* Pearson Education (2009).
4. Furniss, B.S., Hannaford, A.J., Smith, P.W.G., Tatchell, A.R. *Practical Organic Chemistry,* 5th Ed.,Pearson (2012).
5. Clarke, H. T., *A Handbook of Organic Analysis (Qualitative and Quantitative)*, Fourth Edition, CBS Publishers and Distributors (2007).
6. *Practical Workbook Chemistry (Honours), UGBS, Chemistry*, University of Calcutta, 2015.

6. Other resources :

*Remarks will specify

- The nature of the class-topic (viz. Theoretical, Practical, and Tutorial).
- Methodology of teaching (whether using ICT, engaging students in group discussion, quiz etc. etc.)
- Different modes of assessment. (Please check UGC evaluation reforms).

Semester: V
Department of Chemistry
Basirhat College

Lesson Plan for Course: INORGANIC CHEMISTRY-IV Code: CEMACOR11T Credit: 4

- Course coordinator: **Dr. Suman Mandal**
- Course Outcome
- CO1: Crystal Field Theory of coordination compounds and its related aspects like magnetic moments, d-d transition, orgel diagram etc, are discussed in detail.
- CO2: CFSE can be calculated.
- CO3: Students can differentiate between CFT and VBT concepts.
- CO4: General comparison of 3d, 4d and 5d elements in term of electronic configuration, oxidation states, redox properties are elucidated.
- CO5: General properties of Lanthanoids and Actinoids are discussed.

Course planner

Sl	Course Topic	Teacher	Class-hrs	Remarks
Aug + Sep	VB description and its limitations. Elementary Crystal Field Theory: splitting of dn configurations in octahedral, square planar and tetrahedral fields, crystal field stabilization energy (CFSE) in weak and strong fields; pairing energy. Spectrochemical series. Jahn- Teller distortion. Octahedral site stabilization energy (OSSE).	SM	10hrs	Class starts from

				21.09.2023
	Transition Elements: (1) General comparison of 3d, 4d and 5d elements in term of electronic configuration, oxidation states, redox properties, coordination chemistry.	BD	6hrs	
Oct	Metalligand bonding (MO concept, elementary idea), sigma- and pi-bonding in octahedral complexes (qualitative pictorial approach) and their effects on the oxidation states of transitional metals (examples). Magnetism and Colour: Orbital and spin magnetic moments, spin only moments of dn ions and their correlation with effective magnetic moments, including orbital contribution.	SM	8hrs	
	Transition Elements: (2) General comparison of 3d, 4d and 5d elements in term of electronic configuration, oxidation states, redox properties, coordination chemistry.	BD	4hrs	
Oct	Quenching of magnetic moment: super exchange and antiferromagnetic interactions (elementary idea with examples only); d-d transitions; L-S coupling; qualitative Orgel diagrams for 3d1 to 3d9 ions.	SM	8 hrs	
Nov	**Lanthanoids and Actinoids: (1)**General Comparison on Electronic configuration, oxidation states, colour, spectral and magnetic properties; lanthanide contraction, separation of lanthanides (ion-exchange method only).	MS	6hrs	
	Selection rules for electronic spectral transitions; spectrochemical series of ligands; charge transfer spectra (elementary idea).	SM	8hrs	
	Lanthanoids and Actinoids: General Comparison on Electronic configuration, oxidation states, colour, spectral and magnetic properties; lanthanide contraction, separation of lanthanides (ion-exchange method only).	MS	6hrs	
Dec	Question Answer & Problem solve	SM+BD	4hrs	
Jan	Assessment: End-term Test		Total: 60Hrs	

Resources :

Books:

1. Huheey, J. E.; Keiter, E.A. &Keiter, R.L. Inorganic Chemistry, Principles ofStructure and Reactivity 4th Ed., Harper Collins 1993, Pearson,2006.

2. Greenwood, N.N. &Earnshaw A. Chemistry of the Elements, ButterworthHeinemann. 1997.

3. Cotton, F.A., Wilkinson, G., Murrillo, C. A., Bochmann, M., Advanced Inorganic Chemistry 6th Ed. 1999., Wiley.

4. Atkin, P. Shriver & Atkins' Inorganic Chemistry 5th Ed. Oxford University Press (2010).

5. Purecell, K.F. and Kotz, J.C., An Introduction toInorganic Chemistry, Saunders: Philadelphia, 1980.

6. Sinha, S. P., Ed., Lanthanide and Actinide Research (Journal, Vol. 1, 1986).

7. Wulfsberg, G., Principles of Descriptive Inorganic Chemistry, Brooks/Cole: Monterey, CA, 1987.

7. Other resources :

*Remarks will specify

- The nature of the class-topic (viz. Theoretical, Practical, and Tutorial).
- Methodology of teaching (whether using ICT, engaging students in group discussion, quiz etc. etc.)
- Different modes of assessment. (Please check UGC evaluation reforms).

Semester: V
Department of Chemistry
Basirhat College

Lesson Plan for Course: INORGANIC CHEMISTRY-IV Code: CEMACOR11P Credit: 2

- Course coordinator: **Dr. Suman Mandal**
- Course Outcome
- CO1: Learners will be accustomed with chromatography for separation of metal ions from solution mixture.
- CO2: Gravimetry is another tool for quantitative estimation and student will learn it.
- CO3: Use of Spectrophotometry,learners also can estimate chloride ions in solution. Other uses of it are also discussed here.

Course planner

Sl	Course Topic	Teacher	Class-hrs	Remarks
Aug Sep	Principles involved in chromatographic separations. Paper chromatographic separation of following metalions: 1. Ni (II) and Co (II) 2. Fe (III) and Al(III)	SM +SK	12hrs	Class starts from 21.09.2023
Oct	**Gravimetry** 1. Estimation of Ni(II) using Dimethylglyoxime(DMG).	SM SM	12hrs 12 hrs	

Nov	2. Estimation of copper asCuSCN. 3. Estimation of Al(III) by precipitating with oxine and weighing as $Al(oxine)_3$ (aluminium oxinate). Repeat Practical & practice	SM SM	12 hrs 12hrs	
Dec				
Jan	Assessment: End-term Test		Total: 60Hrs	

Resources :

Books:

Reference Books

1. Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis* 6th Ed., Pearson,2009.

8. Other resources :

*Remarks will specify

- The nature of the class-topic (viz. Theoretical, Practical, and Tutorial).
- Methodology of teaching (whether using ICT, engaging students in group discussion, quiz etc. etc.)
- Different modes of assessment. (Please check UGC evaluation reforms).

Semester: V
Department of Chemistry
Basirhat College

Lesson Plan for Course: ORGANIC CHEMISTRY-V Code: CEMACOR12T Credit: 4

- Course coordinator: **Dr. Swastik Karmakar**
- Course Outcome
-
- CO1: Synthetic methods of Polynuclear hydrocarbons and their derivatives and there reactions are discussed.
- CO2: Synthesis of 5- and 6-membered Heterocyclic compounds and there reactivity are discussed.
- CO3: Stereochemistry of cyclic compounds, substitution reactions, elimination reactions are discussed.
- CO4: Mechanism, stereochemistry, regioselectivity of Pericyclic reactions are discussed.
- CO5: Chemistry of carbohydrates are discussed here. Different reactions of aldose, ketose and different properties are also discussd.
- CO6: Synthesis of Biomolecules likeAmino acids, peptides, nucleic acids and there properties are discussed.

Course planner

	Course Topic	Teacher	Class-hrs	Remarks
				Class starts from 21.09.2023
	Polynuclear hydrocarbons and their derivatives: synthetic methods include Haworth, Bardhan-Sengupta, Bogert-Cook and other useful syntheses (with mechanistic details); fixation of double bonds and Fries rule; reactions (with mechanism) of naphthalene, anthracene, phenanthrene and their derivatives.	SK	5hrs	
	Alicyclic compounds: concept of I-strain; conformational analysis: cyclohexane, mono and disubstituted cyclohexane; symmetry properties and optical activity; topomerisation; ring-size and ease of cyclisation; conformation & reactivity in cyclohexane system: consideration of steric and stereoelectronic requirements; elimination (E2, E1).	PD	5hrs	
	Heterocyclic compounds: 5- and 6-membered rings with one heteroatom; reactivity, orientation and important reactions (with mechanism) of furan, pyrrole, thiophene and pyridine; synthesis (including retrosynthetic approach and mechanistic details): pyrrole: Knorr synthesis, Paal-Knorr synthesis, Hantzsch synthesis.	SK	5hrs	
	Nucleophilic substitution (SN1, SN2, SNi, NGP), merged substitution-elimination; rearrangements; oxidation of cyclohexanol, esterification, saponification, lactonisation, epoxidation, pyrolyticsyn elimination and fragmentation reactions.	PD	5hrs	
	Furan: Paal-Knorr synthesis, Feist-Benary synthesis and its variation; thiophenes: Paal-Knorr synthesis, Hinsberg synthesis; pyridine: Hantzsch synthesis; benzo-fused 5- and 6-membered rings with one heteroatom: reactivity, orientation and important reactions (with mechanistic details) of indole, quinoline and isoquinoline; synthesis (including retrosynthetic approach and mechanistic details):	SK	4 hrs	
	Monosaccharides: Aldoses up to 6 carbons; structure of D-glucose & D-fructose (configuration & conformation); ring structure of monosaccharides (furanose and pyranose forms): Haworth representations and non-planar conformations; anomeric effect (including stereoelectronic explanation); mutarotation; epimerization; reactions (mechanisms in relevant cases): Fischer glycosidation, osazone formation, brominewater	PD	7 hrs	

	oxidation, HNO3 oxidation, selective oxidation of terminal –CH2OH of aldoses, reduction to alditols, Lobry de Bruyn-van Ekenstein rearrangement; stepping–up (Kiliani-Fischer method) and stepping–down (Ruff‟s&Wohl‟s methods) of aldoses.			
	Mechanism, stereochemistry, regioselectivity in case of Electrocyclic reactions: FMO approach involving 4π- and 6π-electrons (thermal and photochemical) and corresponding cycloreversion reactions.	SK	4 hrs	
	Monosaccharides: Aldoses up to 6 carbons; structure of D-glucose & D-fructose (configuration & conformation); ring structure of monosaccharides (furanose and pyranose forms): Haworth representations and non-planar conformations; anomeric effect (including stereoelectronic explanation); mutarotation; epimerization; reactions (mechanisms in relevant cases): Fischer glycosidation, osazone formation, brominewater oxidation, HNO3 oxidation, selective oxidation of terminal –CH2OH of aldoses, reduction to alditols, Lobry de Bruyn-van Ekenstein rearrangement; stepping–up (Kiliani-Fischer method) and stepping–down (Ruff‟s&Wohl‟s methods) of aldoses.	PD	7hrs	
	Cycloaddition reactions: FMO approach, Diels-Alder reaction, photochemical [2+2] cycloadditions. *Sigmatropic reactions:* FMO approach,sigmatropic shifts and their order; [1,3]- and [1,5]-H shifts and [3,3]-shifts with reference to Claisen and Cope rearrangements.	SK	4hrs	
	Amino acids: synthesis with mechanistic details: Strecker, Gabriel, acetamidomalonic ester, azlactone, Büchererhydantoin synthesis, synthesis involving diketopiperazine; isoelectric point, zwitterions; electrophoresis, reaction (with mechanism): ninhydrin reaction, Dakin-West reaction; resolution of racemic amino acids. *Peptides:* peptide linkage and its geometry; syntheses (with mechanistic details) of peptides using *N*-protection & C-protection, solid-phase (Merrifield) synthesis; peptide sequence: *C*-terminal and *N*-terminal unit determination (Edman, Sanger & „dansyl‟ methods); partial hydrolysis; specific cleavage of peptides: use of CNBr.Nucleic acids: pyrimidine and purine bases (only structure & nomenclature); nucleosides and nucleotides corresponding to DNA and RNA; mechanism for acid catalysed hydrolysis of nucleosides (both pyrimidine and purine types); comparison of alkaline hydrolysis of DNA and RNA; elementary idea of double helical structure of DNA	PD	12 hrs	

	(Watson-Crick model); complimentary base–pairing in DNA.			
	Assessment: End-term Test		Total: 60Hrs	

Resources :

Books:

1. Clayden, J., Greeves, N., Warren, S. *Organic Chemistry,* Second edition, Oxford University Press 2012.
2. Eliel, E. L. &Wilen, S. H. *Stereochemistry of Organic Compounds*, Wiley: London.
3. Nasipuri, D. *Stereochemistry of Organic Compounds,* Wiley Eastern Limited.
4. Fleming, I. *Molecular Orbitals and Organic Chemical reactions*, Reference/Student Edition, Wiley, 2009.
5. Fleming, I. *Pericyclic Reactions*, Oxford Chemistry Primer, Oxford University Press.
6. Gilchrist, T. L. &Storr, R. C. *Organic Reactions and Orbital symmetry*, Cambridge University Press.
7. Finar, I. L. *Organic Chemistry (Volume 1),* Dorling Kindersley (India) Pvt. Ltd.(Pearson Education).
8. Finar, I. L. *Organic Chemistry* (*Volume 2: Stereochemistry and the Chemistry of Natural Products*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
9. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
10. Loudon, G. M. *Organic Chemistry,* Fourth edition, Oxford University Press.
11. James, J., Peach, J. M. *Stereochemistry at a Glance*, Blackwell Publishing, 2003.
12. Robinson, M. J. T., *Stereochemistry*, Oxford Chemistry Primer, Oxford University Press, 2005.
13. Davis, B. G., Fairbanks, A. J., *Carbohydrate Chemistry*, Oxford Chemistry Primer, Oxford University Press.
14. Joule, J. A. Mills, K. *Heterocyclic Chemistry*, Blackwell Science.
15. Acheson, R.M. *Introduction to the Chemistry of Heterocyclic compounds*, John Wiely& Sons (1976).
16. Gilchrist, T. L. *Heterocyclic Chemistry*, 3rd edition, Pearson.
17. Davies, D. T., *Heterocyclic Chemistry*, Oxford Chemistry Primer, Oxford University Press.

9. Other resources :

*Remarks will specify

- The nature of the class-topic (viz. Theoretical, Practical, and Tutorial).
- Methodology of teaching (whether using ICT, engaging students in group discussion, quiz etc. etc.)
- Different modes of assessment. (Please check UGC evaluation reforms).

Semester: V
Department of Chemistry
Basirhat College

Lesson Plan for Course: ORGANIC CHEMISTRY-V LAB Code: CEMACOR12P Credit: 2

- Course coordinator: Mr. Prasanta Das
- Course Outcome
- CO1: Chromatographic Separations of amino acids and different pigments are discussed.
- CO2: Spectroscopic Analysis (IR, UV VISIBLE, NMR) of Organic Compounds are discussed.

Course planner

Sl	Course Topic	Teacher	Class-hrs	Remarks
Jul Aug				Class starts from 21.09.2023
Sep	**A. ChromatographicSeparations** 1. TLC separation of a mixture containing 2/3 aminoacids 2. TLC separation of a mixture of dyes (fluorescein and methyleneblue) 3. Column chromatographic separation of leaf pigments from spinachleaves	PD+SK	24hrs	
Oct	4. Column chromatographic separation of mixture ofdyes 5. Paper chromatographic separation of a mixture containing 2/3 aminoacids	SK PD	12hrs 12 hrs	
Nov	6.Paper chromatographic separation of a mixture containing 2/3sugars.	SK	6 hrs	
Dec	**B. Spectroscopic Analysis of OrganicCompounds** Repeat Practical & practice	PD	6hrs	
Jan	Assessment: End-term Test		Total: 60Hrs	

Resources :

Books:

a. *University Hand Book of Undergraduate Chemistry Experiments,* edited by Mukherjee, G. N. University of Calcutta,2003.
b. *Practical Workbook Chemistry (Honours), UGBS, Chemistry*, University of Calcutta, 2015
c. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.,* Pearson (2012).
d. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry,* PearsonEducation.

10. Other resources :

*Remarks will specify

- The nature of the class-topic (viz. Theoretical, Practical, and Tutorial).
- Methodology of teaching (whether using ICT, engaging students in group discussion, quiz etc. etc.)
- Different modes of assessment. (Please check UGC evaluation reforms).

Semester: V
Department of Chemistry
Basirhat College

Lesson Plan for Course: ADVANCED PHYSICAL CHEMISTRY Code: CEMADSE01T Credit: 4

- Course coordinator: **Dr. Bidyut Debnath**
- Course Outcome
- CO1: This course deals with the Bravais Lattice and Laws of Crystallography.
- CO2: In this course the learner will learn the following: The distance between consecutive planes of crystals, Miller indices, Determination of crystal structure: Powder method; Structure of NaCl and KCl crystals etc.
- CO3: In this course Statistical Thermodynamics are discussed highlighting the following: Macrostates, microstates, Boltzmann distribution, Partition function etc.
- CO4: Specific heat of solid, 3rd law of thermodynamics, adiabatic demagnetization etc are discussed.
- CO5: Classification of polymers, nomenclature, Mechanism and kinetics of step growth and copolymerization, conducting polymers etcare discussed.

Course planner

Sl	Course Topic	Teacher	Class-hrs	Remarks
Jul Aug				Class starts from 21.09.2023
Sep	Configuration: Macrostates, microstates and configuration; calculation of microstates with harmonic oscillator and tossing of coins; variation of W with E; equilibrium configuration .	MS	8hrs	
	Configuration: Macrostates, microstates and configuration; calculation of microstates with harmonic oscillator and tossing of coins; variation of W with E; equilibrium configuration	BD	10hrs	

	Boltzmann distribution: Thermodynamic probability, entropy and probability, Boltzmann distribution formula (with derivation); Applications to barometric distribution; Concept of ensemble - canonical ensemble and grand canonical ensembles			
Oct	Crystal planes: Distance between consecutive planes [cubic, tetragonal and orthorhombic lattices]; Indexing of planes, Miller indices; calculation of dhkl; Relation between molar mass and unit cell dimension for cubic system; Laue‟s diffraction; Bragg‟s law (derivation) Determination of crystal structure: Powder method; Structure of NaCl and KCl crystals	MS	8hrs	
	Partition function: molecular partition function and thermodynamic properties (U, H, S, CV, q, P); Partition function correlating – Chemical equilibrium and Maxwell‟s speed distribution; Gibbs‟ paradox; Ideal gas equation.	BD	8hrs	
Nov	Partition function: molecular partition function and thermodynamic properties (U, H, S, Cv, q, P); Partition function correlating – Chemical equilibrium and Maxwell‟s speed distribution; Gibbs‟ paradox; Ideal gas equation.	MS	6hrs	
	3rd law: Absolute entropy, Plank‟s law, Calculation of entropy, Nernst heat theorem Adiabatic demagnetization: Approach to zero Kelvin, adiabatic cooling, demagnetization, adiabatic demagnetization – involved curves.	SM	6hrs	
	Polymers: Classification of polymers, nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers; Criteria for synthetic polymer formation; Relationships between functionality, extent of reaction and degree of polymerization; Mechanism and kinetics of step growth and copolymerization; Conducting polymers Expectation value; Hermitian operator; Postulates of Quantum Mechanics; General structure of Schrodinger equation (S.E.) and time dependency; Stationary state.	BD	8hrs	
Dec	Question Answer & Problem solve	BD	2 hrs	
	Question Answer &Problem solve	MS	2hrs	
	Question Answer & Problem solve	SM	2hrs	
Jan	Assessment: End-term Test		Total: 60Hrs	

Resources :

Books:

1. Castellan, G. W. *Physical Chemistry*, Narosa
2. Levine, I. N. *Physical Chemistry*, Tata McGraw-Hill
3. Moore, W. J. *Physical Chemistry*, Orient Longman

4. Atkins, P. W. & Paula, J. de *Atkins', Physical Chemistry*, Oxford University Press
5. McQuarrie, D. A. & Simons, J. D. *Physical Chemistry*: A Molecular Approach, Viva Press
6. Engel, T. & Reid, P. *Physical Chemistry*, Pearson
7. Nash, L. K. *Elements of Statistical Thermodynamics*, Dover
8. Rastogi, R. P. &Misra, R.R. *An Introduction to Chemical Thermodynamics*, Vikas
9. Zemansky, M. W. &Dittman, R.H. *Heat and Thermodynamics*, Tata-McGraw-Hill
10. Billmeyer, F. W. *Textbook of Polymer Science*, John Wiley & Sons, Inc.
11. Seymour, R. B. &Carraher, C. E. *Polymer Chemistry: An Introduction*, Marcel Dekker, Inc.
12. Odian, G. *Principles of Polymerization*, Wiley
13. Billmeyer, F. W. *Textbook of Polymer Science*, Wiley Interscience, 1971.

11. Other resources :

*Remarks will specify

- The nature of the class-topic (viz. Theoretical, Practical, and Tutorial).
- Methodology of teaching (whether using ICT, engaging students in group discussion, quiz etc. etc.)
- Different modes of assessment. (Please check UGC evaluation reforms).

Semester: V
Department of Chemistry
Basirhat College

Lesson Plan for Course: ADVANCED PHYSICAL CHEMISTRY LAB Code: CEMADSE01P Credit: 2

- Course coordinator: **Dr. Bidyut Debnath**
- Course Outcome
- CO1: Computer programs based on numerical methods for Roots of equations, Numerical differentiation, Numerical integration, Matrix operations, Simple exercises using molecular visualization software are to be done.

Course planner

Sl	Course Topic	Teacher	Class-hrs	Remarks
Jul Aug				Class starts from 21.09.2023
Sep	Computer programs based on numerical methods for Programming 1: Roots of equations: (e.g. volume of van der Waals gas and comparison with ideal gas, pH of a weak acid) Programming 2: Numerical differentiation (e.g., change in pressure for small change in volume of a van der Waals gas, potentiometric titrations)	BD+MS	24hrs	

Oct	Programming 3: Numerical integration (e.g. entropy/ enthalpy change from heat capacity data), probability distributions (gas kinetic theory) and mean values	BD+MS	12hrs 12 hrs	
Nov	Programming 4: Matrix operations (Application of Gauss-Siedel method in colourimetry) Programming 5: Simple exercises using molecular visualization software	BD	6 hrs	
Dec	Repeat Practical & Tutorial		6hrs	
Jan	Assessment: End-term Test		Total: 60Hrs	

Resources :

Books:

Sl	Course Topic	Teacher	Class-hrs	Remarks
Jul Aug				Class starts from 08.08.2022
Sep	Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals.	BD	5hrs	
	Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert‟s law. *UV-Visible Spectrometry:* Basic principles of instrumentation (choice of source,monochromator and detector) for single and double beam instrument; *Basic principles of quantitative analysis:* estimation of metal ions from aqueous solution,geometrical isomers, keto-enoltautomers. Determination of composition of metal complexes using Job‟s method of continuous variation and mole ratio method. *Infrared Spectrometry:*	SK	8hrs	
	Flame Atomic Absorption and Emission Spectrometry: Basic principles of instrumentation(choice of source, monochromator, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction; Method of background	PD	8hrs	

	correction, sources of chemical interferences and their method of removal.			
Oct	Basic principles of instrumentation (choice of source, monochromator& detector) for single and double beam instrument; sampling techniques.	SK	5hrs	
	Techniques for the quantitative estimation of trace level of metal ions from water samples.	PD	4hrs	
	Theory of thermogravimetry (TG), basic principle of instrumentation. Techniques for quantitative estimation of Ca and Mg from their mixture.	SM	5hrs	
Nov	Classification of electroanalytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points. Techniques used for the determination of pKa values.	MS	10hrs	
	Solvent extraction: Classification, principle and efficiency of the technique. Mechanism of extraction: extraction by solvation and chelation. Technique of extraction: batch, continuous and counter current extractions. Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and nonaqueous media. Chromatography: Classification, principle and efficiency of the technique.	BD	5hrs	
	Mechanism of separation: adsorption, partition & ion exchange. Development of chromatograms: frontal, elution and displacement methods. Qualitative and quantitative aspects of chromatographic methods of analysis: IC, GLC, GPC, TLC and HPLC.	SK	5hrs	
Dec	Stereoisomeric separation and analysis: Measurement of optical rotation, calculation of Enantiomeric excess (ee)/ diastereomeric excess (de) ratios and determination of enantiomeric composition using NMR, Chiral solvents and chiral shift reagents. Chiral chromatographic techniques using chiral columns (GC and HPLC). Role of computers in instrumental methods of analysis.	SM	5hrs	
Jan	Assessment: End-term Test		Total: 60Hrs	

12. McQuarrie, D. A. *Mathematics for Physical Chemistry* University Science Books (2008)

13. Mortimer, R. *Mathematics for Physical Chemistry*. 3rd Ed. Elsevier(2005)

14. Yates, P. *Chemical Calculations*. 2nd Ed. CRC Press(2007)

15. Harris, D. C. *Quantitative Chemical Analysis*. 6th Ed., Freeman (2007) Chapters 3-5

16. Noggle, J. H. *Physical Chemistry on a Microcomputer*. Little Brown & Co.(1985)

Other resources :

*Remarks will specify

- The nature of the class-topic (viz. Theoretical, Practical, and Tutorial).
- Methodology of teaching (whether using ICT, engaging students in group discussion, quiz etc. etc.)
- Different modes of assessment. (Please check UGC evaluation reforms).

Semester: V
Department of Chemistry
Basirhat College

Lesson Plan for Course: ANALYTICAL METHODS IN CHEMISTRY Code: CEMADSE02T Credit: 4

- Course coordinator: **Dr. Monojit Sarkar**
- Course Outcome
- CO1: Qualitative and quantitative aspects of analysis of sampling, evaluation of analytical data, errors, accuracy and precision, etc are discussed.
- CO2: Basics of Optical methods of analysis are discussed. Basic principles of instrumentation of UV-Visible Spectrometry, Infrared Spectrometry, Flame Atomic Absorption and Emission Spectrometry
- CO3: Techniques for the quantitative estimation of trace level of metal ions from water samples
- CO4: Theory of thermogravimetry (TG), basic principle of instrumentation and techniques for quantitative estimation of Ca and Mg from their mixture are discussed.
- CO5: Basic principle of pH metric, potentiometric and conductometric titrations and techniques used for the determination of equivalence points, pKa values are discussed.
- CO6: Different experiments of**Separation techniques like** Solvent extraction, Chromatography, IC, GLC, GPC, TLC and HPLC etc are discussed.
- CO7: Basic principles of Stereoisomeric separation and analysis are also to be done.
- Course planner

Resources :

Books:

1. Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis 6thEd.*,Pearson, 48 2009.
2. Willard, H.H. *et al.*: *Instrumental Methods of Analysis*, 7th Ed. Wardsworth 3.Publishing Company, Belmont, California, USA, 1988. Christian, G.D. *Analytical Chemistry*, 6th Ed. John Wiley & Sons, New York,

2004.
4. Harris, D.C.: *Exploring Chemical Analysis*, 9th Ed. New York, W.H. Freeman,

2016.
5. Khopkar, S.M. *Basic Concepts of Analytical Chemistry*. New Age International Publisher, 2009.
6. Skoog, D.A. Holler F.J. &Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
7. Mikes, O. *Laboratory Hand Book of Chromatographic & Allied Methods*, Elles Harwood Series on Analytical Chemistry, John Wiley & Sons, 1979.
8. Ditts, R.V. Analytical Chemistry; Methods of separation, van Nostrand, 1974.

17. Other resources :

*Remarks will specify

- The nature of the class-topic (viz. Theoretical, Practical, and Tutorial).
- Methodology of teaching (whether using ICT, engaging students in group discussion, quiz etc. etc.)
- Different modes of assessment. (Please check UGC evaluation reforms).

Semester: V
Department of Chemistry
Basirhat College

Lesson Plan for Course: ANALYTICAL METHODS IN CHEMISTRY LAB Code: CEMADSE02P Credit: 2

- Course coordinator: **Dr. Suman Mandal**
- Course Outcome
- CO1: Learners will accustomed with Separation and identification of the monosaccharides, Separate a mixture of Sudan yellow and Sudan Red, active ingredients of plants, flowers and juices by TLC.
- CO2: Solvent Extractions for separation of metal ions and Spectrophotometry for determination of BOD and COD and pKa values of indicator are to be done.

Course planner

Sl	Course Topic	Teacher	Class-hrs	Remarks
Jul Aug				Class starts from 21.09.2023
Sep	**I. SolventExtractions:** To separate a mixture of Ni^{2+}& Fe^{2+} by complexation with DMG and extracting the Ni^{2+}- DMG complex in chloroform, and determine its concentration by spectrophotometry. Analysis of soil: (i) Determination of pH ofsoil.	SM+MS	24hrs	

Oct	(ii) Estimation of calcium, magnesium, phosphate Ionexchange: Determination of exchange capacity of cation exchange resins and anion exchange resins.	MS	12hrs 12 hrs	
Nov	**II. Spectrophotometr**y	PD+SM	6 hrs	
Dec	1. Determination of pKa values of indicator usingspectrophotometry. 2. Determination of chemical oxygen demand(COD). 3. Determination of Biological oxygen demand (BOD). Tutorial class		6hrs	
Jan	Assessment: End-term Test		Total: 60Hrs	

Resources :

Books:

1. Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis 6thEd.*,Pearson,2009.
2. Willard, H.H. *et al.*: *Instrumental Methods of Analysis*, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA,1988.
3. Christian, G.D. *Analytical Chemistry*, 6th Ed. John Wiley & Sons, New York, 2004.
4. Harris, D.C. *Exploring Chemical Analysis*, 9th Ed. New York, W.H. Freeman, 2016.
5. Khopkar, S.M. *Basic Concepts of Analytical Chemistry*. New Age International Publisher,2009.
6. Skoog, D.A. Holler F.J. and Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Edition.
7. Mikes, O. & Chalmes, R.A. *Laboratory Handbook of Chromatographic & AlliedMethods,* Elles Harwood Ltd.London.
8. Ditts, R.V. *Analytical Chemistry: Methods of separation.* Van Nostrand, New York,1974.

18. Other resources :

*Remarks will specify

- The nature of the class-topic (viz. Theoretical, Practical, and Tutorial).

- Methodology of teaching (whether using ICT, engaging students in group discussion, quiz etc. etc.)
- Different modes of assessment. (Please check UGC evaluation reforms).