VII-SEMESTER

Course16A:InorganicChemistry-I:AdvanceStudiesinComplexesand Group theory

I. CourseLearningOutcomes:

Onsuccessfulcompletionofthiscourse,studentshallbeable to:

1) Thestudentwillunderstandthe VSPERtheory,symmetricandunsymmetric Hydrogen bonds ininorganic molecules.
2) UnderstandingtheCrystalfieldtheoryandJahnTeller Effects.
3) TheStudentswillbeabletounderstandthebasicsofmolecularorbitaltheoryand energetic ofhybridization.
4) TheStudentsareabletounderstandthe Jobsmethod,hardandsoftacidsandbases.
5) Thestudents willacquire theknowledgeofsymmetry

II. Syllabus:

Unit-I:Chemistryofnon-transition elements:9 Hours

Inter halogen compounds, Halogen oxides and oxyfluorides, Clathrate compounds, Spectral and Magnetic properties of Lanthanides and Actinides. Analytical applicationsof Lanthanides and Actinides. Synthesis, properties and structure of B-N, S-N,P-N cyclic compounds. Intercalation compounds.

Metal π- complexes: preparation, structure and bonding in Nitrosyl, Dinitrogen and Dioxygen complexes.

Unit-II:StructureandBonding:9Hours

pπ-dπ bonding, Bent's rule, Non-valence cohesive forces, VSEPR theory. Molecular Orbital theory, Symmetry of Moleculararbitals, Moleculararbitals in triatomic(BeH_2) moleculesand ions (NO_2^-) and energy level diagrams. Application of MO theory to square planar

($PtCl_4^{2-}$) and octahedral complexes(CoF_6^{3-},$Co(NH_3)_6^{3+}$). Walsh diagrams for linear (BeH_2) and bent(H_2O)molecules.

Unit-III:Metal–ligandbonding:9Hours

Crystal Field Theory of bonding in transition metal complexes-Splitting of d-orbitals in octahedral, tetrahedral, square planar and Trigonal bipyramidal and Square pyramidal fields. Tetragonal distortions -Jahn-Teller effect. Applications and limitations of CFT.Experimental evidences for covalence in complexes. Molecular Orbital Theory of bonding for Octahedral, tetrahedral and square planar complexes. π-bonding and MOT - Effect of π - donor and π – acceptor ligands on Δo. Experimental evidence for π-bonding in complexes.

Unit-IV:Metal–ligandEquilibriainsolutions:9Hours

Step wise and over all formation constants. Trends in stepwise constant(statistical effect and statistical ratio). Determination of formation constants by Spectrophotometric method (Job's method) and pHmetric method (Bjerrum's). Stability correlations-Irwing-William's series. Hard and soft acids and bases (HSAB),Acid-base strengths.

Unit-V:Grouptheory9Hours

Basic concepts of Symmetry and Group theory- Symmetry elements, symmetry operationsandpointgroups.Schoenfliessymbols-Classificationof molecules into point groups–Axioms of Group theory–Groupmultiplication tables for $C_2V$and C_3Vpoint groups–Similarity.Transformationand classes Representations–reducible and irreducible representations. Mulliken symbols, Orthogonality theorem and its implications,character table and it's anatomy.

III. SuggestedCo-Curricular Activities

1) Trainingofstudentsby relatedindustrialexperts.
2) Assignments,SeminarsandQuiz(onrelatedtopics),collectionofrelevantvideosand material.
3) Visitstoindustries,firms,researchorganizationsetc.
4) Invitedlecturesandpresentationsonrelatedtopicsbyfield/industrialexperts.

IV. ListofTextbooks:

1) InorganicChemistryHuheey,HarperandRow.
2) Physicalmethodsininorganicchemistry,R.S.Drago.AffliatedEast-WestPvt.Ltd.
3) Conciseinorganicchemistry,J.D.Lee,ELBS.
4) ModernInorganicChemistry,W.L.Jolly,McGrawHill.
5) InorganicChemistry,K.F.PurcellandJ.C.KotzHoltSaundersinternational.
6) ConceptsandmethodOfinorganicchemistry,B.E.DouglasandD.H.M.C.Daniel, oxford Press.
7) IntroductoryquantumMechanics,A.K.Chandra.
8) QuantumChemistry,R.K.Prasad.

V. Referencebooks:

1) InorganicChemistry,Atkins,ELBS.
2) AdvancedInorganicChemistry,CottonandWilkinson,WileyEastern.
3) TextbookofCoordinationchemistry,K.SomaSekharaRaoandK.N.K.Vani,Kalyani Publishers.
4) GroupTheory and its Applications to Chemistry, K.V.Raman, TataMcGraw– Hill Publishing Company Ltd., New Delhi.
5) ChemicalApplicationsofGroupTheory,F.A.CottonWileyEastern Limited NewDelhi.

Course16A:InorganicChemistry-I:AdvanceStudiesinComplexesandGrouptheory practical Syllabus:

VI. LearningOutcomes:

Onsuccessfulcompletionofthispracticalcourse,studentshallbeableto:

1) Listout,identifyandhandlevariousequipmentinChemistrylab.
2) Understandthebasicconceptsofqualitativeanalysisofinorganic mixture.
3) Applytheconceptsofcommonioneffect,solubility productandconceptsrelatedto qualitativeanalysis..
4) Acquireskillsineliminationinterferinganion..
5) Identificationoflessfamiliar cation.

Syllabus:

1) SynthesisofInorganicMetalComplexes:
2) Synthesisof3dtransitionmetalcomplexesoftetrahedral,squareplanar andoctahedral geometries.
3) Tetraamminecopper(II) sulphatemonohydrate
4) Potassiumtris(oxalato)ferrate(III)trihydrate
5) Tris(thiourea)copper(I)sulphate

Systematic Semi micro Qualitative Analysis of Inorganic six radical mixtures: In systematic Semi micro qualitative inorganic analysis, inorganic mixture contains three cations and three anions. The analysis involves identificationandconformationofcationsandanions containingone less familiar cation (Tungsten, Molybdenum, Zirconium, Thorium, Titanium, Uranium, Cerium, Vanadium, Lithium, Berkelium etc.,) and one interferinganion.

Anions:

CO_3^{2-},S^{2-},SO_3^{2-},Cl^-,Br^-,I^-,NO_3^-,SO_4^{2-},CH_3COO^-,$C_2O_4^{2-}$,$C_4H_4O_6^{2-}$

,PO_4^{3-},CrO_4^{2-},AsO_4^{3-},F^-,BO_3^{3-}

Cations:

Ammonium (NH_4^{+})

1st group: Hg, Ag, Pb, Tl, W

2nd group:Hg,Pb,Bi,Cu,Cd,As,Sb,Sn,Mo3rd group:Fe,Al,Cr,Ce,Th,Ti,Zr,V,U,Be 4th group: Zn, Mn, Co, Ni

5th group:Ca,Ba,Sr
6th group: Mg, K, Li

Note:Aminimumof4inorganicmixturesmust beanalysedinthisSEMESTER.

VII. SugggestedCo-CurricularActivities

Mandatory:*(Lab/fieldtrainingofstudentsbyteacher:(lab:10+field:05*):

1) **ForTeacher**:Trainingofstudentsbytheteacherinlaboratoryandfieldfornot lessthan15 hours on the field techniques/skills of involves identification and conformation of cations and anions containing one less familiar cation andone interfering anion.

2) **For Students**: Student shall visit a related industry/chemistry laboratory inuniversities/ research organizations / private sector facility and observes the synthetic reactions. Write their observations and submit a hand written fieldwork/project work report not exceeding10 pages in the given format to theteacher.

3) MaxmarksforFieldwork/projectworkReport:05.

4) Suggested Format for Fieldwork/project work**:** Title page, student details, index page, details of place visited, observations, findings and acknowledgements.

5) Unittests(IE).

VIII. ReferenceBooks:

1) PracticalInorganicChemistry,G.MarrandB.W.Rockett.

2) PracticalInorganicChemistrybyG.PassH.Sutchiffe, 2nd ednJohnWiley&Sons.

3) ExperimentalInorganic/PhysicalChemistry,M.A.Malati,Horwood Publishing ,Chichester,UK(1999)

4) Vogel'stextbook ofsemimicroqualitative analysis,5th Edition byG.Svehla.

VII -SEMESTER

Course16B:InorganicMaterialsofIndustrial Importance

I. CourselearningOutcomes:

Bythe endof thecourse, thestudents willbeable to:

1. Learn the composition and applications of the different kinds of glass.
2·Understandglazingofceramicsandthefactorsaffectingtheirporosity.

3·Givethecompositionofcementanddiscussthemechanism of settingofcement. 4· Explain the suitability of fertilizers for different kinds of crops andsoil.

5·Explaintheprocessofformulationofpaintsandthebasicprinciplebehindtheprotection offered by the surface coatings.

6·Explaintheprinciple,workingandapplications ofdifferentbatteries.

7·Listandexplainthepropertiesofengineeringmaterialsformechanicalconstructionused in day today life.

8·Explainthesynthesisandpropertiesofnano-dimensionalmaterials,varioussemiconductor And superconductor oxides

II. Syllabus

Unit1:SilicateIndustries: **[9hours]**

Glass: Glassy state and its properties, classification (silicate and non-silicate glasses). Manufacture andprocessing of glass. Composition and properties of the following types of glasses: Soda lime glass, leadglass, armoured glass, different types of safetyglass, borosilicate glass, fluorosilicate glass, colouredglass, photosensitive glass, photochromic glass, glass wool and optical fibre.

Ceramics: Briefintroductiontotypesofceramics.glazingofceramics.

Unit2:Fertilizers: **[9hours]**

Different types of fertilizers (N, P and K). Importance of fertilizers, chemistry involved inthe manufactureof the following fertilizers: urea, ammonium nitrate, calcium ammonium nitrate,

ammoniumphosphates,superphosphateof lime,potassiumchlorideandpotassium nitrate.

Unit3:Batteries:[9 hours]

Primary and secondary batteries, characteristics of an Ideal Battery, principle, working, applicationsandcomparisonofthefollowingbatteries:Pb-acidbattery,Li-metalbatteries,Li

-ionbatteries,Li-polymerbatteries,solidstateelectrolytebatteries,fuelcells,solarcellsand polymer cells.

Unit 4:Synthesis of inorganic solids: [9hours]

Conventionalheatandbeatmethod,Co-precipitationmethod,Sol-gelmethod,Hydrothermal method, Chemical vapor deposition (CVD), Ion-exchange and Intercalation method.

Unit5:Nanomaterials: [9hours]

Overview of nanostructures and nanomaterial's, classification, preparation and optical properties of gold and silver metallic nanoparticles, concept of surface Plasmon resonance, carbon nanotubes, inorganic nanowires, Bioinorganic nanomaterial's natural and artificial nanomaterial's, self-assembled nanostructures, control of Nano architecture, one dimensional control.

III. SuggestedCo-CurricularActivities

1. Trainingofstudentsby relatedindustrialexperts.

2. Assignments,SeminarsandQuiz(onrelatedtopics),collectionofrelevan t videos and material.

3. Visitsofabilities,firms,researchorganizationsetc.

4. Invitedlecturesandpresentationsonrelatedtopicsbyfield/industrialexperts

IV. SuggestedTextBooks:

1. PooleJr.;CharlesP.;Owens,FrankJ.(2003),**IntroductiontoNanotechnology**,John Wileyand Sons

2. West,A.R.(2014),**SolidStateChemistryandIts Application**,Wiley

3. Smart,L.E.;Moore,E.A.(2012),**SolidStateChemistryAnIntroduction**,CRC PresTaylor &Francis.

4. Atkins,P.W.;Overton,T.L.;Rourke,J.P.;Weller,M.T.;Armstrong,F.A.(2010),**Shriver andAtkins Inorganic Chemistry**, W. H. Freeman and Company.

5. Kent,J.A.(ed**)**(1997),**Riegel'sHandbookofIndustrialChemistry**,CBSPublishers, NewDelhi.

V. References:

1. Svehla,G.(1996),Vogel'sQualitativeInorganicAnalysis,PrenticeHall.

2. Banewicz,J.J.;Kenner,C.T.DeterminationofCalciumandMagnesium inLimestones and Dolomites, Anal. Chem., 1952, 24 (7), 1186–1187.

VII: SEMESTER

Course16B:InorganicMaterialsofIndustrialimportance-

VI. Learningoutcomes:

Bythe endofthecoursestudentswill beable to:

1. Identifysulphateand ammoniumionpresentinammoniumsulphatefertilizer

2. Estimatetheamountofcalciumpresentina fertilizer

3. Synthesizenanoparticlesbychemicalmethod

4. Synthesizemetal doped metal oxidenanoparticles

5. Prepareandcharacterizesilvernanoparticles.

VII. PracticalSyllabus:

1. DetectionofconstituentsofAmmoniumSulphatefertilizer(AmmoniumandSulphate ions) byqualitative analysis and determine its free acidity.

2. DetectionofconstituentsofCANfertilizer(Calcium,AmmoniumandNitrateions) fertilizer andestimation of Calcium content.

3. Synthesisof ZnOnanoparticlesbychemicalmethodanditscharacterizationusing UV-visible Spectrophotometer.4. Cu doped ZnO nanoparticles

5. Synthesisof silvernanoparticlesbygreenmethodsanditscharacterizationusingUV- visible Spectrophotometer.

6. DetectionofconstituentsofDolomite(Calcium, Magnesiumandcarbonateions)and Determination of composition of Dolomite (Complexometric titration).

VIII. Co-CurricularActivities:

Mandatory:*(Lab/fieldtrainingofstudentsbyteacher:(lab:10+field:05*):

1. For Teacher: Training of students by the teacher in laboratory and field for not less than15 hours on the fieldtechniques/skills of synthesis of nanoparticles

and its characterization using various techniques.

2. **For Students**: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observes the stages in cement preparation. Write their observations and submit a hand written fieldwork/project work report not exceeding 10 pages in the given format to the teacher.

3. Max.MarksforFieldwork/projectworkReport:05.

4. SuggestedFormatforFieldwork/projectwork**:***Titlepage,studentdetails,*

index page, details of place visited, observations, findings, and acknowledgements.

5. Unittests(IE).

IX. References:

1. Ghorbani,H.R.;Mehr, F.P.;Pazoki,H.;RahmaniB.M.Synthesis ofZnONanoparticles byPrecipitation Method.Orient J Chem. 2015;31(2).

2. Orbaek,W.;McHale,M.M.;Barron,A.R.Synthesisandcharacterizationofsilver nanoparticles for an undergraduate laboratory, J. Chem. Educ. 2015, 92, 339−344.

VII -SEMESTER

Course17A:SpectroscopyofOrganiccompounds

I. Learning Outcomes:

Bythe endof thecourse, thestudents willbeable to:

1) Gaininsightintothebasicfundamental principles of IRandUV-Visspectroscopic techniques.

2) UsebasictheoreticalprinciplesunderlyingUV-visibleandIRspectroscopyasatoolfor functional group identification in organic molecules

3) InterpretofIR,UV-visiblespectraandtheirapplications

4) InterpretofNMR,Massspectraandtheir applications

5) Interpretthespectrainidentifyingtheorganiccompounds

II. Syllabus

Unit-I **[9hours]**

UV-VisSpectroscopy

Energy transitions – Simple chromophores – UV absorption of Alkenes –polyenesunsaturated cyclic systems – Carbonyl compounds, α,β-unsaturated carbonylsystems - Woodward Fieserrules–aromaticsystems–solventeffects–geometricalisomerism –acid

and base effects – typical examples – calculation of λ_{max} values usingWoodward - Fieser rules.

b)**ORD:**Theory ofoptical rotatory dispersion,α-Axial haloketone rule and octant rule–

Application of these rules in the determination of absolute configuration of cyclohexanones, decalones and cholestanones.

Unit-II [9hours]

Infrared Spectroscopy (FT-IR): Fundamental modes of vibrations – Stretching and bending vibrations – overtones, combination bands and Fermi resonance, factors influencing vibrational frequencies, hydrogen bonding – fingerprint region and its importance – Studyof

typical group frequencies for – CH, -OH, -NH, -CO-NH_2, -CC, -CHO, -CO and aromatic systems. Application in structural determination –Simple problems

Unit-III [9hours]

^{1}H NMR spectroscopy:

a) Magnetic properties of Nuclei, Nuclear resonance, Fourier Transformation and its importance in NMR. Equivalent and non-equivalent protons, The chemical shift and it's importance, calculation of chemical shift, factors affecting the chemical shifts such as electronegativity and anisotropy, effect of deuteration, Signal integration, Spin-spin coupling: vicinal (Karplus relationships), germinal and long range. Coupling constants (*J*) and factors affecting coupling constants. –Shielding and deshielding mechanisms in acetylene carbonyl andBenzene,anisotropy –Spin-SpinInteractionsrelatedto firstorderandhigherorderspectra (AB,A_2;AB_2,ABX,ABC,AMX)–temperaturedependencespectra,Hydrogenbonding.

Unit-IV [9hours]

ElectronSpinResonanceSpectroscopy(ESR):

Basic Principles, Comparison of NMR &ESR.Determination of 'g' value, Factorsaffectingthe 'g' value.Isotropic and Anisotropic constants.Splitting, hyperfine splitting couplingconstants. Line width, Zero field splitting, and Kramer degeneracy. Crystal field splitting,Crystal field effects.

Applications: Detection of free radicals; ESR spectra of(a) Methyl radical ($CH_3\cdot$), (b) Benzene anion (C_6H_6-).

UNIT-V

MASSSPECTROMETRY **[9hours]**

Introduction, ion production, type of ionization, EI, CI, FD, and FAB-factors affecting fragmentation, ion analysis, ion abundance. Mass spectral fragmentation of organic compounds, common functional groups, molecular-ion peak, metastable peak, Mac Lafferty rearrangement. Nitrogen rule, isotope labeling. High resolution mass spectrometry, Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.

III. SuggestedCo-CurricularActivities

1. Trainingofstudentsby relatedindustrialexperts.

2. Assignments,SeminarsandQuiz(onrelatedtopics),collectionofrelevant videos and material.

3. Visitsofabilities,firms,researchorganizationsetc.

4. Invitedlecturesandpresentationsonrelatedtopicsbyfield/industrialexperts.

IV. SuggestedTextBooks:

1. Organicspectroscopy,W.Kemp5thEd,ELBS

2. Spectroscopyoforganic compounds,RMSilversteenandothers,5thEd,JohnWiley

3. Spectroscopyoforganiccompounds,P.S.Kalsi,Wiley,1993.

V. References:

1. NMRinchemistry-Amultinuclearintroduction,WilliamKemp,McMillan,1986.

2. SpectroscopicmethodsinOrganicchemistry,DHWilliams&IFlemmi

Course17A:SpectroscopyofOrganicCompounds-PracticalSyllabus

VI. Learningoutcomes:

Bythe endof thecoursestudents willbeable to

1. Identifythefunctionalgroupspresentinthemolecules

2. Applydatatoinidentificationofthemolecule

3. DescribeprinciplesinvolvedinSpectroscopicmethods

4. Predictnumberof signals,splitting patternsinthe protonNMR ofacompound

5. Developabilityinthecombineduseofmassspectrometryandspectroscopictechniquesfo r structure elucidation

VII. PracticalSyllabus

a) Problemsinvolvingindividualspectralmethods– UV, IR,PMRandMass

b) ProblemsinvolvingcombinedanytwoofUV,IR,PMRandMass

c) ProblemsinvolvingcombinedanythreeofUV, IR,PMRandMass

c)ProblemsinvolvingallfourUV,IR,PMRandMassspectraldata.

VIII. Co-CurricularActivities:

Mandatory:*(Lab/fieldtrainingofstudentsbyteacher:(lab:10+field:05*):

1. **ForTeacher**:Trainingof studentsbytheteacherinlaboratoryandfieldfornot

less than15 hours on the field techniques/skills of detection of organic compounds using spectroscopic data.

2. **For Students**: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observes thesynthetic reaction and obtaining spectral data and analyzing the organic compounds. Write their observations and submit a hand written fieldwork/project work report not exceeding

10pages inthegiven formatto theteacher.

3. Max.MarksforFieldwork/projectworkReport:05.

4. Suggested Format for Fieldwork/project work**:** *Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.*

5. Unittests(IE).

IX. References:

1. NMRinchemistry-Amultinuclearintroduction,WilliamKemp,McMillan,1986.

2. Spectroscopicmethods inOrganicchemistry,DH Williams&IFlemmi

VII-SEMESTER

***Course17B*:OrganicChemistry:StereoChemistryandNaturalProducts**

I. CourseLearningoutcomes:

Onsuccessful completionofthiscourse,studentshallbeableto:

1) Understandandapplythesubstitutionandeliminationreactionmechanismsat aliphaticand aromatic substrates for various reactions leading to research
2) Writethe stereochemical forms fordifferent organicmolecules.
3) Understandtheconformationsofacyclic,monocyclicandfusedringsystemsand applying it toorganic compounds.
4) Explain formationofvariousheterocycliccompoundsandtheirsynthesisand importance.
5) Describetheimportanceofnaturalproductsinmedicinalchemistry

II. Syllabus:

Unit– IReactionMechanism **9 Hours**

AliphaticNucleophilicSubstitutionandNucleophilicAromaticsubstitution:

Stereo chemistry of $SN_2$and SN_1mechanisms, Neighboring Group Participation (Anchimeric assistance), NGP by O, S, N : Aromatic Nucleophilic substitution SN2 (Ar) (Addition – Elimination), SN1(Ar) and benzyne mechanisms (Elimination - Addition); evidence for the structure of benzyne. Von Richter Sommelet-Hauser rearrangements.

Elimination Reactions:

Type of elimination reactions, mechanisms, Stereochemistry and Orientation, Hofmannand Saytzeff rules, Syn elimination versus anti-elimination,competition between elimination and substitution, dehydration, dehydrogenation, dehalogenation, decarboxylative eliminations and pyrolytic eliminations

Unit-II:StereoChemistry-I: **9Hours**

Concept and Recognition of Molecular Symmetry and Chirality. Definition and

classification of Stereoisomers, Enantiomer, Diastereomer, Homomer, Epimer, Anomer, Configuration and

Conformation, Configurational nomenclature: D,L and R,S nomenclature. Molecular representation of organic molecules: Fischer,Newman and Sawhorse projections and their inter-conversions. Geometrical Isomerism. Cis-trans, E, Z-and Syn and anti nomenclature, Methods of determining configuration of Geometrical isomers using physical, spectral and chemical methods, Stability, Cis-trans interconversion.

Unit-III:StereoChemistry-II: 9Hours

Conformation and factors influencing on stability ofConformations;Conformational analysis of cyclic molecules - cyclobutane, cyclohexane – mono and disubstituted cyclohexanes and carbon heteroatom bonds having C–O&C–N. Prochiralityand

Prostereoisomerism:-Homotopic ligands and faces; enantiotopic ligands and faces; diastereotopic ligands and faces; nomenclature of enantiotopic ligands and faces(Pro-R, Pro- S, Re, Si carbonyl compounds and Alkenes)

Stereoisomerism in molecules without chiral Center Axial chiralityAllenes, Alkylidene cycloalkanes, spiranes. Atropisomerism: Biphenyl derivatives, nomenclature. Planar chirality: Ansa compounds, paracyclophanes, trans-cyclooctene and Helicity.

UNIT–IVHeterocyclic compounds 9Hours

Importance of heterocyclic compounds as drugs. Nomenclature of heterocyclicsystems basedon ring size, number and nature of hetero atoms. Chemistry of heterocyclic compounds, synthesis and reactivity of the following systems: Quinoline, Isoquinoline, Indole, Pyrazole, Imidazole, Oxazole, Isoxazole, Pyridazine, pyrimidine and Pyrazine.

UNIT-VChemistry of sometypicalnaturalproducts 9Hours

Isolation,classification,structureelucidation,synthesisof:

Alkaloids: Atropine,Nicotine,andQuinine.

Terpenoids:α-Terpeneol,α-PineneandCamphor.

III. SuggestedCo-CurricularActivities

1) Trainingofstudentsby relatedindustrialexperts.

2) Assignments,SeminarsandQuiz(onrelatedtopics),collectionofrelevant videos and material.

3) Visitstolaboratories,firms,researchorganizationsetc.

4) Invitedlecturesandpresentationsonrelatedtopicsbyfield/industrialexperts.

IV. List ofTextbooks:

1) Advancedorganicchemistry-Reaction,mechanismandstructure,JerryMarch, John Wiley.

2) Advancedorganic chemistry,F.A.CareyandR.J.Sundberg,Springer,NewYork.

3) AguidebooktoMechanism inorganicchemistry,PeterSykes,Longman.

4) Organicchemistry, I.L.Finar,Vol.I,Fifthedi.ELBS.

5) Organicchemistry,Hendrickson,CramandHammond(McGraw–Hill).

V. Referencebooks:

1) Structureandmechanism inorganicchemistry,C.K.Ingold,CornellUniversityPress.

2) Principlesoforganicsynthesis,R.O.C.NormanandJ.M.Coxon,BlakieAcademic & Professional.

3) ReactionMechanisminOrganicChemistry,S.M.MukherjiandS.P.Singh,Macmillan.

4) BasicPrinciplesofOrganicChemistrybyJ.B.RobertsandM.Caserio.

5) StereochemistryofOrganiccompoundsbyErnestL.Eliel,SamuelH.Wilen

6) Chemistryof naturalproducts byS.V.Bhat,B.A.Nagasampangi.

7) StereochemistryofOrganiccompoundsbyD.Nasipuri.

CourseNo 17 B :ORGANIC CHEMISTRYPRACTICALS

VI. LearningOutcomes:

Onsuccessfulcompletionofthispracticalcourse,studentshallbeableto:

1) Listout,identifyandhandlevariousequipmentinChemistrylab.
2) Acquireskillsintheseparationoforganiccompoundsinthegivenmixtureusing solvent extraction.
3) DeterminetheMeltingandBoilingpointsofOrganiccompounds.
4) Understandtheapplicationofconceptsofdifferentorganicreactionsstudied inthe theory partof Organic chemistry.

VII. Syllabus.

Systematic qualitative analysis of an organic mixture containing two compounds; Identification of method of separation and the functional group(s) present in each of them and preparation of one solid derivative for the conformation of each of the functional group(s).Purification of derivatives-ThestudenthastodoRecrystallizationtofinalderivatives(s)andsubmitthesample. If the sample is impure liquid must carry out distillation process.

VIII. SuggestedCo-CurricularActivities

Mandatory:*(Lab/fieldtrainingofstudentsbyteacher:(lab:10+field:05*):

1) **For Teacher**: Training of students bythe teacher inlaboratory and field for not lessthan15 hours on the field techniques/skills of separation of the given organicmixture,identifyingandconfirmingthefunctionalgroupfollowed by the preparation of recrystallized solidderivative.
2) **For Students**: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observesthe synthetic reactions. Write their observations and submit a hand written fieldwork/projectwork report not exceeding10 pages in the given format to the teacher.

3) MaxmarksforFieldwork/projectworkReport:05.

4) SuggestedFormatforFieldwork/projectwork**:**Titlepage,studentdetails,index page, details of place visited, observations, findings and acknowledgements.

5) Unittests(IE).

IX. ReferenceBooks:

1) Vogel's Text Book of QuantitativeChemicalAnalysis,J.Mendham,R.C. Denney,J.D.BarnesandM.J.Thomas,4th&6thEd.(PearsonEducationAsia).

2) Vogel'sTextBookofPracticalOrganicChemistry,B.S.Furniss,A.J.Hannaford, P.W.G.Smith, A.R. Tatchell, 5 Ed.(Longman Scientific & Technical).

VII-SEMESTER

***Course18A*:PhysicalChemistry–I:Thermodynamics,ElectrochemistryandChemicalKinetics**

I. CourseLearning outcomes:

Onsuccessful completionofthiscourse,studentshallbeableto:

1) Understandtheclassicalthermodynamics,fugacity.
2) DescribetheElectrochemicalcells,Liquidjunctionpotential.
3) DerivetheButler-VolmerequationandIlkovicequation
4) Understandthecomplex reactions,chainreactions.
5) DemonstratetheBranchingChainReactions,EnzymecatalysisandPhotochemical equilibrium.

II. Syllabus

Unit-I:Thermodynamics: 9Hours

Classical thermodynamics - Entropy change inreversible and irreversible processes - Entropy of mixing of ideal gases - Entropy and disorder – Free energy functions - Gibbs-Helmholtz equation – Maxwell partial relations. Conditions of equilibrium and spontaneity - Free energy changesinchemicalreactions,Van'tHoffreactionisotherm-Van'tHoffequation –Classiuss

-Clapeyronequation-partialmolarquantities-Chemicalpotential-Gibbs-Duhemequation

- partial molar volume -determination ofpartial molar quantities - Fugacity - Determinationof fugacity – Thermodynamic derivation of Raoult'slaw.

Unit-II:Electrochemistry-1: 9 Hours

Electrochemical cells - Measurement of EMF - Nernst equation –Equilibrium constant from EMF Data - pH and EMF data - Determination of solubility product from EMFmeasurements. Concentration cells with and without transference – Liquid junction potential and its determination -Activity and activity coefficients - Debye Huckel limiting law andits

verification. Effect of dilution on equivalent conductance of electrolytes - Anomalous behaviorofstrongelectrolytes. DebyeHuckel –Onsagarequation-verification andlimitations-Bjerrum treatment of electrolytes.

Unit-III:ElectroChemistry-II: 9Hours

Reference electrode - Standard hydrogen electrode. Calomel electrode-Indicator electrodes: Metal- metal ion electrodes – Inert electrodes-Membrane electrodes - theory of glass membranepotential,potentiometrictitrations,Conductometrictitrations.Electrodepotentials

-Doublelayerattheinterface-rate ofcharge transfer-Decompositionpotential–Over

potential - Tafel plots - Derivation of Butler- Volmer equation for one electron transfer – electro chemical potential.

Unit-IV:Chemicalkineticsand Photochemistry: 9Hours

Branching Chain Reactions- Hydrogen-oxygen reaction - lower and upper explosion limits - Fast reactions - Study of kinetics by flow methods -Relaxation methods - Flash photolysis. Acid base catalysis –protolytic and prototropic mechanism. Enzyme catalysis-Michelis-Mentenkinetics.

Photochemistry: Quantum yield and its determination, Actinometry, Reactions with low and high quantum yields, Photo sensitization, Exciplexes and Excimers,Kinetics of collisional quenching- Stern-Volmer equation.

Unit-V:Chemicalkinetics- II: 9Hours

Methods of deriving rate laws - complex reactions - Rate expressions for opposing, parallel and consecutive reactions involving unimolecular steps. Theories of reaction rates - collision theory-Steric factor-Activated complex theory -Thermo dynamic aspects– Unimolecular reactions- Lindemann's theory -Lindemann Hinshelwood theory. Primary and secondary salt effects. Elementary account of linear free energy relationships - Hammet-Taftequation - Chain reactions - Rate laws of H2-Br2, photochemical reaction of H2 - Cl2. Decomposition of acetaldehyde and ethane- Rice-Hertzfeld mechanism.

III. SuggestedCo-CurricularActivities:

1) Trainingofstudentsby relatedindustrialexperts.
2) Assignments,Seminars,discussionsanddebatesandQuiz(onrelatedtopics), collection of relevant videos and material.
3) Visitstolaboratories,firms,researchorganizationsetc.
4) Invitedlecturesandpresentationsonrelatedtopicsbyfield/industrialexperts.

IV. List ofTextbooks:

1) PhysicalChemistryP.W.Atkins,ELBS.
2) ChemicalKinetics-K.J.Laidler,McGrawHillPub.
3) TextBookofPhysicalChemistry.SamuelGlasstone,McmillanPub.
4) PhysicalChemistry,G.W.Castellan.NarosaPublishingHouse

V. Referencebooks:

1) ThermodynamicsforChemists.SamuelGlasstone.
2) Electrochemistry,SamuelGlasstone,AffiliatedEastWest
3) PhysicalChemistry,W.J.Moore,PrenticeHall

Course18A :PHYSICALCHEMSITRYPRACTICALS–I

LearningOutcomes:

Onsuccessfulcompletionofthispracticalcourse,studentshallbeableto:

1) Listout,identifyandhandlevariousequipmentinChemistrylab.
2) Learnandapplytheconceptsofelectro chemistryinexperiments.
3) Be familiar with electro analytical methods and techniques which study an analyte by measuring the potential (volts) and / or current (amperes) in an electro chemical cell containing the analyte..
4) Learntheproceduresofpreparationofstandardsolutions.
5) Acquireskillsinoperationandcalibrationofinstruments..

Syllabus:

1) ConductometrictitrationofStrong acidversusStrongbase
2) Dissociationconstantofweak acid(CH3COOH)byconductometricmethod.
3) ConductometrictitrationofWeakacidvsStrongbase.
4) Determinationofcellconstant
5) Acid-catalyzedhydrolysisofmethylacetate
6) Determinationofpartialmolarvolumeof solute–H2Osystembyapparent molar volume method.

Suggested Co-CurricularActivities

Mandatory:*(Lab/fieldtrainingofstudentsbyteacher:(lab:10+field:05*):

1) **For Teacher**: Training of students by the teacher in laboratory and field for not lessthan15 hours on the fieldtechniques/skillsofhandlingconductometric titrations.
2) **For Students**: Student shall visit a related industry / chemistry laboratory in universities/research organizations/privatesectorfacility andobserves the synthetic reactions. Write their observations and submit a hand written field

work/projectworkreportnotexceeding10pagesinthegivenformatto theteacher.

3) MaxmarksforFieldwork/projectworkReport:05.

4) SuggestedFormatforFieldwork/projectwork**:**Titlepage,studentdetails,index page,details of place visited, observations, findings and acknowledgements.

5) Unittests(IE).

VI. Referencebook:

1) Vogel'sTextBookof QuantitativeChemicalAnalysis,J.Mendham,R.C.Denney,J. D.BarnesandM. J.Thomas,4th& 6th Ed.(Pearson EducationAsia).

VII -SEMESTER

Course18B:InstrumentalMethodsofChemical Analysis

I. LearningOutcomes

Bythe endof thecourse, thestudents willbeable to:

1) Handleanalyticaldata

2) UnderstandbasiccomponentsofIR,FTIR,UV-VisibleandMassspectrometer.

3) InterpretofIR,FTIR, UV-visiblespectraandtheirapplications.

4) Understandthe useof single anddouble beam instruments.

5) Learnelementalanalysis,ElectroanalyticalMethods,RadiochemicalMethods,X-ray analysis and electron spectroscopy

II. Syllabus:

Unit-I:Introductiontoanalyticalmethodsofdataanalysisand Electroanalytical Methods: [9 hours]

Treatmentofanalyticaldata,includingerroranalysis.Classificationofanalyticalmethods and the types of instrumental methods. Consideration of electromagnetic radiations.

Potentiometry&Voltammetry.

Unit–II:Molecularspectroscopy[9hours]

Infrared spectroscopy: Interaction of radiations with molecules: absorption and scattering. Means of excitation (light sources), separation of spectrum (wavelength dispersion, time resolution), detection of the signal (heat, differential detection), interpretation of spectrum (qualitative, mixtures, resolution),and advantages of Fourier-Transform Infrared (FTIR) spectroscopy.

Applications: Issuesof qualityassurance andqualitycontrol,special problemsforportable instrumentation and rapid detection.

Unit- III:UV-Visible/ Near IR Spectroscopy [9hours]

Emission, absorption, fluorescence and photoacoustic. Excitation sources (lasers, time resolution),wavelength dispersion (gratings, prisms, interference filters, laser, placement of sample relative to dispersion, resolution), Detection of signal (photocells, photomultipliers,

diode arrays, sensitivity and S/N),Single and double beam instruments, Interpretation (quantification, mixtures, absorption vs. fluorescence and the use of time).

Unit–IV:Massspectroscopy[9hours]

Making the gaseous molecule into an ion (electron impact, chemical ionization), Making liquids and solids into ions (electrospray, electrical discharge, laser desorption, fast atom bombardment), Separation of ionson basis of mass to charge ratio, Magnetic, Time of flight, Electric quadrapole. Resolution, time and multiple separations, detection and interpretation.

Unit–V:Elementalanalysis[9hours]

Atomic spectroscopy**:** Atomic absorption, atomic emission, and atomic fluorescence. Excitation and getting sample into gas phase (flames, electrical discharges, plasmas),

wavelength separation and resolution (dependence on technique), detection of radiation (simultaneous/scanning, signal noise),interpretation (errors due to molecular and ionicspecies, matrix effects, other interferences).

III. SuggestedCo-CurricularActivities

1. Trainingofstudentsbyrelatedindustrialexperts.

2. Assignments,SeminarsandQuiz(onrelatedtopics),collection of relevant videos and material.

3. Visitsofabilities,firms,researchorganizationsetc.

4. Invitedlecturesandpresentationsonrelatedtopicsbyfield/industrialexperts.

IV. SuggestedTextBooks:

1. Willard,H.H.;Merritt,L.L.Jr.;Dean,J.A.;Settle, F.A.Jr.(2004), **Instrumentalmethods of analysis**, 7th edition, CBS Publishers.

2. Skoog,D.A.;Holler,F.J.;Crouch,S.(2006),**PrinciplesofInstrumentalAnalysis**, Thomson Brooks/Cole.

3. Banwell,C.N.(2006),**FundamentalsofMolecularSpectroscopy**,TataMcGraw-Hill Education

V. ReferenceBooks:

1. Skoog,D.A.;Holler,F.J.;Crouch,S.(2006),**PrinciplesofInstrumentalAnalysis**, Cengage Learning.

2. Christian,G.D.(2004),**AnalyticalChemistry**,6thEdition,JohnWiley&Sons,NewYork.

Course18B:InstrumentalMethodsofChemicalAnalysis-PracticalSyllabus

VI:Courselearningoutcomes

Bythe endofthecoursestudentswill beable to

1) DeterminetheisoelectricpHofaprotein

2) Identifythefunctionalgroupspresent inorganiccompounds

3) Estimatethe amountof chlorideandiodidepresentinthesolution

4) Recognizethequality ofwater

VII. Practical-Syllabus

1. DeterminationoftheisoelectricpHofaprotein.

2. Titration curveofanaminoacid

3. IRabsorptionspectra(studyofaldehydesandketones)

4. Potentiometrictitrationofachloride-iodidemixture

5. PotentiometricTitrationofMetalIonsinEthanol

6. Estimationof Alkalinity,BODandCOD

VIII. Co-CurricularActivities:

a) **Mandatory:***(Lab/fieldtrainingofstudentsbyteacher:(lab:10+field:05*):

1. **ForTeacher**: Training ofstudents by theteacher inlaboratoryand field for not lessthan15 hours on the field techniques/skills of detection of organic compounds using spectroscopic data.

2. **ForStudents**:Student shall visit a related industry/ chemistry laboratory in universities/research organizations/private sector facility andobserves the synthetic reactions and obtain spectral data for interpretation of the synthetic compounds. Write their observations and submit a hand written fieldwork/project work report not exceeding10

3.

4. pagesinthegivenformattotheteacher.

5. Max.marksforFieldwork/projectworkReport:05.

6. Suggested Format for Fieldwork/project work: *Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.*

7. Unittests(IE).

IX. References:

1. Skoog,D.A.;Holler,F.J.;Crouch,S.(2006),**PrinciplesofInstrumentalAnalysis**, Cengage Learning.

2. Christian,G.D.(2004),**AnalyticalChemistry**,6thEdition,John Wiley&Sons,NewYork.

VII-SEMESTER

Skill Enhancement Course

Course19A:GreenChemistry

I. Learning Outcomes:

Bythe endofthecourseStudentswill beable to:

1. Understand the twelve principles of green chemistry and will build the basic understanding of toxicity, hazard and risk of chemical substances·

2. Understandstoichiometric calculationsandrelate themtogreenchemistrymetrics.

3. Theywilllearnabout atomeconomyandhowitisdifferent frompercentageyield.

4. Learn to design safer chemical, products and processes that are less toxic, than current alternatives. Hence, they will understand the meaning of inherently safer design for accident prevention and the principle "what you don't have can't harmyou"

5. Understand benefits of use of catalyst and bio catalyst,use of renewable feed stock which helps in energy efficiency and protection of the environment, renewable energy sources, and importance led reactions in various green solvents.

6. Appreciate the use of green chemistry in problem solving skills, critical thinking and valuable skills to innovate and findoutsolutiontoenvironmental problems. Thus the students are able to realize that chemistry can be used to solve rather than cause environmental problems.

7. Green chemistry is a way to boost profits, increase productivity and ensure sustainability with absolute zero waste. Success stories and real world cases also motivate them to practice green chemistry.

II. Syllabus:

Unit1:IntroductiontoGreenChemistry [9hours]

What is Green Chemistry? Some important environmental laws, pollution prevention Act of 1990, emergence of green chemistry, Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry.

Unit2:PrinciplesofGreenChemistryandDesigningaChemicalsynthesis[9hours]

TwelveprinciplesofGreenChemistryandtheirexplanationwithexamples

Specialemphasisonthefollowing:

Prevention of Waste/ by products; maximum incorporation of the materials used in theprocess into the final products, Environmental impact factor, waste or pollution prevention hierarchy.Green metrics to assessgreennessof areaction, e.g.AtomEconomy,calculation of atom economy of the rearrangement, addition, substitution and elimination reactions. Prevention/ minimization of hazardous/ toxic products reducing toxicity. Risk = (function) hazard x exposure. Designing safer chemicals with minimum toxicity yet has the ability to perform the desired functions. Green solvents: super critical fluids with special reference to carbon dioxide, water as a solvent for organic reactions, ionic liquids, fluorous biphasic solvent, PEG, solventless processes, solvents obtained from renewable resources and how to compare greenness of solvents. Energy requirements for reactions – alternative sources of energy: use of microwaves,

Ultrasonic energy and photochemical energy. Selection of starting materials; should be renewable rather than depleting, Illustrate with few example such as biodiesel and polymers from renewable resources (such as green plastic). Avoidance of unnecessary derivatization – careful use of blocking/protecting groups. Use of catalytic reagents (wherever possible) in preference to stoichiometric reagents; catalysis andgreen chemistry, comparison of heterogeneous and homogeneous catalysis, biocatalysis, asymmetric catalysis and photocatalysis.

Unit3:ExamplesofGreenSynthesis/Reactions[9hours]

Green Synthesis of the following compounds: adipic acid, catechol, disodium iminodiacetate (alternative toStrecker synthesis).Green Reagents: Non-phosgene Isocyanate Synthesis, Selective Methylation using Dimethylcarbonate. Microwave assisted solvent free synthesis of copper phthalocyanine. Microwave assisted reactions in water: Hofmann Elimination, methyl benzoate to benzoic acid. AndDecarboxylation reactionUltrasound assisted reactions: sonochemical Simmons-Smith Reaction (Ultrasonic alternative to Iodine)

Unit 4:[9 hours]

Real world case studies based on the Presidential green chemistry awards of EPA Surfactants for Carbon Dioxide – replacing smog producing and ozone depleting solventswith CO_2 for precision cleaning and dry cleaning of garments. A new generation of environmentally advanced wood preservatives: Getting the chromium and Arsenic out of pressure treated wood.An efficient,green synthesis of a compostable andwidely applicable

plastic(polylacticacid) madefromcorn.HealthierFatsandoilsbyGreenChemistry: Enzymatic Inter esterification for production of No Trans-Fats and Oils.

Unit 5:Future Trends in Green Chemistry [9 hours]

Oxidation reagents and catalysts; Biomimcry and green chemistry, Biomimetic, Multifunctional Reagents; mechanochemical and solvent free synthesis of inorganic complexes; co crystal controlled solid state synthesis(C_2S_3); Green chemistry in sustainable development.

III. SuggestedCo-CurricularActivities

1. Trainingofstudentsbyrelatedindustrialexperts.

2. Assignments,SeminarsandQuiz(onrelatedtopics),collectionofrelevan t videos and material.

3. Visitsofabilities,firms,researchorganizationsetc.

4. Invitedlecturesandpresentationsonrelatedtopicsbyfield/industrialexperts.

IV. SuggestedTextBooks:

1. Anastas,P.T.;Warner,J.C.(1998),**GreenChemistry,TheoryandPractice,**Oxford University Press.

2. Lancaster,M.(2016),**GreenChemistryAnIntroductoryText.**2ndEdition,RSC Publishing.

3. Cann,M.C.;Connely,M.E.(2000),**Real-WorldcasesinGreenChemistry,**American Chemical Society,Washington.

4. Matlack,A.S.(2001),**IntroductiontoGreenChemistry,** MarcelDekker.

5. Alhuwalia,V.K.;Kidwai,M.R.(2005),**NewTrendsin Greenchemistry**,Anamalaya

Publishers

V. References:

1. Kirchoff, M.; Ryan, M.A. (2002), **Greener approaches to undergraduate chemistry experiment.** AmericanChemical Society, Washington DC.

2. Sharma,R.K.;Sidhwani, I.T.;Chaudhari,M.K.(2013), **GreenChemistry Experiments:A monograph,** I.K.International Publishing House Pvt Ltd. New Delhi.

3. Pavia,D.L.; Lamponam, G.H.; Kriz, G.S.W. B.(2006),**Introduction to organic Laboratory Technique-A Micro-scale approach**,4th Edition, Brooks-Cole Laboratory Series for Organic chemistry.

VII-SEMESTER

Skill Enhancement Course

Course19A:GreenChemistrypractical

LearningOutcomes:

By the end of the course students will be able to

1. Synthesizenanoparticlesusinggreenmethods
2. Preparebiodieselformwastecooking oil
3. Synthesizeinorganiccomplexesusinggreenmethods
4. Synthesizebenzopinacolinthepresenceofsunlight

VI. PracticalSyllabus

1. Preparation and characterization ofnanoparticles of CuO/ ZnOnanoparticles usingplant extracts.

2. Preparationofbiodieselfromwastecookingoiland characterization(TLC,pH,Solubility, Combustion Test,Density, Viscosity.

3. BenzoincondensationusingThiamineHydrochlorideas acatalystinsteadofcyanide.

4. Solventfree,microwaveassistedonepotsynthesisofphthalocyaninecomplexof copper(II).

5. Photoreductionofbenzophenonetobenzopinacolinthepresenceofsunlight.

6. Spottestsforqualitativeinorganicanalysisforcationsandanions,andqualitativeorganic analysis for preliminary test and functional group analysis.

VII. Co-CurricularActivities:

Mandatory:*(Lab/fieldtrainingofstudentsbyteacher:(lab:10+field:05*):

1. For Teacher: Training of students by the teacher in laboratory and field for not less than15 hours on the field techniques/skills of green methodologies in place of

polluting solvents/chemicals

2. **For Students**: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observes the green synthetic methods adopted in the industry. Write their observations and submit a hand written fieldwork/project work report not exceeding 10 pages in the given format to the teacher.

3. Max.MarksforFieldwork/projectworkReport:05.

4. Suggested Format for Fieldwork/project work**:** *Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.*

5. Unittests(IE).

VIII. References:

1. Wealth from Waste: A green method to produce biodiesel from waste cooking oil and generation of usefulproducts from waste further generated. Indu Tucker Sidhwaniet al. University of Delhi, Journal ofUndergraduate Research and Innovation, Volume 1, Issue 1,February 2015, ISSN: 2395-2334.

2. Sidhwani, Tucker I.; Chowdhury, S. Greener alternatives to Qualitative Analysis for Cations withoutH_2S and other sulfur containing compounds, J. Chem. Educ. 2008, 85, 1099.

3. Sidhwani, Tucker I.; Chowdhury, S. et al., DU Journal of Undergraduate Research and Innovation,2016, Volume 2, Issue 2, 70-79.

4. Dhingra,S.,;Angrish,C.Qualitativeorganicanalysis:Anefficient,safer,andeconomical approach to preliminary tests and functional group analysis. *Journal of ChemicalEducation*, 2011, *88*(5), 649-651.

VII-SEMESTER

SkillEnhancement Course

Course19B:AnalysisofDrugs,Foods,DairyProducts&Bio-ChemicalAnalysis

I. LearningOutcomes:

Studentsaftersuccessful completionofthecoursewillbeableto:

1. Explaintheprinciplesof formulationandapplicationofDrugs.
2. Acquirea critical knowledgeon synthetictechniques ofdrugs.
3. Demonstratetheskillsinanalysisof**Foods,DairyProducts.**
4. Comprehendedtheapplicationsof**Bio-ChemicalAnalysis**.
5. Acquireacritical knowledgeon analysisof**Foods,DairyProducts.**

II. Syllabus)

UNIT-I **9hours**

Analysis of the following drugs and pharmaceuticals preparations: (Knowledge of molecular formula, structure and analysis): Analysis of analgesics and antipyretics like aspirin and paracetamol,Analysisof antimalerialslikecholoroquine,Analysisof drugsinthetreatmentof infections and infestations: Amoxycillin, chloramphenicol, penicillin, tetracycline.

UNIT-II **9hours**

Analysis of the following drugs and pharmaceuticals preparations :(Knowledge of molecular formula, structure and analysis):

Analysis of antihistamine drugs and sedatives like: allegra, zyrtec (citirizine), alprazolam, trazodone, lorazepem, ambien(zolpidem).

UNIT-III **9hours**

Analysis of anti epileptic and anti convulsant drugs like phenobarbital and phenacemide.Analysis of drugs used in case of cardiovascular drugs:atenolol,norvasc(amlodipine),Analysis of lipitor(atorvastatin) a drug for the prevention of production of cholesterol.

Analysisofdiureticslike:furosemide(Lasix),triamterene

Analysis of prevacid(lansoprazole)a drug used for the prevention of production of acids in stomach.

UNIT-IV **10hours**

Analysis of Milk and milk products:Acidity,total solids,fat,total nitrogen,protenines, lactose, phosphate activity, casein, choride. Analysis of food materials-Preservatives :Sodium carbonate, sodium benzoate sorbicacid. Coloring matters –Briliant blue FCF, fastgreenFCF, tertrazine, erytrhosine, sunset yellowFCF.

Flavoringagents -Vanilla,diacetyl,isoamylacetate,limonene, ethylpropionate, allyl

hexanoateandAdulterantsinriceandwheat,wheatfloor,sago,coconutoil,coffeepowder, tea powder, milk.

UNIT-V **8hours**

Clinicalanalysisofblood:Compositionofblood,clinical analysis,traceelementsinthebody. Estimation of blood chlolesterol, glucose,enzymes, RBC&WBC,Blood gas analyser.

III. SuggestedCo-CurricularActivities

1) Trainingofstudentsby relatedindustrialexperts.
2) Assignments,SeminarsandQuiz(onrelatedtopics), collectionofrelevant videosand material.
3) Visitsofrelated Industries/firms,researchorganizations etc.
4) Invitedlecturesandpresentationsonrelatedtopicsbyfield/industrialexperts.

IV. Text Books:

1. WilsonandGiswold'sOrganicmedicinalandPharmaceuticalChemistry.

2. Foye'sPrinciplesofMedicinalChemistry.

3. Burger'sMedicinalChemistry,VolItoIV.

4. Introductiontoprinciplesofdrugdesign-Smithand Williams.

V. ReferencesBooks:

1. WilsonandGiswold'sOrganicmedicinal andPharmaceuticalChemistry.

2. Foye'sPrinciplesofMedicinalChemistry.

3. Burger'sMedicinalChemistry,VolItoIV.

4. Introductiontoprinciplesofdrugdesign-Smithand Williams.

5. Remington'sPharmaceuticalSciences.

6. Martindale'sextrapharmacopoeia.

7. OrganicChemistrybyI.L.Finar,Vol.II.

8. TheOrganicChemistryofDrugSynthesis byLednicer, Vol.1-5.

9. Textbookofpracticalorganicchemistry-A.I.Vogel.

Course19B.AnalysisofDrugs,Foods,DairyProducts&Bio-ChemicalAnalysis-PracticalSyllabus

VI. LearningOutcomes:

Onsuccessfulcompletionofthispracticalcourse,studentshallbeableto:

1. Developcomprehensiveproductdevelopmentprogramsto meetnewproductcriteria and timing.
2. Acquireskills intheAnalysisofDrugs,foodsandDairyProducts.
3. Demonstrateproficiencyintheexperimentaltechniquesofbiomedicalchemical
4. Carryout foodtesting with theknowledgeof foods.
5. Learntheprocedureofsynthesisofdrugs.
6. Criticallydevelop,apply,report,interpretandreflectonstrategies forcollectingdata in the lab and field.

VII. Practical(Laboratory)Syllabus:

1. PreparationofAspirin
2. PreparationofParacetamol
3. PreparationofAcetanilide
4. PreparationofBarbutiricAcid
5. PreparationofPhenylAzoβ-naphthol

VIII. ReferencesBooks:

1. Introduction toprinciplesofdrugdesign-SmithandWilliams.
2. Remington'sPharmaceuticalSciences.
3. Martindale'sextrapharmacopoeia.
4. OrganicChemistrybyI.L.Finar,Vol.II.
5. TheOrganicChemistryofDrugSynthesis byLednicer, Vol.1-5.
6. Textbookofpracticalorganicchemistry-A.I.Vogel.

IX. Co-CurricularActivities

Mandatory:*(Lab/fieldtrainingofstudentsbyteacher:(lab:10+field:05*):

1. **For Teacher**: Training of students by the teacher in laboratory and field for not lessthan15 hours on the fieldtechniques/skills of comprehensive product development programs to meet new product criteria and timing. Acquire skills in the preparation of Drugs, foods and Dairy Products, carry out food testing with the knowledge of testing food adultrationand learn the procedure of synthesis of drugs.
2. **ForStudents**:Studentshallvisitarelatedindustry/chemistrylaboratoryinuniversities/res e arch organizations/private sector facility and observes the preparation of CosmeceuticalsandPharmaceutical.Writetheirobservationsandsubmitahandwritten fieldwork/project workreportnotexceeding10 pages in the given format to the teacher.

   a). MaxmarksforFieldwork/projectworkReport:05.

   b). SuggestedFormatforFieldwork/projectwork**:***Titlepage,student details,indexpage,detailsofplacevisited, observations,findings,andacknowledgements.*

   c).Unittests(IE).

SEMESTER– VII

Skill Enhancement course

Course20A:PolymerChemistry

I. CourseLearningOutcomes

Bythe endofthiscourse, studentswill beable to:

1. Knowabout history ofpolymericmaterials and theirclassification

2·Learnaboutdifferentmechanismsofpolymerizationandpolymerizationtechniques 3· Evaluate kinetic chain length of polymers based on their mechanism

4·Differentiatebetweenpolymersandcopolymers

5·Learn aboutdifferent methodsoffindingoutaveragemolecularweightofpolymers

6·Differentiatebetweenglasstransitiontemperature(Tg)andcrystallinemeltingpoint(Tm) 7· Determine Tg and Tm

8·Knowaboutsolidand solution propertiesofpolymers

9·Learnpropertiesandapplications ofvarioususefulpolymers inourdaily life.

II. Syllabus:

Unit-1

Historyofpolymericmaterialsandfunctionalityanditsimportance [9hours]

Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers.Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization. Bi-functional systems, Poly-functional systems.

Unit-II

KineticsofPolymerization [9hours]

Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques.

Unit-III

Determination of molecular weight of polymers and crystallinity [9 hours]

(*Mn*,*Mw*, etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance. Poly dispersity index. Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point.

Unit-IV

Glasstransition temperature(Tg)andPolymerSolution [9hours]

Free volume theory, WLF equation, Factors affecting glass transition temperature (Tg). Criteria for polymer solubility, Solubility parameter, Thermodynamics of polymersolutions, entropy, enthalpy, and free energy change of mixing of polymers solutions, Flory- Huggins theory, Lower and Upper critical solution temperatures.

Unit-V

PropertiesofPolymers [9hours]

(Physical,thermal,Flow&Mechanical Properties).

Brief introduction to preparation, structure, properties and application of the following polymers: poly olefins, polystyrene and styrene copolymers, poly (vinyl chloride) and related polymers, poly(vinyl acetate) and related polymers, acrylic polymers, fluoro polymers, polyamides and related polymers. Phenol formaldehyde resins (Bakelite, Novalac), polyurethanes, silicone polymers, polydienes, Polycarbonates, Conducting Polymers, [poly acetylene, poly aniline, poly(p-phenylene sulphide poly pyrrole, poly thiophene)].

III. SuggestedCo-CurricularActivities

1. Trainingofstudentsby relatedindustrialexperts.

2. Assignments,SeminarsandQuiz(onrelatedtopics),collectionofrelevant videos and material.

3. Visitsofabilities,firms,researchorganizationsetc.

4. Invitedlecturesandpresentationsonrelatedtopicsbyfield/industrialexperts.

IV. SuggestedTextBooks:

1. R.B.Seymour&C.E.Carraher:*PolymerChemistry:AnIntroduction,*MarcelDekker,Inc. New York, 1981.

2. G.Odian:*Principlesof Polymerization*,4th Ed.Wiley,2004.

3. F.W.Billmeyer:*TextbookofPolymerScience*,2ndEd.WileyInterscience,1971.

4. P.Ghosh:PolymerScience&Technology,Tata McGraw-HillEducation,1991.

5. R.W.Lenz:*OrganicChemistryofSyntheticHighPolymers.* InterscicencePublishers,New York, 1967.

V. Refernces:

1. Allcock,H.R.;;Lampe,F.W.;Mark,J.E.(2003),**ContemporaryPolymerChemistry**, Prentice-Hall.

2. Fried,J.R.(2003),**PolymerScienceandTechnology**,Prentice-Hall.

Course20A:PolymerChemistry-PracticalSyllabus

VI. LearningOutcomes:

Bythe endofthecoursestudentswill beable to

1. Determinethemolecularweightof apolymerbyviscometricstudies

2. Prepareurea formaldehydepolymer

3. Determinethemolecularweightbyendgroupanalysis

VII. PracticalSyllabus

1. EstimationoftheamountofHCHOinthe givensolutionbysodium sulphitemethod

2. Determinationofmolecularweightbyviscometry:Polyvinylproplylidine(PVP)inwater

3. Determinationofmolecularweightbyendgroupanalysis

4. Preparationofurea-formaldehyderesin

5. Precipitationpolymerizationofacrylonitrile

6. Redoxpolymerizationofacrylamide

VIII. Co-CurricularActivities:

Mandatory:*(Lab/fieldtrainingofstudentsbyteacher:(lab:10+field:05*):

1. For Teacher: Training of students by the teacher in laboratory and field for not less than15 hours on the field techniques/skills of preparation of polymers.

2. For Students: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observes the preparation steps of polymers and quality polymer formed using various techniques. Write their observations and submit a hand written fieldwork/project work report not exceeding

10pages inthegiven formatto theteacher.

3. Max.MarksforFieldwork/projectworkReport:05.

4. Suggested Format for Fieldwork/project work**:** *Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.*

5. Unittests(IE).

IX. References:

1. Munk,P.;Aminabhavi,T.M.(2002),**IntroductiontoMacromolecularScience,** John Wiley &Sons.

2. Sperling,L.H.(2005),**IntroductiontoPhysical PolymerScience**,John Wiley&Sons

SEMESTER– VII

SkillEnhancementCourse

Course20B.IndustrialChemicalsand Environment

I. LearningOutcomes:

Studentsaftersuccessful completionofthecoursewillbeableto:

1. Identifytheimportanceof Manufactureof***InorganicChemicals***
2. Acquireknowledgeonproduction,uses,storageandhazardsof*IndustrialGases*.
3. Understandtheimportanceof**Environment.**
4. Understandingaboutwaterpollutionanditseffects.
5. Acquireknowledgeon**EnergyanditseffectsonEnvironment**

Syllabus

Unit-I *9Hours*

Inorganic Chemicals: Manufacture, application, analysis and hazards in handling the following chemicals: hydrochloric acid, nitricacid, sulphuricacid, causticsoda, common salt, borax, bleaching powder, sodium thiosulphate, hydrogen peroxide, potash alum,chrome alum, potassium dichromate and potassium permanganate.

Unit-II 9Hours

IndustrialGases: Largescaleproduction,uses,storageandhazardsinhandlingofthefollowing gases: oxygen, nitrogen, argon, neon, helium, hydrogen, acetylene, carbon monoxide, chlorine,fluorine,sulphur dioxide and phosgene

IndustrialMetallurgy:

Preparationofmetals(ferrousandnonferrous)andultrapuremetalsforsemiconductortechnology.

Unit-III 9 hours

Airpollution

Air Pollution: Major regions of atmosphere. Chemical and photochemical reactions in atmosphere. Air pollutants :types, sources, particle size and chemical nature; Photochemical smog: its constituents and photochemistry. Environmental effects of ozone, Major sources of

air pollution. Pollution bySO_2, CO_2, CO, NOx, H_2S and other foul smelling gases. Methods of estimation of CO, NOx, Sox and control procedures. Effects of air pollution on living organisms and vegetation. Greenhouse effect and Global warming, Ozone depletion by oxides of nitrogen, chloro fluoro carbons and Halogens, removal of sulphur from coal. Control of particulates.

Unit-IV **9hours**

Water Pollution: Hydrological cycle, water resources, aquatic ecosystems, Sources and nature of water pollutants, Techniques for measuring water pollution, Impacts of water pollution on hydrological and ecosystems. Water purification methods. Effluent treatment plants (primary, secondary and tertiary treatment). Industrial effluents from the following industries and their treatment: electroplating, textile, tannery, dairy, petroleum and petrochemicals, agro, fertilizer,etc.

Unit-V

Energy&Environment **9hours**

Sources of energy: Coal, petrol and naturalgas.NuclearFusion/Fission,Solarenergy,Hydrogen,geothermal,TidalandHydel,etc. Nuclear Pollution: Disposal of nuclear waste, nuclear disaster and its management.

Biocatalysis:Introductiontobiocatalysis:Importancein—GreenChemistryandChemical Industry.

II. SuggestedCo-CurricularActivities

1. Trainingofstudentsby relatedindustrialexperts.
2. Assignments,SeminarsandQuiz(onrelatedtopics),collectionofrelevant videosand material.
3. Visitsofrelated Industries/firms,researchorganizationsetc.
4. Invitedlecturesandpresentationsonrelatedtopicsbyfield/industrialexperts.

III. Text Books:

1. J.A.Kent:Riegel's*HandbookofIndustrialChemistry*,CBSPublishers,NewDelhi.
2. S.S.Dara:*ATextbookofEngineeringChemistry*,S.Chand&CompanyLtd.NewDelhi.
3. K.De,*EnvironmentalChemistry*:NewAgeInternationalPvt.,Ltd,New Delhi.
4. E.Stocchi:*IndustrialChemistry*,Vol-I,EllisHorwoodLtd.UK.

IV. ReferencesBooks:

1. E.Stocchi:*IndustrialChemistry*,Vol-I,EllisHorwoodLtd.UK.
2. R.M.Felder,R.W.Rousseau:*ElementaryPrinciplesofChemicalProcesses*, WileyPublishers,New Delhi.
3. J.A.Kent:Riegel's*HandbookofIndustrialChemistry*,CBSPublishers,NewDelhi.
4. S.S.Dara:*ATextbookofEngineeringChemistry*,S.Chand&CompanyLtd.NewDelhi.
5. K.De,*EnvironmentalChemistry*:NewAgeInternationalPvt.,Ltd,New Delhi.
6. S.M.Khopkar,*EnvironmentalPollution Analysis*: WileyEasternLtd,NewDelhi.
7. S.E.Manahan,EnvironmentalChemistry,CRCPress(2005).
8. G.T.Miller,EnvironmentalScience11thedition.Brooks/Cole(2006).
9. A.Mishra,EnvironmentalStudies.SelectiveandScientificBooks,NewDelhi(2005).

Course20B:IndustrialChemicals&Environment-PracticalSyllabus

V. LearningOutcomes:

Onsuccessfulcompletionofthispracticalcourse,studentshall beableto:

1. PerformDeterminationofDO,CODandBOD
2. Learn the procedure for measurementofchloride,sulphateandsalinityofwa ter
3. Estimationoftotal alkalinityofwater
4. AcquireskillsindeterminationofdissolvedgaseslikeO2,CO2,SPMetc.

Practical(Laboratory)Syllabus:

1. DeterminationofDissolvedOxygen(DO)inwater.
2. DeterminationofChemicalOxygenDemand(COD)
3. DeterminationofBiologicalOxygenDemand(BOD)
4. Percentageofavailablechlorineinbleachingpowder.
5. Measurement of chloride, sulphate and salinity of watersamples by simpletitration method ($AgNO_3$ and potassium chromate).
6. Estimation of total alkalinity ofwatersamples (CO_3^{2-},HCO_3^-) using doubletitration method.
7. Measurementof dissolvedCO_2.
8. Studyofsome ofthecommonbio-indicators ofpollution.
9. EstimationofSPMinairsamples.
10. Preparationofborax/boricacid.

VI. LabReferences:

1. E.Stocchi:*IndustrialChemistry*,Vol-I,EllisHorwoodLtd.UK.
2. R.M.Felder,R.W.Rousseau:*ElementaryPrinciplesofChemicalProcesses*, WileyPublishers,New Delhi.
3. J.A.Kent:Riegel's*HandbookofIndustrialChemistry*,CBSPublishers,NewDelhi.
4. S.S.Dara:*ATextbookofEngineeringChemistry*,S.Chand&CompanyLtd.NewDelhi.
5. K.De,*EnvironmentalChemistry*:NewAgeInternationalPvt.,Ltd,NewDelhi.
6. S.M.Khopkar,*EnvironmentalPollution Analysis*:WileyEasternLtd,NewDelhi.

VII. Co-CurricularActivities

Mandatory:*(Lab/fieldtrainingofstudentsbyteacher:(lab:10+field:05*):

5. **For Teacher**: Training of students by the teacher in laboratory and field for not lessthan15 hours on the field techniques/skills in determinationofDO,COD,BOD,CO2,SPMetc.Learntheprocedure for measurementofchloride,sulphateandsalinityofwater, total alkalinityof water
6. **ForStudents**:Studentshallvisitarelatedindustry/chemistrylaboratoryinu n iversities/research organizations/private sector facility and observes the determinationofDO, COD,BOD, CO2,SPM etc. Write theirobservations and submit a hand written fieldwork/project workreportnotexceeding10 pages inthegivenformat totheteacher.

a. MaxmarksforFieldwork/projectworkReport:05.

b. SuggestedFormatforFieldwork/projectwork**:***Titlepage,student details, indexpage,detailsofplacevisited, observations,findings,andacknowledgements.*

c. Unittests(IE).