BS-Chemistry Week Wise Course Modules for Courses offered to Other Departments

Department of Biochemistry

Course Title: Fundamental Inorganic Chemistry
Course Code: CHM-301
Course Structure: Theory (3), Lab (1)

Semester: BS-I
Session: 2019-Onwards
Credit Hours: 4 (3 + 1)

CONTENTS	WEEK	Lectures
Introduction to the major core chemistry. **Chapter 1: The Periodic Law and Periodicity** Development of Periodic Table: Doberiner Trieds, Newland's Octaves, Mendeleev's Periodic Table, Modern Periodic Law.	**1**	**1** **2** **3** **4**
Quantum Numbers, Hund's rule and Aufbau principle, Periodic table and Classification of elements based on s, p, d and f orbitals,	**2**	**5** **6** **7** **8**
Group trends, and periodic properties in s, p, d and f block elements, i.e., atomic radii, ionic radii, ionization potential, electron affinities, electronagetivities, electropositivity, redox potential and electrochemical series.	**3**	**9** **10** **11** **12**
Chapter 2: Principles of Chemical Bonding Types of chemical bonding: Ionic bond, covalent bond, coordinate covalent bond, metallic bond and hydrogen bonding. **Lab: Laboratory Ethics and Safety Measures:** Awareness about the toxic nature of chemicals and their handling, cleaning of glassware, safe laboratory operations.	**4**	**13** **14** **15** **16**
Electron deficient molecules. Lewis structures and prediction of shapes using VSPER model: shapes of molecule containing two, three, four electron pairs. **Lab: Qualitative Analysis:** Analysis of four ions (two anions and two cations) from mixture of salts.	**5**	**17** **18** **19** **20**

Localized bond approach: theories of chemical bonding, valance bond theory (VBT), hybridization of orbitals, sigma and pi bonds. **Lab: Quantitative Analysis:** Volumetric Analysis based on Redox reaction	**6**	**21** **22** **23** **24**
Resonance, the delocalized bond approach to bonding: molecular orbital theory (MOT) applied to diatomic molecules and poly atomic molecules, three center bonds, bonding theory of metals and intermetallic compounds	**7**	**25** **26** **27** **28**
Conductors, insulators, and semiconductors. **Lab: Quantitative Analysis:** Volumetric Analysis based on Iodometric and Iodimetric,	**8**	**29** **30** **31** **32**
MID TERM EXAM	**9**	
Chapter 3: Acids and Bases Concepts of acids and bases including Arrhenious concept, Protonic concept, Lewis concept,	**10**	**33** **34** **35** **36**
Lux-Flood concept, soft and hard acids and bases (SHAB) concept. **Lab: Quantitative Analysis:** Volumetric Analysis based on Precipitation and Complexometric Reactions.	**11**	**37** **38** **39** **40**
Relative strength of acids and bases, significance of pH, pKa, pKb and buffer solutions. **Lab: Quantitative Analysis:** Gravimetric Analysis based on Estimation of Ni^{2+}	**12**	**41** **42** **43** **44**
Theory of indicators, solubility, solubility product, common ion effect and their industrial applications. Leveling effect. **Lab: Quantitative Analysis:** Gravimetric Analysis based on Estimation of Ba^{2+}.	**13**	**45** **46** **47** **48**
Chapter 4: Chemistry of p-block Chemistry and structure of p-block elements; Group trend, characteristics, applications of Boron family, carbon family, nitrogen family, oxygen family, halogens and noble gases.	**14**	**49** **50** **51** **52**

Structure of noble gases and their compounds such as hydrides, clathrates, compounds with BF_3 and helides.	**15**	**53** **54** **55** **56**
Chemistry and structure: types, preparation and applications of inter-halogens, pseudo-halogens and polyhalides	**16**	**57** **58** **59** **60**
Lab: Quantitative Analysis: Determine percent of P and P_2O_5 in a sample of ammonium phosphomolybdate.	**17**	**61** **62** **63** **64**
FINAL TERM EXAM	**18**	

Department of Biochemistry

Course Title: Fundamental Physical Chemistry
Course Code: CHM-302
Course Structure: Theory (3), Lab (1)

Semester: BS-II
Session: 2019-Onwards
Credit Hours: 4 (3 + 1)

CONTENTS	WEEK	Lectures
Chapter 1: Physical properties of matter Concept of ideal and real gases, state variables, equations of states (ideal gas equation and van der waal equation)	**1**	**1** **2** **3** **4**
Kinetic model of gases, collision diameter, mean free path and collision frequency **Lab:** Determination of viscosity and parachor values of liquids.	**2**	**5** **6** **7** **8**
Properties of liquid, surface tension, viscosity, refractive index and polarity **Lab:** Determination of percent composition of liquid solutions viscometrically.	**3**	**9** **10** **11** **12**
Homogeneous and heterogeneous solutions, types of interactions in liquids, van der waal interactions and dipole-dipole interactions, Hydrogen bonding,	**4**	**13** **14** **15** **16**

Unit cell, crystal lattice, crystal system, miller indices, Crystalline and amorphous solids	**5**	**17** **18** **19** **20**
Chapter 2: Thermodynamics Thermodynamics system, surrounding, zeroth law of thermodynamics, concept of equilibrium, first law of thermodynamics. **Lab:** Determination of refractive index and molar refractivity.	**6**	**21** **22** **23** **24**
Concept of internal energy, enthalpy, thermodynamic processes under different conditions (isothermal, adiabatic, reversibility concept) **Lab:** Determination of percent composition of liquid solutions by refractive index measurements.	**7**	**25** **26** **27** **28**
Second law of thermodynamics, concept of entropy and Gibbs free energy	**8**	**29** **30** **31** **32**
MID TERM EXAM	**9**	
Chapter 3: Chemical Kinetics Rate of reactions, order of reactions, molecularity, extent of reaction, rate law	**10**	**33** **34** **35** **36**
Rate law of zero and first order reactions with examples and its differential and integrated forms	**11**	**37** **38** **39** **40**
Concept of half-life and mean life, factors affecting rates (Arrhenius equation) **Lab:** Determination of molecular weight of a compound by elevation of boiling point (ebullioscopic method).	**12**	**41** **42** **43** **44**
Chapter 4: Electrochemistry Introduction of electrochemistry (ions in solution, conductance,	**13**	**45** **46** **47**

resistance)		**48**
Ohm's law, Kohlrausch law **Lab:** Determination of heat of solution by solubility method.	**14**	**49** **50** **51** **52**
Concept of electrolysis, electrolytes, and electrode potentials.	**15**	**53** **54** **55** **56**
Electrochemical cell (galvanic cell and electrolytic cell)	**16**	**57** **58** **59** **60**
Lab: Determination of heat of neutralization of an acid with a base.	**17**	**61** **62** **63** **64**
FINAL TERM EXAM	**18**	

Department of Biochemistry

Course Title: Fundamental Organic Chemistry
Course Code: CHM-401
Course Structure: Theory (3), Lab (1)

Semester: BS-III
Session: 2019-Onwards
Credit Hours: 4 (3 + 1)

CONTENTS	WEEK	Lectures
Chapter 1: Introduction to organic Chemistry Organic chemistry-the chemistry of carbon compounds; the nature of organic chemistry-a historical perspective.	**1**	**1** **2** **3** **4**
Localized and delocalized chemical bonding, Rules **Lab: Qualitative organic analysis:** Systematic identification of organic compounds (monofunctional and simple bifunctional) and preparation of their derivatives.	**2**	**5** **6** **7** **8**
Concept of hybridization and shapes of organic molecules; resonance; aromaticity;	**3**	**9** **10** **11** **12**
Tautomerism; hyperconjugation; hydrogen bonding.	**4**	**13** **14**

Lab: Preparation of Suphanilic acid and dibenzyl acetone		**15**
		16
Chapter 2: Classes and Nomenclature of Organic Compounds: Classification of organic compounds (on the basis of Origin, structure, and functional group)	**5**	**17**
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Development of systematic nomenclature of organic compounds; IUPAC nomenclature of hydrocarbons (Alkanes, Alkenes, Alkynes, Alkyl Halides, Alcohols, Aldehydes, Ketones, Carboxylic Acids, Ethers, and Esters)	**6**	**21**
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		24
IUPAC nomenclature of heteroatom functional groups including polycyclic system and compounds containing more than one functional groups.	**7**	**25**
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		27
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Lab: Preparation of; methyl orange, dinitrobenzene from benzene, isolation of caffeine.	**8**	**29**
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		32
MID TERM EXAM	**9**	
Chapter 3: Functional Group Chemistry A brief introduction to the chemistry of hydrocarbons; Preparation and Reaction of alkanes, alkenes, and alkynes	**10**	**33**
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A brief introduction to the chemistry of hydrocarbons; Preparation and Reaction of alkyl halides, alcohols, and their derivatives.	**11**	**37**
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A brief introduction to the chemistry of hydrocarbons; Preparation and Reaction of phenols, amines, and their derivatives.	**12**	**41**
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		43
		44
A brief introduction to the chemistry of hydrocarbons; Preparation and Reaction of carboxylic acids and their derivatives.	**13**	**45**
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		48
Chapter 4: Applications of Chemistry Use of organic compounds in industries, like medicinal,	**14**	**49**
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		51

and pharmaceutical		**52**
Use of organic compounds in cosmetics, paints and pigments, **Lab:** Estimation of phenol (bromide-bromate method) and aniline (bromide-bromate and acetylation methods).	**15**	**53** **54** **55** **56**
Use of organic compounds in polymers **Lab:** Equivalent weight of an acid (neutralization).	**16**	**57** **58** **59** **60**
Lab: Identification of organic functional groups by I.R. spectroscopy.	**17**	**46** **47** **48**
FINAL TERM EXAM	**18**	

Department of Biochemistry

Course Title: Fundamental Analytical Chemistry
Course Code: CHM-403
Course Structure: Theory (3), Lab (1)

Semester: BS-IV
Session: 2019-Onwards
Credit Hours: 4 (3 + 1)

CONTENTS	WEEK	Lectures
Chapter 1: Introduction to analytical chemistry Historical background, Basic concepts (Definition, Types, and Purpose/aim), Applications of analytical chemistry in various fields.	**1**	**1** **2** **3** **4**
Chemical Analysis and its Types (classical, and Instrumental analysis, Volumetric and gravimetric analysis).	**2**	**5** **6** **7** **8**
Principal steps in chemical analysis and methods of chemical analysis Analytical Process and steps involved in analytical process	**3**	**9** **10** **11** **12**
Analytical tools, tritimatric, spectroscopic, chromatographic, and their	**4**	**13** **14**

application in various fields of life.		**15**
		16
Sampling and Application (concept of sampling, sample, analyte, population, census, factors that affect sample representativeness, and Sampling techniques)	**5**	**17**
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Chapter-2: Measurements and Chemical Analysis Concentration Units (Concentration, Percentage composition (Mole) with numerical, Molarity, normality,molality formality,ppm,ppb)	**6**	**21**
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		24
Stoichiometric calculations (Definition, Limiting ,excess reagent steps in stoichiometry, and Calculation, numericals having Mole-mole , mole-mass conversion)	**7**	**25**
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		28
Lab: Lab safety and precautions **Lab:** Introduction and calibration of glassware and instruments	**8**	**29**
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MID TERM EXAM	**9**	
Chapter 3: Data Handling Experimental errors, Types, and numericals. Accuracy, Precision, limit of detection. **Lab:** Determination of Cations and anions (mass measurement)	**10**	**33**
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		36
Evaluation of data, Quality of results, Quality assurances. Calibration methods.	**11**	**37**
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Chapter 4: Chemical Equilibria General concept of Chemical equilibria, Types of equilibria, Acid base	**12**	**41**
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		43

equilibria in water, Lechatlier Principle and various effects on chemical equilibrium constant **Lab:** Acid-base titrations		**44**
PH scale, Buffer, Redox (Redox reactions, examples) **Lab:** Redox titrations	**13**	**45** **46** **47** **48**
Complexation (Complexes stability, complexes constant, Chelates, examples and chelate effect) **Lab:** Complexation titrations	**14**	**49** **50** **51** **52**
Precipitation (digestion, impurities in precipitate, Washing and filtering of precipitate) Gravimetric calculation.	**15**	**53** **54** **55** **56**
Solubility and solubility product, Ionic strength, activity and activity coefficient, numericals	**16**	**57** **58** **59** **60**
Titration Curves (Titration, Titrant, Titrand, Eqvivalnce point, end point, detection of end point, indicators, Strong acid base titration)	**17**	**61** **62** **63** **64**
FINAL TERM EXAM	**18**	

Department of Microbiology/Physics/Other Departments (excluding Biochemistry/Zoology) if they require this Course for their Academic Program(s))

Course Title: General Chemistry
Course Code: CHM-300
Course Structure: Theory (3), Lab (1)

Semester: BS-I
Session: 2019-Onwards
Credit Hours: 4 (3 + 1)

CONTENTS	WEEK	Lectures
Introduction to the major core chemistry. **Chapter 1: The Periodic Law and Periodicity** Development of Periodic Table: Doberiner Trieds, Newland's Octaves, Mendeleev's Periodic Table, Modern Periodic Law.	**1**	**1** **2** **3** **4**

Quantum Numbers, Hund's rule and Aufbau principle, Periodic table and Classification of elements based on s, p, d and f orbitals,	**2**	**5**
		6
		7
		8
Group trends, and periodic properties in s, p, d and f block elements, i.e., atomic radii, ionic radii, ionization potential, electron affinities, electronagetivities, electropositivity, redox potential and electrochemical series.	**3**	**9**
		10
		11
		12
Chapter 2: Principles of Chemical Bonding Types of chemical bonding: Ionic bond, covalent bond, coordinate covalent bond, metallic bond and hydrogen bonding. **Lab: Laboratory Ethics and Safety Measures:** Awareness about the toxic nature of chemicals and their handling, cleaning of glassware, safe laboratory operations.	**4**	**13**
		14
		15
		16
Electron deficient molecules. Lewis structures and prediction of shapes using VSPER model: shapes of molecule containing two, three, four electron pairs. Localized bond approach: theories of chemical bonding, valance bond theory (VBT), hybridization of orbitals, sigma and pi bonds.	**5**	**17**
		18
		19
		20
Resonance, the delocalized bond approach to bonding: molecular orbital theory (MOT) applied to diatomic molecules and poly atomic molecules, three center bonds, bonding theory of metals and intermetallic compounds	**6**	**21**
		22
		23
		24
Conductors, insulators, and semiconductors. **Lab: Qualitative Analysis:** Analysis of four ions (two anions and two cations) from mixture of salts.	**7**	**25**
		26
		27
		28
Chapter 3: Acids and Bases Concepts of acids and bases including Arrhenious concept, Protonic concept, Lewis concept, Lux-Flood concept, soft and hard acids and bases (SHAB) concept.	**8**	**29**
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		31
		32
MID TERM EXAM	**9**	
Relative strength of acids and bases, significance of pH, pKa, pKb and	**10**	**33**

buffer solutions. Theory of indicators, solubility, solubility product, common ion effect and their industrial applications. Leveling effect.		**34** **35** **36**
Chapter 4: Thermodynamics Thermodynamics system, surrounding, zeroth law of thermodynamics, concept of equilibrium, first law of thermodynamics. **Lab:** Determination of heat of neutralization of an acid with a base.	**11**	**37** **38** **39** **40**
Concept of internal energy, enthalpy, thermodynamic processes under different conditions (isothermal, adiabatic, reversibility concept) Second law of thermodynamics, concept of entropy and Gibbs free energy	**12**	**41** **42** **43** **44**
Chapter 5: Chemical Kinetics Rate of reactions, order of reactions, molecularity, extent of reaction, rate law Rate law of zero and first order reactions with examples and its differential and integrated forms	**13**	**45** **46** **47** **48**
Concept of half-life and mean life, factors affecting rates (Arrhenius equation)	**14**	**49** **50** **51** **52**
Chapter 6: Functional Group Chemistry A brief introduction to the chemistry of hydrocarbons; Preparation and Reaction of alkanes, alkenes, alkynes, alkyl halides,	**15**	**53** **54** **55** **56**
Preparation and Reaction of alcohols, phenols, amines, carboxylic acids and their derivatives.	**16**	**57** **58** **59** **60**
Lab: Qualitative Organic Analysis: Systematic identification of organic compounds (monofunctional and simple bifunctional) and preparation of their derivatives	**17**	**61** **62** **63** **64**
FINAL TERM EXAM	**18**	

Department of Zoology

Course Title: Fundamental Inorganic Chemistry
Course Code: CHM-301
Course Structure: Theory (3), Lab (1)

Semester: BS-II
Session: 2019-Onwards
Credit Hours: 4 (3 + 1)

CONTENTS	WEEK	Lectures
Introduction to the major core chemistry. **Chapter 1: The Periodic Law and Periodicity** Development of Periodic Table: Doberiner Trieds, Newland's Octaves, Mendeleev's Periodic Table, Modern Periodic Law.	**1**	**1** **2** **3** **4**
Quantum Numbers, Hund's rule and Aufbau principle, Periodic table and Classification of elements based on s, p, d and f orbitals,	**2**	**5** **6** **7** **8**
Group trends, and periodic properties in s, p, d and f block elements, i.e., atomic radii, ionic radii, ionization potential, electron affinities, electronagetivities, electropositivity, redox potential and electrochemical series.	**3**	**9** **10** **11** **12**
Chapter 2: Principles of Chemical Bonding Types of chemical bonding: Ionic bond, covalent bond, coordinate covalent bond, metallic bond and hydrogen bonding. **Lab: Laboratory Ethics and Safety Measures:** Awareness about the toxic nature of chemicals and their handling, cleaning of glassware, safe laboratory operations.	**4**	**13** **14** **15** **16**
Electron deficient molecules. Lewis structures and prediction of shapes using VSPER model: shapes of molecule containing two, three, four electron pairs. **Lab: Qualitative Analysis:** Analysis of four ions (two anions and two cations) from mixture of salts.	**5**	**17** **18** **19** **20**
Localized bond approach: theories of chemical bonding, valance bond theory (VBT), hybridization of orbitals, sigma and pi bonds. **Lab: Quantitative Analysis:** Volumetric Analysis based on Redox reaction	**6**	**21** **22** **23** **24**
Resonance, the delocalized bond approach to bonding: molecular	**7**	**25**

orbital theory (MOT) applied to diatomic molecules and poly atomic molecules, three center bonds, bonding theory of metals and intermetallic compounds		**26** **27** **28**
Conductors, insulators, and semiconductors. **Lab: Quantitative Analysis:** Volumetric Analysis based on Iodometric and Iodimetric,	**8**	**29** **30** **31** **32**
MID TERM EXAM	**9**	
Chapter 3: Acids and Bases Concepts of acids and bases including Arrhenious concept, Protonic concept, Lewis concept,	**10**	**33** **34** **35** **36**
Lux-Flood concept, soft and hard acids and bases (SHAB) concept. **Lab: Quantitative Analysis:** Volumetric Analysis based on Precipitation and Complexometric Reactions.	**11**	**37** **38** **39** **40**
Relative strength of acids and bases, significance of pH, pKa, pKb and buffer solutions. **Lab: Quantitative Analysis:** Gravimetric Analysis based on Estimation of Ni^{2+}	**12**	**41** **42** **43** **44**
Theory of indicators, solubility, solubility product, common ion effect and their industrial applications. Leveling effect. **Lab: Quantitative Analysis:** Gravimetric Analysis based on Estimation of Ba^{2+}.	**13**	**45** **46** **47** **48**
Chapter 4: Chemistry of p-block Chemistry and structure of p-block elements; Group trend, characteristics, applications of Boron family, carbon family, nitrogen family, oxygen family, halogens and noble gases.	**14**	**49** **50** **51** **52**
Structure of noble gases and their compounds such as hydrides, clathrates, compounds with BF_3 and helides.	**15**	**53** **54** **55** **56**
Chemistry and structure: types, preparation and applications of inter-halogens, pseudo-halogens and polyhalides	**16**	**57** **58** **59** **60**

Lab: Quantitative Analysis: Determine percent of P and P_2O_5 in a sample of ammonium phosphomolybdate.	**17**	**61** **62** **63** **64**
FINAL TERM EXAM	**18**	

Department of Zoology

Course Title: Fundamental Organic Chemistry
Course Code: CHM-401
Course Structure: Theory (3), Lab (1)

Semester: BS-III
Session: 2019-Onwards
Credit Hours: 4 (3 + 1)

CONTENTS	WEEK	Lectures
Chapter 1: Introduction to organic Chemistry Organic chemistry-the chemistry of carbon compounds; the nature of organic chemistry-a historical perspective.	**1**	**1** **2** **3** **4**
Localized and delocalized chemical bonding, Rules **Lab: Qualitative organic analysis:** Systematic identification of organic compounds (monofunctional and simple bifunctional) and preparation of their derivatives.	**2**	**5** **6** **7** **8**
Concept of hybridization and shapes of organic molecules; resonance; aromaticity;	**3**	**9** **10** **11** **12**
Tautomerism; hyperconjugation; hydrogen bonding. **Lab**: Preparation of Suphanilic acid and dibenzyl acetone	**4**	**13** **14** **15** **16**
Chapter 2: Classes and Nomenclature of Organic Compounds: Classification of organic compounds (on the basis of Origin, structure, and functional group)	**5**	**17** **18** **19** **20**
Development of systematic nomenclature of organic compounds; IUPAC nomenclature of hydrocarbons (Alkanes, Alkenes, Alkynes, Alkyl Halides, Alcohols, Aldehydes, Ketones, Carboxylic Acids, Ethers, and Esters)	**6**	**21** **22** **23** **24**

IUPAC nomenclature of heteroatom functional groups including polycyclic system and compounds containing more than one functional groups.	**7**	**25** **26** **27** **28**
Lab: Preparation of; methyl orange, dinitrobenzene from benzene, isolation of caffeine.	**8**	**29** **30** **31** **32**
MID TERM EXAM	**9**	
Chapter 3: Functional Group Chemistry A brief introduction to the chemistry of hydrocarbons; Preparation and Reaction of alkanes, alkenes, and alkynes	**10**	**33** **34** **35** **36**
A brief introduction to the chemistry of hydrocarbons; Preparation and Reaction of alkyl halides, alcohols, and their derivatives.	**11**	**37** **38** **39** **40**
A brief introduction to the chemistry of hydrocarbons; Preparation and Reaction of phenols, amines, and their derivatives.	**12**	**41** **42** **43** **44**
A brief introduction to the chemistry of hydrocarbons; Preparation and Reaction of carboxylic acids and their derivatives.	**13**	**45** **46** **47** **48**
Chapter 4: Applications of Chemistry Use of organic compounds in industries, like medicinal, and pharmaceutical	**14**	**49** **50** **51** **52**
Use of organic compounds in cosmetics, paints and pigments, **Lab:** Estimation of phenol (bromide-bromate method) and aniline (bromide-bromate and acetylation methods).	**15**	**53** **54** **55** **56**
Use of organic compounds in polymers **Lab:** Equivalent weight of an acid (neutralization).	**16**	**57** **58** **59**

		60
Lab: Identification of organic functional groups by I.R. spectroscopy.	**17**	**46** **47** **48**
FINAL TERM EXAM	**18**	

Department of Zoology

Course Title: Environmental Chemistry
Course Code: CHM-402
Course Structure: Theory (3), Lab (1)

Semester: BS-IV
Session: 2019-Onwards
Credit Hours: 4 (3 + 1)

CONTENTS	WEEK	Lectures
Introduction to Environment and Environmental Chemistry, Spheres of Environment, (a) Lithosphere, (b) Biosphere, (c) Atmosphere and (d) Anthrosphere **Chapter 1: Atmospheric Chemistry** Various Segments in Atmosphere, Temperature and Pressure Profile,	**1**	**1** **2** **3** **4**
Temperature Inversion (Radiation Inversion), Introduction, Types and Pollution due to Temperature Inversion**,** Photochemical Smog (Conditions and Pollutants in photochemical smog**),** Types of smog **Lab:** Safety Rules and Regulations, Techniques in solution preparation	**2**	**5** **6** **7** **8**
Particulate Matter (Particulate Pollutants); Sources, Types and Classification of Particulate matter, Adverse effect of Particulate matter, Particulate Emission Control Mechanism **Lab:** The pH and Buffer Capacity of Environmental Waters.	**3**	**9** **10** **11** **12**
Environmental Radioactivity; Impact of Radioactivity on human body, animals and Plants, Atmospheric Aerosols, Industrial Pollutants, Various industries in Pakistan and their Pollutants	**4**	**13** **14** **15** **16**
Acid Rain (Acid Deposition); Major Sources, Mechanism**,** Control**,** Effects on Building and Vegetation **Lab:** Inorganic and Organic Profiles of Soil and Sediment Cores.	**5**	**17** **18** **19** **20**
Global Warming (Green House Effect); Major Green House Gases responsible for global Warming, Causes of Green House gases, Control Measures, Global Impact **Lab:** Alkalinity of Water Samples.	**6**	**21** **22** **23** **24**

The stratospheric Ozone; Ozone occurrence, Structure, Preparation, Ozone layer, The ozone hole, Advantages of ozone gas and ozone layer, Constituents involved in ozone layer depletion, Consequences of Ozone layer depletion and Protection from these Radiation.	**7**	**25** **26** **27** **28**
Chapter 2: Water Pollution Sources of Water Pollution, Industrial Sources and Agricultural Sources, Heavy Metals Contamination of Water, Eutrophication; Types, Sources of Nutrients, Degree of Eutrophication, Consequences of Eutrophication and its Control	**8**	**29** **30** **31** **32**
MID TERM EXAM	**9**	
Detergents and Phosphates in Water; Water quality Criteria (Parameters); pH, Alkalinity, Suspended Solids (S.S), Redox Reaction, Hardness, Total Dissolved Solids (TDS), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Temperature, Dissolved Oxygen. Water Purification; Primary, Secondary and Advanced treatment system	**10**	**33** **34** **35** **36**
Organic Matter in Water and its Purification; Removal of Nitrogen and Phosphorous compounds from Polluted Water, Organic Matter in Water and its decomposition **Lab:** Conductivity of Various Water Samples	**11**	**37** **38** **39** **40**
Chapter 4: Soil Pollution Soil and Mineral Resources, General Principles of Metals Extraction; Minerals and ores, Types of metallurgical Processes Heavy Metals Contamination of Soil	**12**	**41** **42** **43** **44**
Toxicity of Heavy Metals (Lead, Mercury, Chromium, Arsenic, Cadmium metals), Bioaccumulation of Heavy Metals (Lead, Mercury, Chromium, Arsenic, Cadmium metals) **Lab:** Metals Determination in water samples by Electrogravimetry.	**13**	**45** **46** **47** **48**
Organic Matter in Soil Soil pH and Nutrients Availability **Lab:** Determination of Chloride Ion in Natural Waters.	**14**	**49** **50** **51** **52**
Macro and Micronutrients in Soil Ion Exchange in Soil **Lab:** Determination of the Temporary and Permanent Hardness of Waters by Complexometric and Precipitation Titration respectively.	**15**	**53** **54** **55** **56**
Chapter 4: Energy Production and Environment Liquid and Gaseous Fuels, Hydrogen Economy **Lab:** Determining Iron and Manganese in Natural Waters and	**16**	**57** **58** **59** **60**

Sediments.		
Lab: Determination of the DO, BOD and Chemical Oxygen Demand of Natural Water and Waste water Using Standard Method. **Lab:** Introduction to Air Sampling: Particulates in Urban Air. **Lab:** Determination of the Concentration of Carbon Dioxide in the Atmosphere	**17**	**61** **62** **63** **64**
FINAL TERM EXAM	**18**	