‘General Chemistry’Course Syllabus

Course Code：09046001

Course Category：Major Basic

Majors：Chemical engineering and technology(Chemistry Engineering Class)

Semester：Fall

Total Hours：90 Hours Credit：4

Lecture Hours：90 Hours

Instructors：Zhangxiong Wu

Textbooks：Chemistry: The Central Science / Theodore L. Brown ... [et al.]—12th ed.

**Teaching Aim**

 General Chemistry is one of the main courses for chemistry, chemical engineering and materials science students. Its theoretical knowledge and methods are not only the basis of chemical research, but also the foundation of chemistry education, chemistry, chemical engineering, biological, geological, environmental, materials science work. The course is mainly based on chemical substances, about the state of being and microscopic structure of matter, the basic principle and application of physical and chemical changes.The teaching aim is to make students armed with basic knowledge of theoretical and applied scientific research.

**Chapter 1 Introduction: Matter and Measurement**

课时：共1课时

**Contents**

**1.1 The Study Of Chemistry**

**Teaching Outline:** The Atomic And Molecular Perspective Of Chemistry; Why Study Chemistry?

**1.2 Classifications Of Matter**

**Teaching Outline:** States Of Matter; Pure Substances; Elements; Compounds; Mixtures.

**1.3 Properties Of Matter**

**Teaching Outline:** Physical And Chemical Changes; Separation Of Mixtures.

**1.4 Units Of Measurement**

**Teaching Outline:** SI Units; Length And Mass; Temperature; Derived SI Units; Volume; Density.

**1.5 Uncertainty In Measurement**

**Teaching Outline:** Precision And Accuracy; Significant Figures; Significant Figures In Calculations.

**1.6 Dimensional Analysis**

**Teaching Outline:** Using Two Or More Conversion Factors; Conversions Involving Volume.

**Chapter 2 Atoms, Molecules, And Ions**

课时： 2课时

**Contents**

**2.1 The Atomic Theory Of Matter**

**2.2 The Discovery Of Atomic Structure**

**Teaching Outline:** Cathode Rays And Electrons; Radioactivity; The Nuclear Model Of The Atom.

**2.3 The Modern View Of Atomic Structure**

**Teaching Outline:** Atomic Numbers, Mass Numbers, Isotopes.

**2.4 Atomic Weights**

**Teaching Outline:** The Atomic Mass Scale; Atomic Weight.

**2.5 The Periodic Table**

**2.6 Molecules And Molecular Compounds**

**Teaching Outline:** Molecules And Chemical Formulas; Molecular And Empirical Formulas; Picturing Molecules.

**2.7 Ions And Ionic Compounds**

**Teaching Outline:** Predicting Ionic Charges; Ionic Compounds.

**2.8 Naming Inorganic Compounds**

**Teaching Outline:** Names And Formulas Of Ionic Compounds; Names And Formulas Of Acids; Names And Formulas Of Binary Molecular Compounds.

**2.9 Some Simple Organic Compounds**

**Teaching Outline:** Alkanes; Some Derivatives Of Alkanes.

**Chapter 3 Stoichiometry: Calculations With Chemical Formulas And Equations**

课时：共1课时

**Contents**

**3.1 Chemical Equations**

**Teaching Outline:** Balancing Equations; Indicating The States Of Reactants And Products.

**3.2 Some Simple Patterns Of Chemical Reactivity**

**Teaching Outline:** Combination And Decomposition Reactions; Combustion Reactions.

**3.3 Formula Weights**

**Teaching Outline:** Formula And Molecular Weights; Percentage Composition From Chemical Formulas.

**3.4 Avogadro’s Number And The Mole**

**Teaching Outline:** Molar Mass; Interconverting Masses And Moles; Interconverting Masses And Numbers Of Particles.

**3.5 Empirical Formulas From Analyses**

**Teaching Outline:** Molecular Formulas From Empirical Formulas; Combustion Analysis.

**3.6 Quantitative Information From Balanced Equations**

**3.7 Limiting Reactants**

**Teaching Outline:** Theoretical Yields.

**Chapter 4 Reactions in Aqueous Solution**

课时：共2课时

**Contents**

**4.1 General Properties Of Aqueous Solutions**

**Teaching Outline:** Electrolytic Properties; Ionic Compounds In Water; Molecular Compounds In Water; Strong And Weak Electrolytes.

**4.2 Precipitation Reactions**

**Teaching Outline:** Solubility Guidelines For Ionic Compounds; Exchange (Metathesis) Reactions; Ionic Equations.

**4.3 Acids, Bases, And Neutralization ReactionsTeaching Outline:** Acids; Bases; Strong And Weak Acids And Bases; Identifying Strong And Weak Electrolytes; Neutralization Reactions And Salts; Neutralization Reactions With Gas Formation.

**4.4 Oxidation-Reduction ReactionsTeaching Outline:** Oxidation And Reduction; Oxidation Numbers; Oxidation Of Metals By Acids And Salts; The Activity Series.

**4.5 Concentrations Of Solutions**

**Teaching Outline:** Molarity; Expressing The Concentration Of An Electrolyte; Interconverting Molarity, Moles, And Volume; Dilution.

**4.6 Solution Stoichiometry And Chemical Analysis**

**Chapter 5 Thermochemistry**课时：共4课时**Contents5.1 The Nature Of Energy**

**Teaching Outline:** Kinetic Energy And Potential Energy; Units Of Energy; System And

Surroundings; Transferring Energy: Work And Heat.

**5.2 The First Law Of Thermodynamics**

**Teaching Outline:** Internal Energy; Relating To Heat And Work; Endothermic And Exothermic Processes; State Functions; ΔE.

**5.3 Enthalpy**

**5.4 Enthalpies Of Reaction**

**5.5 Calorimetry**

**Teaching Outline:** Heat Capacity And Specific Heat; Constant-Pressure Calorimetry; Bomb Calorimetry (Constant-Volume Calorimetry).

**5.6 Hess’s Law**

**5.7 Enthalpies Of Formation**

**Teaching Outline:** Using Enthalpies Of Formation To Calculate Enthalpies Of Reaction.

**5.8 Foods And FuelsTeaching Outline:** Foods; Fuels; Other Energy Sources.

**Chapter 6 Electronic Structure Of Atoms**

课时：1周，共4课时

**Contents**

**6.1 The Wave Nature Of Light**

**6.2 Quantized Energy And Photons**

**Teaching Outline:** Hot Objects And The Quantization Of Energy; The PhotoelectricEffect And Photons;

**6.3 Line Spectra And The Bohr Model**

**Teaching Outline:** Line Spectra; Bohr’s Model; The Energy States Of The Hydrogen Atom; Limitations Of The Bohr Model.

**6.4 The Wave Behavior Of MatterTeaching Outline:** The Uncertainty Principle.

**6.5 Quantum Mechanics And Atomic OrbitalsTeaching Outline:** Orbitals And Quantum Numbers.

**6.6 Representations Of OrbitalsTeaching Outline:** The s Orbitals; The p Orbitals; The d And f Orbitals.

**6.7 Many-Electron AtomsTeaching Outline:** Orbitals And Their Energies; Electron Spin And The Pauli Exclusion Principle.

**6.8 Electron ConfigurationsTeaching Outline:** Hund’s Rule; Condensed Electron Configurations; Transition Metals; The Lanthanides And Actinides.

**6.9 Electron Configurations And The Periodic TableTeaching Outline:** Anomalous Electron Configuration.s

**Chapter 7 Periodic Properties Of The Elements**

课时：共4课时

**Contents**

**7.1 Development Of The Periodic Table**

**7.2 Effective Nuclear Charge**

**7.3 Sizes Of Atoms And Ions**

**Teaching Outline:** Periodic Trends In Atomic Radii; Periodic Trends In Ionic Radii.

**7.4 Ionization Energy**

**Teaching Outline:** Variations In Successive Ionization Energies; Periodic Trends In First Ionization Energies; Electron Configurations Of Ions.

**7.5 Electron Affinities**

**7.6 Metals, Nonmetals, And Metalloids**

**Teaching Outline:** Metals; Nonmetals; Metalloids.

**7.7 Trends For Group 1A And Group 2A Metals**

**Teaching Outline:** Group 1A: The Alkali Metals; Group 2A: The Alkaline Earth Metals.

**7.8 Trends For Selected Nonmetals**

**Teaching Outline:** Hydrogen; Group 6A: The Oxygen Group; Group 7A: The Halogens;

Group 8A: The Noble Gases.

**Chapter 8 Basic Concepts Of Chemical Bonding**

课时：共4课时

**Contents**

**8.1 Lewis Symbols And The Octet Rule**

**Teaching Outline:** The Octet Rule.

**8.2 Ionic Bonding**

**Teaching Outline:** Energetics Of Ionic Bond Formation; Electron Configurations Of Ions Of The s- And p-Block Elements; Transition-Metal Ions.

**8.3 Covalent BondingTeaching Outline:** Lewis Structures; Multiple Bonds.

**8.4 Bond Polarity And ElectronegativityTeaching Outline:** Electronegativity; Electronegativity And Bond Polarity; Dipole Moments; Differentiating Ionic And Covalent Bonding.

**8.5 Drawing Lewis StructuresTeaching Outline:** Formal Charge And Alternative Lewis Structures.

**8.6 Resonance StructuresTeaching Outline:** Resonance In Benzene.

**8.7 Exceptions To The Octet RuleTeaching Outline:** Odd Number Of Electrons; Less Than An Octet Of Valence Electrons; More Than An Octet Of Valence Electrons.

**8.8 Strengths Of Covalent BondsTeaching Outline:** Bond Enthalpies And The Enthalpies Of Reactions; Bond Enthalpy And Bond Length.

**Chapter 9 Molecular Geometry And Bonding Theories**

课时：共5课时

**Contents**

**9.1 Molecular Shapes**

**9.2 The VSEPR Model**

**Teaching Outline:** Effect Of Nonbonding Electrons And Multiple Bonds On Bond Angles; Molecules With Expanded Valence Shells; Shapes Of Larger Molecules.

**9.3 Molecular Shape And Molecular Polarity**

**9.4 Covalent Bonding And Orbital Overlap**

**9.5 Hybrid Orbitals**

**Teaching Outline:** sp Hybrid Orbitals; sp2 And sp3 Hybrid Orbitals**;** Hybrid Orbital Summary.

**9.6 Multiple Bonds**

**Teaching Outline:** Resonance Structures, Delocalization, And Bonding; General Conclusions.

**9.7 Molecular OrbitalsTeaching Outline:** The Hydrogen Molecule; Bond Order.

**9.8 Period 2 Diatomic MoleculesTeaching Outline:** Molecular Orbitals For Li2 And Be2 Molecular Orbitals From 2p Atomic Orbitals; Electron Configurations For B2 Through Ne2 Electron Configurations And Molecular Properties.

**Chapter 10 Gases**

课时：共3课时

**Contents**

**10.1 Characteristics Of Gases**

**10.2 Pressure**

**Teaching Outline:** Atmospheric Pressure And The Barometer.

**10.3 The Gas Laws**

**Teaching Outline:** The Pressure–Volume Relationship: Boyle’s Law; The Temperature–Volume Relationship: Charles’s Law; The Quantity–Volume Relationship: Avogadro’s Law.

**10.4 The Ideal-Gas EquationTeaching Outline:** Relating The Ideal-Gas Equation And The Gas Laws.

**10.5 Further Applications Of The Ideal-Gas Teaching Outline:** Equation Gas Densities And Molar Mass; Volumes Of Gases In Chemical Reactions.

**10.6 Gas Mixtures And Partial PressuresTeaching Outline:** Partial Pressures And Mole Fractions; Collecting Gases Over Water.

**10.7 The Kinetic-Molecular Theory Of GasesTeaching Outline:** Distributions Of Molecular Speed; Application Of Kinetic-Molecular Theory To The Gas Laws.

**10.8 Molecular Effusion And DiffusionTeaching Outline:** Graham’s Law Of Effusion; Diffusion And Mean Free Path.

**10.9 Real Gases: Deviations From Ideal BehaviorTeaching Outline:** The Van Der Waals Equation.

**Chapter 11 Liquids And Inter molecular Forces**

课时：共3课时

**Contents**

**11.1 A Molecular Comparison Of Gases, Liquids And Solids**

**11.2 Intermolecular ForcesTeaching Outline:** Dispersion Forces; Dipole–Dipole Forces; Hydrogen Bonding; Ion–Dipole Forces; Comparing Intermolecular Forces.

**11.3 Select Properties Of LiquidsTeaching Outline:** Viscosity; Surface Tension.

**11.4 Phase ChangesTeaching Outline:** Energy Changes Accompanying Phase Changes; Heating Curves; Critical Temperature And Pressure.

**11.5 Vapor PressureTeaching Outline:** Volatility, Vapor Pressure, And Temperature; Vapor Pressure And Boiling Point.

**11.6 Phase DiagramsTeaching Outline:** The Phase Diagrams Of H2O And CO2.

**11.7 Liquid CrystalsTeaching Outline:** Types Of Liquid Crystals.

**Chapter 12 Solids And Modern Materials**

课时：共4课时

**Contents**

**12.1 Classifications Of Solids**

**12.2 Structures Of Solids**

**Teaching Outline:** Crystalline And Amorphous Solids; Unit Cells And Crystal Lattices; Filling The Unit Cell.

**12.3 Metallic SolidsTeaching Outline:** The Structures Of Metallic Solids; Close Packing; Alloys.

**12.4 Metallic BondingTeaching Outline:** Electron-Sea Model; Molecular-Orbital Model.

**12.5 Ionic SolidsTeaching Outline:** Structures Of Ionic Solids.

**12.6 Molecular Solids**

**12.7 Covalent-Network Solids**

**Teaching Outline:** Semiconductors; Semiconductor Doping.

**12.8 Polymeric SolidsTeaching Outline:** Making Polymers; Structure And Physical Properties Of Polymers.

**12.9 NanomaterialsTeaching Outline:** Semiconductors On The Nanoscale; Metals On The Nanoscale; Fullerenes; Carbon Nanotubes, And Graphene.

**Chapter 13 Properties Of Solutions**

课时：共3课时

**Contents**

**13.1 The Solution Process**

**Teaching Outline:** The Natural Tendency Toward Mixing; The Effect Of Intermolecular Forces On Solution Formation; Energetics Of Solution Formation; Solution Formation And Chemical Reactions.

**13.2 Saturated Solutions And Solubility**

**13.3 Factors Affecting Solubility**

**Teaching Outline:** Solute–Solvent Interactions; Pressure Effects; Temperature Effects.

**13.4 Expressing Solution ConcentrationTeaching Outline:** Mass Percentage, Ppm, And Ppb; Mole Fraction, Molarity, And Molality; Converting Concentration Units.

**13.5 Colligative PropertiesTeaching Outline:** Vapor-Pressure Lowering; Boiling-Point Elevation; Freezing-Point Depression; Osmosis.

**13.6 ColloidsTeaching Outline:** Hydrophilic And Hydrophobic Colloids; Removal Of Colloidal Particles.

**Chapter 14 Chemical Kinetics**

课时：共4课时

**Contents**

**14.1 Factors That Affect Reaction Rates**

**14.2 Reaction Rates**

**Teaching Outline:** Change Of Rate With Time; Instantaneous Rate; Reaction Rates And Stoichiometry.

**14.3 Concentration And Rate LawsTeaching Outline:** Reaction Orders: The Exponents In The Rate Law; Magnitudes And Units Of Rate Constants; Using Initial Rates To Determine Rate Laws.

**14.4 The Change Of Concentration With TimeTeaching Outline:** First-Order Reactions; Second-Order Reactions; Zero-Order Reactions; Half-Life.

**14.5 Temperature And RateTeaching Outline:** The Collision Model; The Orientation Factor; Activation Energy; The Arrhenius Equation; Determining The Activation Energy.

**14.6 Reaction MechanismsTeaching Outline:** Elementary Reactions; Multistep Mechanisms; Rate Laws For Elementary Reactions; The Rate-Determining Step For A Multistep Mechanism; Mechanisms With A Slow Initial Step; Mechanisms With A Fast Initial Step.

**14.7 CatalysisTeaching Outline:** Homogeneous Catalysis; Heterogeneous Catalysis; Enzymes.

**Chapter 15 Chemical Equilibrium**

课时：共4课时

**Contents**

**15.1 The Concept Of Equilibrium**

**15.2 The Equilibrium Constant**

**Teaching Outline:** Evaluating Kc; Equilibrium Constants In Terms Of Pressure, Kp; Equilibrium Constants And Units.

**15.3 Understanding And Working With EquilibriumTeaching Outline:** Constants The Magnitude Of Equilibrium Constants; The Direction Of The Chemical Equation And K Relating Chemical Equation Stoichiometry And Equilibrium Constants.

**15.4 Heterogeneous Equilibria**

**15.5 Calculating Equilibrium Constants**

**15.6 Applications Of Equilibrium Constants**

**Teaching Outline:** Predicting The Direction Of Reaction; Calculating Equilibrium Concentrations.

**15.7 Le ChaTelier’s Principle Teaching Outline:** Change In Reactant Or Product Concentration; Effects Of Volume And Pressure Changes; Effect Of Temperature Changes; The Effect Of Catalysts.

**Chapter 16 Acid–Base Equilibria**

课时：共4课时

**Contents**

**16.1 Acids And Bases: A Brief Review**

**16.2 Brønsted–Lowry Acids And Bases**

**Teaching Outline:** The H+ Ion In Water; Proton-Transfer Reactions; Conjugate Acid–Base Pairs; Relative Strengths Of Acids And Bases.

**16.3 The Autoionization Of WaterTeaching Outline:** The Ion Product Of Water.

**16.4 The pH ScaleTeaching Outline:** pOH And Other “p” Scales; Measuring pH.

**16.5 Strong Acids And BasesTeaching Outline:** Strong Acids; Strong Bases.

**16.6 Weak AcidsTeaching Outline:** Calculating Ka From pH and Percent Ionization; Using Ka To Calculate pH; Polyprotic Acids.

**16.7 Weak BasesTeaching Outline:** Types Of Weak Bases.

**16.8 Relationship Between Ka And Kb**

**16.9 Acid–Base Properties Of Salt Solutions**

**Teaching Outline:** An Anion’s Ability To React With Water; A Cation’s Ability To React With Water; Combined Effect Of Cation And Anion In Solution.

**16.10 Acid–Base Behavior And Chemical StructureTeaching Outline:** Factors That Affect Acid Strength; Binary Acids; Oxyacids; Carboxylic Acids.

**16.11 Lewis Acids And Bases**

**Chapter 17 Additional Aspects Of Aqueous Equilibia**

课时：共5课时

**Contents**

**17.1 THE COMMON-ION EFFECT**

**Teaching Outline:** a specific example of Le Chatelier’s principle known as the common-ion effect.

**17.2 BUFFERED SOLUTIONS**

**Teaching Outline:** pH change when small amounts of a strong acid or strong base are added to buffed solutions.

**17.3 ACID–BASE TITRATIONSTeaching Outline:** acid–base titrations and explore how to determine pH at any point in an acid–base titration.

**17.4 SOLUBILITY EQUILIBRIATeaching Outline:** use solubility-product constants to determine to what extent a sparingly soluble salt dissolves in water.

**17.5 FACTORS THAT AFFECT SOLUBILITY**

**Teaching Outline:** some factors that affect solubility, including the common-ion effect and the effect of acids.

**17.6 PRECIPITATION AND SEPARATION OF IONSTeaching Outline:** differences in solubility can be used to separate ions through selective precipitation.

**17.7 QUALITATIVE ANALYSIS FOR METALLIC ELEMENTS**

**Teaching Outline:** how the principles of solubility and complexation equilibria can be used to identify ions in solution.

**Chapter 18 Chemical Thermodynamics**

课时：共3课时

**Contents**

**18.1 Spontaneous ProcessesTeaching Outline:** Seeking A Criterion For Spontaneity; Reversible And Irreversible Processes.

**18.2 Entropy And The Second Law Of Teaching Outline:** Thermodynamics Entropy Change; ΔS For Phase Changes; The Second

Law Of Thermodynamics.

**18.3 Molecular Interpretation Of EntropyTeaching Outline:** Expansion Of A Gas At The Molecular Level; Boltzmann’s Equation And Microstates; Molecular Motions And Energy; Making Qualitative Predictions About The Third Law Of Thermodynamics.

**18.4 Entropy Changes In Chemical ReactionsTeaching Outline:** Entropy Changes In The Surroundings.

**18.5 Gibbs Free EnergyTeaching Outline:** Standard Free Energy Of Formation.

**18.6 Free Energy And Temperature**

**18.7 Free Energy And The Equilibrium Constant Teaching Outline:** Free Energy Under Nonstandard Conditions; Relationship Between ΔG And K.

**Chapter 19 Electrochemistry;**

课时：共5课时

**Contents**

**19.1 Oxidation States And Oxidation-Reduction**

**19.2 Balancing Redox EquationsTeaching Outline:** Half-Reactions; Balancing Equations By The Method Of Half-Reactions; Balancing Equations For Reactions Occurring In Basic Solution; ΔG°.

**19.3 Voltaic Cells**

**19.4 Cell Potentials Under Standard Conditions**

**Teaching Outline:** Standard Reduction Potentials; Strengths Of Oxidizing And Reducing Agents.

**19.5 Free Energy And Redox ReactionsTeaching Outline:** Emf, Free Energy, And The Equilibrium Constant.

**19.6 Cell Potentials Under Nonstandard ConditionsTeaching Outline:** The Nernst Equation; Concentration Cells.

**19.7 Batteries And Fuel CellsTeachingOutline:** Lead-Acid Battery; Alkaline Battery; Nickel-Cadmium, Nickel-Metal- Hydride, And Lithium-Ion Batteries; Hydrogen Fuel Cells.

**19.8 CorrosionTeaching Outline:** Corrosion Of Iron (Rusting) Preventing Corrosion Of Iron.

**19.9 ElectrolysisTeaching Outline:** Quantitative Aspects Of Electrolysis.

**Chapter 20 Nuclear Chemistry**

课时：共2课时

**Contents**

**20.1 RadioactivityTeaching Outline:** Nuclear Equations; Types Of Radioactive Decay.

**20.2 Patterns Of Nuclear StabilityTeaching Outline:** Neutron-To-Proton Ratio; Radioactive Series; Further Observations.

**20.3 Nuclear TransmutationsTeaching Outline:** Accelerating Charged Particles; Reactions Involving Neutrons; Transuranium Elements.

**20.4 Rates Of Radioactive DecayTeaching Outline:** Radiometric Dating; Calculations Based On Half-Life.

**20.5 Detection Of RadioactivityTeaching Outline:** Radiotracers.

**20.6 Energy Changes In Nuclear ReactionsTeaching Outline:** Nuclear Binding Energies.

**20.7 Nuclear Power: FissionTeaching Outline:** Nuclear Reactors; Nuclear Waste.

**20.8 Nuclear Power: Fusion**

**20.9 Radiation In The Environment And**

**Teaching Outline:** Living Systems Radiation Doses; Radon.

**Chapter 21 Chemistry Of The Nonmetals**

课时：共5课时

**Contents**

**21.1 Periodic Trends And Chemical ReactionsTeaching Outline:** Chemical Reactions.

**21.2 HydrogenTeaching Outline:** Isotopes Of Hydrogen; Properties Of Hydrogen; Production Of Hydrogen; Uses Of Hydrogen; Binary Hydrogen Compounds.

**21.3 Group 8A: The Noble GasesTeaching Outline:** Noble-Gas Compounds.

**21.4 Group 7A: The HalogensTeaching Outline:** Properties And Production Of The Halogens; Uses Of The Halogens; The Hydrogen Halides; Interhalogen Compounds; Oxyacids And Oxyanions.

**21.5 OxygenTeaching Outline:** Properties Of Oxygen; Production Of Oxygen; Uses Of Oxygen; Ozone; Oxides; Peroxides And Super oxides.

**21.6 The Other Group 6A Elements: S, Se, Te, And PoTeaching Outline:** General Characteristics Of The Group 6a Elements; Occurrence And Production Of S, Se, And Te; Properties And Uses Of Sulfur, Selenium, And Tellurium; Sulfides; Oxides, Oxyacids, And Oxyanions Of Sulfur.

**21.7 NitrogenTeaching Outline:** Properties Of Nitrogen; Production And Uses Of Nitrogen; Hydrogen Compounds Of Nitrogen; Oxides And Oxyacids Of Nitrogen.

**21.8 The Other Group 5A Elements: P, As, Sb, And BiTeaching Outline:** General Characteristics Of The Group 5a Elements; Occurrence, Isolation, And Properties Of Phosphorus; Phosphorus Halides; Oxy Compounds Of Phosphorus.

**21.9 CarbonTeaching Outline:** Elemental Forms Of Carbon; Oxides Of Carbon; Carbonic Acid And Carbonates; Carbides; Other Inorganic Compounds Of Carbon.

**21.10 The Other Group 4A Elements: Si, Ge, Sn, And Pb**

**Chapter 22 Transition Metals And Coordination Chemistry**

课时：共4课时

**Contents**

**22.1 The Transition Metals**

**Teaching Outline:** Physical Properties; Electron Configurations And Oxidation States; Magnetism.

**22.2 Transition Metal Complexes**

**Teaching Outline:** The Development Of Coordination Chemistry: Werner’s Theory; The Metal–Ligand Bond ; Charges, Coordination Numbers, And Geometries.

**22.3 Common Ligands In Coordination Chemistry**

**Teaching Outline:** Metals And Chelates In Living Systems.

**22.4 Nomenclature And Isomerism In Coordination**

**Teaching Outline:** Chemistry Isomerism; Structural Isomerism; Stereoisomerism.

**22.5 Color And Magnetism In Coordination Chemistry**

**Teaching Outline:** Color; Magnetism Of Coordination Compounds.

**22.6 Crystal-Field Theory**

**Teaching Outline:** Electron Configurations In Octahedral Complexes; Tetrahedral And Square-Planar Complexes.

**Chapter 23 Chemistry Of The Environment**

课时：共2课时

**Contents**

**23.1 Earth’s AtmosphereTeaching Outline:** Composition Of The Atmosphere; Photochemical Reactions In The Atmosphere; Ozone In The Stratosphere.

**23.2 Human Activities And Earth’s AtmosphereTeaching Outline:** The Ozone Layer And Its Depletion; Sulfur Compounds And Acid Rain; Nitrogen Oxides And Photochemical Smog; Greenhouse Gases: Water Vapor, Carbon Dioxide, And Climate;

**23.3 Earth’s WaterTeaching Outline:** The Global Water Cycle; Salt Water: Earth’s Oceans And Seas; Freshwater And Groundwater.

**23.4 Human Activities And Earth’s WaterTeaching Outline:** Dissolved Oxygen And Water Quality; Water Purification: Desalination; Water Purification: Municipal Treatment.

**23.5 Green ChemistryTeaching Outline:** Supercritical Solvents; Greener Reagents And Processes.

**Chapter 24 BRIEF INTRODCUTION TO ORGANIC CHEMISTRY**

课时：共2课时

**Contents**

**24.1** **GENERAL CHARACTERISTICS OF ORGANIC MOLECULESTeaching Outline:** We begin with a review of the structures and reactivities of organicCompounds

**24.2 INTRODUCTION TO HYDROCARBONSTeaching Outline:** We consider hydrocarbons, compounds containing only C and H, including the hydrocarbons called alkanes, which contain only single bonds. We also look at isomers, compounds with identical compositions but different molecular structures.

**24.3 ALKENES, ALKYNES, AND AROMATIC** **HYDROCARBONSTeaching Outline:** We next explore hydrocarbons with one or more bonds called alkenes, and those with one or more C‚C bonds, called alkynes. Aromatic hydrocarbons have at least one planar ring with delocalized electrons.

**24.4 ORGANIC FUNCTIONAL GROUPSTeaching Outline:** We recognize that a central organizing principle of organic chemistry is the functional group, a group of atoms at which most of the compound’s chemical reactions occur.

**Chapter 25 INTRODUCTION TO CHEMICAL AND INSTRUMENTAL ANANLYSIS**

课时：共10课时

**Contents**

**25.1 Basic Concepts Of Quantitative Analyses**

**Teaching Outline:** definition of analytical chemistry and its tasks; classification of analysis; the process of quantitative analysis; errors in quantitative analysis; data analysis and processing; significant numbers; titrimetric analysis.

**25.2 Instrumental Analyses**

**Teaching Outline:** FTIR; Uv-Vis; Molecular fluorescence; AES; AAS; MS; Potentiometry; Chromatography.

三、各章课时分配表

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| --- | --- | --- |
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| 3 | Stoichiometry : Calculations With Chemical Formulas And Equations | 1 |
| 4 | Reactions in Aqueous Solution | 2 |
| 5 | Thermochemistry | 4 |
| 6 | Electronic Structure Of Atoms | 4 |
| 7 | Periodic Properties Of The Elements | 4 |
| 8 | Basic Concepts Of Chemical Bonding | 4 |
| 9 | Molecular Geometry And Bonding Theories | 5 |
| 10 | Gases | 3 |
| 11 | Liquids And Inter molecular Forces | 3 |
| 12 | Solids And Modern Materials | 4 |
| 13 | Properties Of Solutions | 4 |
| 14 | Chemical Kinetics | 4 |
| 15 | Chemical Equilibrium | 3 |
| 16 | Acid–Base Equilibria | 4 |
| 17 | Additional Aspects Of Aqueous Equilibia | 5 |
| 18 | Chemical Thermodynamics | 3 |
| 19 | Electrochemistry | 5 |
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| 25 | INTRODUCTION TO CHEMICAL AND INSTRUMENTAL ANANLYSIS | 10 |
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参考书目

1. Chemistry: the central science / Theodore L. Brown ... [et al.]—12th ed.
2. Chemical Principles/ Atkins & Jones et al., 5th Edition
3. Principles of Modern Chemistry, Oxtoby, Gillis, & Campion et al., 6th Edition

 执笔人：吴张雄

 2016 年 10月 08 日