

GEN- 3101 Fundamentals of chemistry		Credit Hrs. 3(2-1)
Week	Lecture Topics	Assignment/ Quiz
Week 1: Periodic table and Periodicity	Lecture 1: Definition and scope of inorganic chemistry Lecture 2: Introduction to modern periodic table Lecture 3: Classification of periodic table in blocks	
Week 2: Introduction and History of Inorganic chemistry	Lecture 1: Atomic radii and its trend in periodic table Lecture 2: Ionization potential Lecture 3: Electron affinity and electronegativity	
Week 3: Periodic table	Lecture 1: Redox potential. Lecture 2: anomalies in periodic table. Lecture 3: Introduction to glass ware.	
Week 4: Introduction and History of Inorganic chemistry	Lecture 1: Diagonal effect in periodic table. Lecture 2: Inert pair effect. Lecture 3: Introduction to glass ware.	Assignment#1
Week 5: Organic chemistry	Lecture 1: Classification of organic compound Lecture 2: Nomenclature of organic compound. Lecture 3: Molarity and molality	
Week 6: Nomenclature of organic chemistry	Lecture 1: Nomenclature of hydrocarbon Lecture 2: Nomenclature of hetro functional group. Lecture 3: normality	Quiz # 1
Week 7: Nomenclature of organic chemistry	Lecture 1: Localized and delocalized bonding Lecture 2: Hybridization and its types Lecture 3: Solution preparation.	
Week 8:	Mid- Term Exam	
Week 9: Chemical bonding	Lecture 1: Geometry and shape Lecture 2: Bond angle and bond length. Lecture 3: Titration	Assignment #2

Week 10: Introduction to biochemistry	Lecture 1: Introduction to biochemistry Lecture 2: Classification and composition of biomolecules Lecture 3: Acid base titration	
Week 11: Introduction to biochemistry	Lecture 1: Proteins and its classification Lecture 2: Carbohydrates and its classification Lecture 3: Redox titration	Quizz#2
Week 12: Biomolecules	Lecture 1: Vitamins Lecture 2: Lipids Lecture 3: Standardizing different solution	
Week 13: Biomolecules	Lecture 1: Minerals Lecture 2: Introduction to physical states Lecture 3: Experiments based on physical aspects and calculate parameters	
Week 14: Solids	Lecture 1: Crystalline solids Lecture 2: Liquids and its properties Lecture 3: Experiments based on physical aspects and calculate parameters	
Week 15: Liquids	Lecture 1: Surface tension and viscosity Lecture 2: Evaporation Lecture 3: Titration of weak base and strong acid	
Week 16: gas, Plasma	Lecture 1: Gases Lecture 2: Laws related to gas Lecture 3: Plasma, Application of plasma	
Week 17	Terminal Examination	

GEN-3102 Principle of biochemistry		Credit Hrs. 3(2-1)
Weeks	Topic of lecture	Activity
1 st	Introduction to biochemistry	
	Scope of biochemistry	
2 nd	Concept Hydrogen bounding	
	Hydrogen bounding in water	
3 rd	Solvent properties of water	
	Chemical equilibrium	
4 th	Applications of chemical equilibrium	Assignment #1
	pH, Acids, Bases, Buffers	
5 th	Various types of buffers	
	Henderson equation, Application of Henderson equation	
6 th	Bicarbonate buffer	Quiz #1
	Bicarbonate buffer system of blood	
7 th	Enzymes introduction	
	Mechanism of enzyme action, Factors effecting enzyme action	
8 th	Mid Term Exam	
9 th	Enzyme inhibition	Assignment #2
	The ATP cycle	
10 th	Bioenergetics	
	Introduction and structure carbohydrates	
11 th	Biological function of carbohydrates	Quiz #2
	Introduction to proteins	
12 th	Biological functions of proteins	
	Introduction to Lipids	
13 th	Biological functions of lipids	
	Electron transport	
14 th	Oxidative phosphorylation and regulation of ATP production	
	Nucleic acids	
15 th	Detoxification and human system	
	Electrolyte and water balance	
16 th	Acid base balance	
	Redox reactions	
17 th	Terminal Examination	

GEN-3103 Quantitative Reasoning-I		Credit Hrs. 3(3-0)
Week	Topics	Assignment/Quiz
Week 1	<ul style="list-style-type: none"> • Number systems and basic arithmetic operations 	
Week 2	<ul style="list-style-type: none"> • Units, unit conversions, dimensions 	
Week 3	<ul style="list-style-type: none"> • Area, perimeter, and volume calculations 	
Week 4	<ul style="list-style-type: none"> • Rates, ratios, proportions, and percentages 	Assignment#1
Week 5	<ul style="list-style-type: none"> • Types and sources of data; measurement scales 	
Week 6	<ul style="list-style-type: none"> • Tabular and graphical presentation of data; exercises on number knowledge 	Quiz #1
Week 7	<ul style="list-style-type: none"> • Basics of geometry: lines, angles, circles 	
Week 8	Midterm	
Week 9	<ul style="list-style-type: none"> • Basics of geometry: polygons and their properties 	Assignment#2
Week 10	<ul style="list-style-type: none"> • Sets and set operations • Relations, functions, and their graphs 	
Week 11	<ul style="list-style-type: none"> • Exponents, factoring, and simplifying algebraic expressions 	Quiz #2
Week 12	<ul style="list-style-type: none"> • Population, sample, measures of central tendency 	
Week 13	<ul style="list-style-type: none"> • Measures of dispersion and data interpretation 	
Week 14	<ul style="list-style-type: none"> • Rules of counting: multiplication principle, permutations, combinations 	
Week 15	<ul style="list-style-type: none"> • Basic probability theory and examples 	
Week 16	<ul style="list-style-type: none"> • Introduction to random variables and their probability distributions 	
Week 17	Terminal Examination	

GEN-3104		Natural Science	Credit Hrs. 3(2-1)
Weeks	Topic of lecture	Activity	
1 st	Definiton and categorization of natural science		
	Introduction to natural science and nature of science		
2 nd	Historical development of natural science		
	Historical development of natural science(continue)		
3 rd	Contribution of muslim scientists in the evolution of science		
	Impact of science on society		
4 th	Introduction to physical sciences	Assignmet #1	
	Origin of Universe (Big Bang Theory)		
5 th	Galaxies, its types and formation		
	Solar System and Their characteristics		
6 th	Sun and Earth (Structure and layers of earth)	Quiz #1	
	Minerals , Solar and Lunar eclipse		
7 th	Atmosphere composition		
	Energy , Units of energy, sources of energy		
8 th	Mid Term Exam		
9 th	Resources of energy conservation	Assignment #1	
	Ceramics		
10 th	Plastics and semi-conductors		
	Communication systems (Radio, television, telephone)		
11 th	Camera, Microscope	Quiz #2	
	Computers and satellites		

12 th	Antibiotics, vaccines, pesticides and fertilizers	
	Introduction to biological sciences	
13 th	The basis of life- The cell, Chromosomes Genes ,Nucleic acids	
	Carbohydrates, proteins. Hormones and other nutrients	
14 th	Concept of balanced diet and metabolism	
	Introduction and Classification of plant kingdom	
15 th	Introduction and Classification of animal kingdom	
	Introduction to Human Body systems	
16 th	System of Human body (Continue.....)	
	Brief account of human physiology	
17 th	Terminal exam	Terminal exam

GEN-3105		Functional English	Credit Hrs. 3(3-0)
Week	Lecture	Topics	Activity
Week 1	Lecture 1	Introduction To Grammar: Role of Grammar in Communication, Course Overview	
	Lecture 2	Sentence Elements: Subject, Verb, Object, Complement, Predicate, Sentence Agreement	
	Lecture 3	Parts of Speech: Noun, Pronoun, Verb, Adjective, Adverb, Conjunction, Interjection, Preposition Noun: Proper Noun, Common Noun, Abstract Noun, Concrete Noun, Collective Noun, Compound Noun, Countable Noun, Uncountable Noun	
Week 2	Lecture 1	Pronoun: Personal Pronoun, Possessive Pronoun, Indefinite Pronoun, Relative Pronoun, Intensive Pronoun, Demonstrative Pronoun, Interrogative Pronoun, Reflexive Pronoun	
	Lecture 2	Adjective: Descriptive, Demonstrative, Possessive, Interrogative, Indefinite, Compound Adjectives, Adjectives of Number or Adjectives Of Quantity (Definite Numeral Adjectives, Indefinite Numeral Adjectives, Distributive Numeral Adjectives) Verb: Action Verb, Compound Verb, Transitive and Intransitive Verb, Auxiliary Verb, Modal Verb, Phrasal Verb, Regular, Irregular Verbs	
	Lecture 3	Adverb: Adverb of Manner, Adverb of Time, Adverb of Place Prepositions: Types of Preposition (Functional Types: Preposition of Time, Preposition of Place, Preposition of Direction/Movement) Types of Preposition (on the Basis of Structure): Double Prepositions, Compound Prepositions, Participle Prepositions, Phrase Prepositions	
Week 3	Lecture 1	Conjunction: Coordinating Conjunction, Correlative Conjunction, Subordinating Conjunction	
	Lecture 2	Interjection: Emotive Interjection, Volitive Interjection, Cognitive Interjection	
	Lecture 3	Articles: Definite and Indefinite, Usage Rules, Exceptions Parts of Speech: Practice- Identification, Correction Exercises	
Week 4	Lecture 1	Sentence Structure: Sentence Basics (Simple, Negative, Interrogative); Types By Structure: Simple, Compound,	Assignment #1

		Complex, Compound-Complex; Types by Function: Declarative, Interrogative, Imperative, Exclamatory	
	Lecture 2	Tenses: Present, Past and Future Tense: Rules and Exercises	
	Lecture 3	Voice: Active and Passive: Introduction, Definition of Voice, Transformation Rules for all Tenses, Passive of Imperatives	
Week 5	Lecture 1	Voice Practice: Conversion Exercises, Correcting Passive Misuse	
	Lecture 2	Unified Sentences in English: Definition, Coherence, Unity, Logical Flow	
	Lecture 3	Unified Sentences (Continued): Use Of Transitional Devices, Maintaining Paragraph Unity	
Week 6	Lecture 1	Phrases: Introduction, Structure and Types: Noun, Verb, Adjective, Adverb, Prepositional Phrases Phrase Practice: Usage in Writing, Combining Phrases	Quiz #1
	Lecture 2	Clauses: Introduction Difference between Clause and Phrase	
	Lecture 3	Types of Clause: Independent Clause, Dependent Clause Types Of Dependent Clauses: Noun, Adjective, Adverb Clauses with Examples	
Week 7	Lecture 1	Punctuation (Basics): Full Stop, Comma, Question Mark, Exclamation Mark	
	Lecture 2	Advanced Punctuation: Semicolon, Colon, Apostrophe, Quotation Marks, Parentheses	
	Lecture 3	Advanced Punctuation (Continued): Brackets, Braces, Dash, Hyphen, Ellipsis	
Week 8	Midterm		
Week 9	Lecture 1	Spelling Rules: Common Spelling Rules (E.G., -Ie/-Ei, Silent Letters, Homophones), Doubling Consonants, Silent Letters (Kn, Wr, Gh)	
	Lecture 2	Spelling Rules (Continued): Suffixes (-Ing, -Ed, -Able), Confusing Pairs (Their/There/They Are, Affect/Effect)	Assignment #2
	Lecture 3	Reading Comprehension: Definition, Levels of Comprehension, Principles/Rules of Comprehension	
Week 10	Lecture 1	Reading Comprehension (Continued): Literal, Inferential	
	Lecture 2	Reading Comprehension (Continued): Evaluative Reading; Skimming and Scanning Techniques	
	Lecture 3	Comprehension Practice: Exercises On Reading between and Beyond the Lines, Answering Questions	
Week 11	Lecture 1	Discussion Skills: Introduction and Importance	

	Lecture 2	Discussion Skills (Continued): Strategies-Turn-Taking, Active Listening, Using Transitions, Asking Clarifying Questions, Agreeing/Disagreeing Politely	Quiz #2
	Lecture 3	Discussion Practice-Topics: Narrating Past Events, Comparing Ideas, Expressing Opinions	
Week 12	Lecture 1	Listening Skills: Introduction, Types of Listening: Active, Reflective, Critical, Appreciative, Empathetic; Common Listening Barriers	
	Lecture 2	Listening Practice: Note-Taking, Summarizing Audio/Video Clips, Identifying Key Ideas	
	Lecture 3	Listening Practice: Listening to Documentaries for Main Ideas	
Week 13	Lecture 1	Translation Skills: Introduction Types of Translation: Literal, Contextual, Idiomatic, Communicative	
	Lecture 2	Translation Skill: Basic Rules for Urdu to English Translation and Sentence Structure	
	Lecture 3	Translation Practice: Urdu To English Sentence and Paragraph Translation	
Week 14	Lecture 1	Paragraph Writing: Introduction, Parts of a Paragraph: Topic Sentence, Supporting Details, Coherence, Conclusion	
	Lecture 2	Paragraph Practice: Descriptive, Narrative, Argumentative Paragraphs with Transitions	
	Lecture 3	Presentation Skills: Introduction, Types of Presentations: Informative, Persuasive, Demonstrative	
Week 15	Lecture 1	Types of Presentations (Continued): Motivational, Instructional, Impromptu	
	Lecture 2	Structure and Tips For Effective Presentations	
	Lecture 3	Presentation Techniques: Verbal/Non-Verbal Communication, Visual Aids	
Week 16	Lecture 1	Presentation Techniques (Continued): Slide Design, Tone, Pace	
	Lecture 2	Student Presentations (Prepared): Delivering Informative or Persuasive Talks with Feedback	
	Lecture 3	Student Presentations (Impromptu): On-The-Spot Speaking, Timing, Confidence-Building	
Week 17		Terminal Examination	

GEN-3106 Application of Information and Communication Technology Credit Hrs. 3(2-1)			
Week	Topics (Theory)	Practical Work	Assignment/ Quiz
Week 1	Introduction to ICT, Scope, and Components (hardware, software, networks, cloud storage)	Basic computer usage, file management (creating folders, naming conventions)	
Week 2	ICT in Daily Life: Use in education, business, governance, healthcare, etc.	Cloud storage: Google Drive, Dropbox, OneDrive – uploading, organizing, and sharing files	
Week 3	Emerging technologies and future trends	Web exploration: Effective searching using Google, Bing (search operators, filters)	
Week 4	Formal Communication Tools: Gmail, Outlook & Netiquette	Send professional emails, attach files, apply formatting, set auto-reply	Assignment #1
Week 5	MS Word: Basics, formatting, document creation	Hands-on with MS Word: Create letter, resume, formatted report	
Week 6	MS Excel: Data entry, formulas, functions, charts	Hands-on with MS Excel: Budget sheet, formulas, basic chart creation	Quiz #1
Week 7	MS PowerPoint: Slide design, presentation techniques	Create a presentation on ICT tools in education (insert media, animations)	
Week 8	Midterm		
Week 9	Google Workspace: Docs, Sheets, Slides overview	Create a document using Google Docs, collaborate in real-time	Assignment#2
Week 10	Evernote & OneNote: Note-taking and organization tools	Use OneNote/Evernote to create categorized notes, to-do lists	
Week 11	Video Conferencing Tools: Zoom, Meet, Teams	Setup a meeting, share screen, chat, use breakout rooms	Quiz #2
Week 12	LMS and Online Education: Moodle, Google Classroom, Coursera	Practice logging in, submitting assignments, participating in discussion forums	
Week 13	ICT in Health: Fitness apps and Telemedicine	Explore Google Fit or Samsung Health; simulate booking on Sehat Kahani	
Week 14	Online Banking & E-Commerce	Simulate wallet setup (JazzCash), explore Daraz.pk features	
Week 15	Digital Citizenship, Cyberbullying, Intellectual Property	Group discussion & case study on online harassment and plagiarism	
Week 16	Ethics in ICT, Content Authenticity, and Misinformation	Final practical assessment: Document + presentation + cloud storage submission	
Week 17	Terminal Examination		

3rd Semester

GEN-4301		Islamic Studies	Credit Hrs. 2(2-0)
Week	Lecture No.	Topic	Activity
Week 1	Lecture 1	• قرآن پاک کا تعارف، فضائل ، اعجاز	
	Lecture 2	• قرآن پاک کا نزول قرآن ، جمع و تدوین	
Week 2	Lecture 3	• علوم قرآن: علم تفسیر ، ماخذ تفسیر	
	Lecture 4	• علم اسباب نزول، علم ناسخ و منسوخ	
Week 3	Lecture 5	• سورہ حجرات آیت (01 تا 09)	
	Lecture 6	• سورہ حجرات آیت (10 تا 18)	
Week 4	Lecture 7	• سنت و حدیث کا تعارف: معنی و مفہوم، اقسام	Assignment#01
	Lecture 8	• تاریخ تدوین حدیث	
Week 5	Lecture 9	• سنت کی آئینی حیثیت	
	Lecture 10	• منتخب متون احادیث کا مطالعہ: حدیث نمبر 1-05	
Week 6	Lecture 11	• منتخب متون احادیث کا مطالعہ: حدیث نمبر 5-10	Quiz # 01
	Lecture 12	• منتخب متون احادیث کا مطالعہ: حدیث نمبر 10-15	
Week 7	Lecture 13	□ منتخب متون احادیث کا مطالعہ: حدیث نمبر 20-15	
	Lecture 14	□ پیدائش سے بعثت تک نبی کریم ﷺ کی زندگی کے اہم واقعات	
Week 8	Midterm		
Week 09	Lecture 15	□ نبی پاک ﷺ کی مکی زندگی کے اہم واقعات	
	Lecture 16	□ نبی پاک ﷺ کی مدنی زندگی کے اہم واقعات	Assignment# 02

Week 10	Lecture 17	□ خلافت راشدہ (حضرت ابو بکر صدیق رضی اللہ عنہ و حضرت عمر رضی اللہ عنہ کے دور کی اہم خصوصیات	
	Lecture 18	□ خلافت راشدہ (حضرت عثمان رضی اللہ عنہ و حضرت علی رضی اللہ عنہ کے دور کی اہم خصوصیات	
Week 11	Lecture 19	□ عقائد : ایمانیات ثلاثہ (ایمان باللہ ، ایمان بالرسالت اور ایمان بالآخرت) (الف)	Quiz # 02
	Lecture 20	□ عقائد : ایمانیات ثلاثہ (ایمان باللہ ، ایمان بالرسالت اور ایمان بالآخرت) (ب)	
Week 12	Lecture 21	□ فقہ کا تعارف : پس منظر	
	Lecture 22	□ فقہی مسالک کا تعارف	
Week 13	Lecture 23	□ نماز : اہمیت ، طریقہ نماز ، مسائل نماز (الف)	
	Lecture 24	□ نماز : اہمیت ، طریقہ نماز ، مسائل نماز (ب)	
Week 14	Lecture 25	□ روزہ : اہمیت ، مسائل روزہ	
	Lecture 26	□ زکوٰۃ : اہمیت ، مسائل زکوٰۃ	
Week 15	Lecture 27	□ حج اور عمرہ : اہمیت ، طریقہ کار ، مسائل (الف)	
	Lecture 28	□ حج اور عمرہ : اہمیت ، طریقہ کار ، مسائل (ب)	
Week 16	Lecture 29	□ جہاد : اہمیت ، مقاصد جہاد ، اداب جہاد (الف)	
	Lecture 30	□ جہاد : اہمیت ، مقاصد جہاد ، اداب جہاد (ب)	
Week 17	Terminal Examination		

GEN-4302		Entrepreneurship	Credit Hrs. 2(2-0)
Week No.	Lecture No.	Topic	Activity
Week 01	Lecture 01 Lecture 02	Introduction to Entrepreneurship Definition and concept of entrepreneurship Why to become and entrepreneur?	
Week 02	Lecture 03 Lecture04	Entrepreneurial process Role of entrepreneurship in economic development.	
Week 03	Lecture 05 Lecture 06	Entrepreneurial Skills Characteristics and qualities of successful entrepreneurs . Stories of success and failures of entrepreneurs.	
Week04	Lecture 07 Lecture08	Areas of essentials entrepreneurial skill and ability, such as creative and critical thinking. Innovation and risk taking abilities of entrepreneurs	Assignment 01
Week 05	Lecture 09 Lecture 10	Opportunities recognition and idea generation Opportunity identification, evaluation and exploitation Innovation, idea generation techniques for entrepreneurial ventures	
Week 06	Lecture 11 Lecture12	Marketing and sales ● Target market identification and segmentation ● Four P's of Marketing	Quiz #1
Week 07	Lecture 13 Lecture 14	Developing a marketing strategy Branding	
Week 08		Mid Term	
Week 09	Lecture 15 Lecture 16	Financial Literacy: Basic concepts of income, savings and investments Basic concepts of assets, liabilities and equity	Assignment #2
Week 10	Lecture 17 Lecture 18	Basic concepts of revenue and expenses Overview of cash-flows.	
Week 11	Lecture 19 Lecture 20	Overview of banking products Islamic models of financing	Quiz #2
Week 12	Lecture 21 Lecture 22	Sources of funding for startups(angel financing) Debt and equity financing	
Week 13	Lecture 23 Lecture 24	Team Building for Startups:	

		Characteristics and features of effective teams. Features of effective teams	
Week 14	Lecture 25 Lecture 26	_ Team building and effective leadership for startups <u>Regulatory Requirements to Establish Enterprises in Pakistan:</u> Types of enterprises (e.g., sole proprietorship,)	
Week 15	Lecture 27 Lecture 28	Partnership, private limited companies. Intellectual property rights and protection	
Week 16	Lecture 29 Lecture 30	Regulatory requirements to register and enterprise in Pakistan, with special emphasis on export firms. Taxation and financial reporting obligation.	
Week 17		Terminal examination	

GEN-4303	Quantitative Reasoning-II	Credit Hrs. 3(3-0)
Week	Topics	Assignment/Quiz
Week 1	<ul style="list-style-type: none"> • Introduction to logic; importance of logical reasoning 	
Week 2	<ul style="list-style-type: none"> • Inductive, deductive, and abductive reasoning approaches 	
Week 3	<ul style="list-style-type: none"> • Propositions, arguments (valid and invalid) 	
Week 4	<ul style="list-style-type: none"> • Logical connectives, truth tables 	Assignment#1
Week 5	<ul style="list-style-type: none"> • Propositional equivalences and logical fallacies 	
Week 6	<ul style="list-style-type: none"> • Venn diagrams; predicates and quantifiers; reasoning exercises 	Quiz #1
Week 7	<ul style="list-style-type: none"> • Introduction to deterministic models 	
Week 8	<ul style="list-style-type: none"> • Midterm 	
Week 9	<ul style="list-style-type: none"> • Using linear functions for real-world modeling 	Assignment#2
Week 10	<ul style="list-style-type: none"> • Modeling with systems of linear equations and solutions 	
Week 11	<ul style="list-style-type: none"> • Elementary introduction to derivatives in modeling 	Quiz #2
Week 12	<ul style="list-style-type: none"> • Linear growth and decay models • Exponential growth and decay models 	
Week 13	<ul style="list-style-type: none"> • Introduction to probabilistic models; bivariate analysis and scatter plots 	
Week 14	<ul style="list-style-type: none"> • Simple linear regression model and correlation analysis 	
Week 15	<ul style="list-style-type: none"> • Basics of estimation and confidence intervals • Hypothesis testing: z-test and t-test basics 	
Week 16	<ul style="list-style-type: none"> • Statistical inference in decision making 	
Week 17	<ul style="list-style-type: none"> • Terminal Examination 	

BOT-4304 Plant Systematics, Anatomy and development Credit Hrs. 3(2-1)		
Week	Contents	
1	Introduction to Plant Systematics: aims & importance	
	Classification: artificial, natural & phylogenetic systems	
2	Modern systematics & APG overview	
	Nomenclature: binomial system & Latin names	
3	ICBN – principles	
	Morphology — root, stem & leaf	
4	Morphology — inflorescence & flower types	Assignment #1
	Placentation & fruits	
5	Diagnostic families I: Ranunculaceae, Brassicaceae, Fabaceae, Rosaceae	
	Diagnostic families II: Euphorbiaceae, Cucurbitaceae, Solanaceae	
6	Diagnostic families III: Lamiaceae, Apiaceae, Asteraceae	Quiz #1
	Monocot families: Liliaceae, Poaceae	
7	Integration: Taxonomy & Morphology	
	Introduction to Plant Anatomy & scope	
8	Midterm	
9	Plant tissues overview	Assignment #2
	Parenchyma & Collenchyma	
10	Sclerenchyma, trichomes & stomatal types	
	Xylem — structure & function	

11	Phloem — structure & function	Quiz #2
	Meristems: types, stem & root apices	
12	Primary structure: root, stem & leaf	
	Vascular cambium & activity	
13	Secondary growth in dicot stem	
	Periderm & bark types	
14	Wood characteristics: annual rings, sapwood, heartwood	
	Softwood vs Hardwood	
15	Early development: <i>Capsella bursa-pastoris</i>	
	Anther structure, Microsporogenesis	
16	Ovule, Megasporogenesis & Megagametophyte	
	Endosperm formation, Parthenocarpy & Polyembryony	
17	Terminal	

CHM 4305 Physical Chemistry		Credit Hrs. 4(3-1)
Week	Topics	Assignment/Quiz
Week 1	General characteristics of gases. Gay Lussacs law, ideal gas equation	
	Kinetic Mol. Theory of gases, Molecular velocities	
	Ideal and real gases. Deviation of gases from ideality	
Week 2	Derivation of the kinetic gas equation, Molecular collision	
	Collision diameter, Liquefaction, and critical phenomenon of gases	
	Mean free path, the van der Waals equation for gases	
Week 3	Gen. Characteristics of liquids, Surface tension, and viscosity	
	Parachor, Rheochor and their applications	
	Specific and molar refraction and their applications	
Week 4	Refractive index, Optical activity, specific rotation	Assignment #1
	Dipole moment and molecular structure	
	Gen. Characteristics of solids, types of solids	
Week 5	Habit of crystal, Isotropy and Anisotropy	
	Crystal lattice, Unit cell, Crystal systems	
	Bragg's equation, Bravais lattices	
Week 6	X-ray crystallography of NaCl crystals	Quiz#1
	Introduction to quantum mechanics, Bohr model and its defects	
	Classical mechanics and its failure, the De Broglie equation	
Week 7	Dual nature of matter	
	Heisenberg uncertainty principle and its limitations	
	Wave function and derivation of the Schrodinger wave equation	
	Quantum numbers, electronic configuration, atomic orbitals, and Quantization	
Week 8	Midterm	
Week 9	Introduction to thermodynamics, System, Surroundings, State and State function, Boundary, Internal energy, Extensive intensive properties	Assignment#2
	First law of thermodynamics, Enthalpy, Entropy	
	Relationship between Enthalpy and Free energy change	
Week 10	Cp and Cv and their relationship	
	2 nd law of thermodynamics, Change in free energy and eq. constant	
	Entropy Change in phase transitions, Concept of Gibbs and Helmholtz Free energy	

Week 11	Intro to Kinetics, rate, rate law order and molecularity, Velocity constant	Quiz#2
	Elementary and complex reactions Zero, 1 st , and second order reactions	
	Derivation of the kinetic equation for 1st and second order reactions when initial conc of both are same	
Week 12	Methods of determining the rate of reaction.	
	Arrhenius equation, Lindemann's theory of unimolecular reaction	
	Transition state theory for Bimolecular reaction	
Week 13	Basic Electrochemistry, Conductors, insulators Electrolytic and electronic Conduction, Electrochemical cells and types	
	Specific conductance and its measurement, Cell constant and its determination	
	Molar and Equivalent conductance, Ostwald dilution law, Faraday's law of electrolysis with significance	
Week 14	An introduction to surface chemistry Absorption, adsorption and type, Applications of Adsorption	
	Characteristics and factors of adsorption, Catalysis, types, and characteristics Enzyme catalysis,	
	Freundlich and Langmuir Adsorption Isotherms	
Week 15	Intro and types of solutions Concentration units of solutions	
	Molecular interactions in solutions, Zeo and Azeotropic mixtures, Ideal and Non-Ideal solutions, Raoult's Law	
	Colligative properties and their determination	
Week 16	Determination of colligative properties	
Week 17	Terminal examination	

ZOO-4306 Principle of Animal Life-II		Credit Hrs. 3(2-1)
Weeks	Topic of Lecture	Activity
1 st	Cell Division: <ul style="list-style-type: none"> • Cell cycles • Mitosis and meiosis----- 	
2 nd	<ul style="list-style-type: none"> • Mitosis and meiosis • control of the cell cycle. 	
3 rd	Inheritance Patterns: <ul style="list-style-type: none"> • Mendelian genetics • Inheritance patterns 	
4 th	<ul style="list-style-type: none"> • Inheritance patterns 	Assignment #1
5 th	<ul style="list-style-type: none"> • gene, structure, chemical composition and types 	
6 th	Chromosomes and Gene Linkage: <ul style="list-style-type: none"> • Eukaryotic chromosomes; linkage and crossing over 	Quiz #1
7 th	<ul style="list-style-type: none"> • Chromosomal aberrations. 	
8 th	Midterm Examination	
9 th	Molecular Genetics: Cellular Control: DNA: the genetic material	Assignment #2
10 th	DNA replication in prokaryotes and eukaryotes Control of gene expression in eukaryotes	
11 th	gene mutation recombinant DNA and applications of genetic technologies	
12 th	Animal Behaviour: <ul style="list-style-type: none"> • Behavior and its types, proximate and ultimate causes • Anthropomorphism 	

	<ul style="list-style-type: none"> • development of behavior; learning; factors controlling animal behavior • communication • behavioral ecology <p>social behavior</p>	
13 th	<p>Evolution:</p> <ul style="list-style-type: none"> • Historical Perspective: <p>Theories of evolution: Lamarckism and natural selection, neo larmarckism, Darwinism, and neo-Darwinian</p>	
14 th	<p>Evolution and Gene Frequencies:</p> <ul style="list-style-type: none"> • Hardy-Weinberg principle • evolutionary mechanisms: population size, genetic drift, gene flow 	
15 th	<ul style="list-style-type: none"> • de Vries mutation theory and rates of evolution, • polymorphism; species and speciation • molecular evolution • mosaic evolution 	
16 th	<p>Terminal</p>	
17 th		

5th Semester

CHM-5501		Physical chemistry-I	Credit Hrs. 4(3-1)
Weeks	Topic of lecture	Activity	
1 st	Brief reference to the first order rate law		
	Details of second order rate law		
	Details of third order rate law		
2 nd	Methods to find out order of reaction		
	Measurement of the rate of chemical reaction		
	Factors effecting the rate of chemical reaction		
3 rd	Arrhenius theory		
	Numerical related to Arrhenius equation		
	Theories of reaction rates for unimolecular (Collision theory)		
4 th	Bimolecular reactions (Lindemann Theory)	Assignmet #1	
	Transition state theories,		
	Comparison of collision and transition state theories		
5 th	Introduction to thermodynamics		
	System, Boundary. Internal energy		
	System, Boundary. Internal energy		
6 th	Extensive , intensive properties	Quiz #1	
	Surrounding, State function		
	First law, 2nd law of thermodynamics,		
7 th	Enthalpy. reversibility and maximum work		
	Heat capacity		
	Joule Thomson effect		
8 th	Mid Term Exam		
9 th	Effect of temperature on change in enthalpy (Clausius-Claperon equation)	Assignment #2	
	entropy and its calculations		
	Dependence of free energy on pressure and temperature.		
10 th	Free energy relationship with equilibrium constant for chemical reactions and other thermodynamic functions.		
	third law of thermodynamics w.r.t unattainability of absolute zero		
	Ideal and real gases,		
11 th	Equations of state for real gases (Beatte-Bridgeman and Varial equation)	Quiz #2	
	Maxwell law of molecular velocities		
	calculations of Root mean square velocity		
12 th	calculations of mean velocity		
	Calculation of average velocity		
	Maxwell and Boltzmann law of energy distribution		

13 th	Graphical explanation of Maxwell and Boltzmann law of energy distribution	
	Molecular collisions with types	
	Viscosity of gases	
14 th	Methods to find out viscosity of gases	
	Distribution of gases	
	Introduction to Molecular spectroscopy	
15 th	Introduction to spectral Terms	
	Electronic Spectroscopy	
	Vibrational Spectroscopy	
16 th	Rotational Spectroscopy introductory terms	
	Rigid and non-rigid rotors	
	Rigid and non-rigid rotors (Continue...)	
17 th	Terminal exam	

CHM-5502		Organic Chemistry –I	Credit Hrs. 4(3-1)
Week	Lecture Contents	Events	
Week 1	<p>Representation of organic structures: Lewis, condensed, skeletal (line-angle), wedge-dash basics; common pitfalls.</p> <p>IUPAC fundamentals: parent chain selection, numbering rules, substituent identification, prefixes/suffixes (intro). IUPAC nomenclature of alkanes (straight/branched); locating substituents; alphabetical order; multiplicative prefixes.</p> <p>Cycloalkanes: naming rules; mono/di-substitution patterns; choosing correct numbering direction.</p> <p>Introduction to functional groups (overview + priority concept preview). IUPAC of alkenes/alkynes: numbering by multiple bonds; naming substituents; basic E/Z idea (preview).</p> <p>IUPAC of aromatic compounds: substituted benzene names; common accepted names vs systematic names (controlled use).</p> <p>Multiple functional groups: priority order; selecting principal functional group; writing correct suffix/prefix combinations.</p>		
Week 2	<p>Lec-1: Atomic orbitals (s, p) → bonding concepts; overlap and bond formation (qualitative).</p> <p>Lec-2: Hybridization (sp³/sp²/sp); sigma vs pi bonds; bond length/strength trends; geometry and bond angles.</p> <p>Lec-3: Organic structures & polarity: electronegativity, bond dipoles, molecular dipole moments; link to physical properties (bp/mp/solubility).</p>		
Week 3	<p>Lec-1: Inductive/field effects: electron-withdrawing/donating groups; distance dependence; stability implications.</p> <p>Lec-2: Resonance & mesomerism: canonical structures, resonance hybrid, resonance rules; resonance stabilization (qualitative).</p> <p>Lec-3: Hyperconjugation & conjugation: stabilizing effects; comparing carbocation/radical/carbanion stabilities (ranking logic).</p>		
Week 4	<p>Lec-1: Hydrogen bonding: inter vs intra; effect on bp/mp/solubility; real organic examples (alcohols, acids, amines).</p> <p>Lec-2: Aromaticity: Hückel rule; aromatic vs antiaromatic vs nonaromatic; aromatic stabilization idea.</p> <p>Lec-3: Aromatic systems overview: typical aromatic ions; brief intro to heteroaromatics (recognition + aromaticity test logic).</p>	Assignment-1.	

Week 5	<p>Lec-1: Acids & bases: Brønsted–Lowry vs Lewis; conjugate acid/base; equilibrium viewpoint.</p> <p>Lec-2: pKa concept: meaning, typical organic pKa ranges; how pKa connects to extent of reaction (qualitative thermodynamics).</p> <p>Lec-3: Organic acids/bases survey: carboxylic acids, phenols, alcohols, amines; solvent effects (water vs aprotic).</p>	
Week 6	<p>Lec-1: Factors controlling acidity: resonance, induction, hybridization, aromaticity (structured comparisons).</p> <p>Lec-2: Basicity trends: resonance/induction/solvation; steric effects; comparing amines vs anilines; pKa of conjugate acids approach.</p> <p>Lec-3: Electrostatic, steric, and hydrogen-bonding contributions; building acidity/basicity ladders for common functional groups.</p>	Quiz 1
Week 7	<p>Lec-1: Linear free energy relationships (LFER) overview; why substituent effects can be quantified.</p> <p>Lec-2: Hammett equation: σ constants; ρ; interpreting sign/magnitude; example sets (benzoic acids / rate vs equilibrium).</p> <p>Lec-3: Review + problem-solving (Hammett plots conceptually).</p>	
Week 8	Midterm	
Week 9	<p>Lec-1: Taft equation: separating polar vs steric contributions (intro); when Taft is preferred over Hammett.</p> <p>Lec-2: Mechanistic foundations: curved-arrow notation; electrophiles/nucleophiles; leaving groups; intermediates vs transition states; energy diagrams.</p> <p>Lec-3: Electrophilic substitution (EAS core): general mechanism (σ-complex), rate-determining step idea (intro level).</p>	Assignment-II
Week 10	<p>Lec-1: Substitution reaction overview (radical vs electrophilic vs nucleophilic); mechanistic classification map.</p> <p>Lec-2: Free-radical substitution: initiation/propagation/termination; selectivity vs reactivity (chlorination vs bromination).</p> <p>Lec-3: Radical stability (allylic/benzylic); synthetic implications; controlling side reactions (intro).</p>	
Week 11	<p>Lec-1: Nucleophilic substitution: SN2 mechanism; kinetics; inversion of configuration; substrate/nucleophile/solvent effects.</p> <p>Lec-2: SN1 mechanism: carbocation formation; rearrangements; racemization concept; solvent effects; leaving group role.</p> <p>Lec-3: SN1 vs SN2 decision framework + competition with elimination (preview).</p>	Quiz #2

Week 12	<p>Lec-1: Addition to C=C: electrophilic addition concept; carbocation intermediates; Markovnikov orientation (logic level).</p> <p>Lec-2: Stereochemistry in additions: syn/anti discussion (intro); halogenation vs hydrohalogenation outcomes (conceptual).</p> <p>Lec-3: Addition to alkynes (intro) + common pitfalls; rearrangements (intro).</p>	
Week 13	<p>Lec-1: Addition to C=O: polarity of carbonyl; nucleophilic addition concept; aldehydes vs ketones reactivity trends.</p> <p>Lec-2: Common nucleophilic additions (intro): hydration, cyanohydrin concept, alcohol addition (hemiacetal concept at intro level).</p> <p>Lec-3: Mechanism practice: curved arrows for carbonyl additions; predicting major product (intro).</p>	
Week 14	<p>Lec-1: Elimination reactions: E1 vs E2 overview; kinetics; base/solvent/substrate factors.</p> <p>Lec-2: Regioselectivity: Zaitsev vs Hofmann; stereochemical requirement for E2 (anti-periplanar, conceptually).</p> <p>Lec-3: Competition: substitution vs elimination—how to predict dominant pathway (synthesis planning at intro level).</p>	
Week 15	<p>Lec-1: Stereochemistry foundations: chirality, stereocenters, symmetry; enantiomers vs diastereomers; meso concept (intro).</p> <p>Lec-2: Optical activity: plane-polarized light; specific rotation; factors affecting observed rotation (conc., path length, solvent).</p> <p>Lec-3: Relationship of stereochemistry to reactivity (preview): stereochemical outcomes in SN2/SN1/additions.</p>	
Week 16	<p>Lec-1: R/S configuration: CIP priority rules; assigning R/S from wedge-dash (worked examples).</p> <p>Lec-2: Fischer projections (intro) and converting between representations; common mistakes; quick checks.</p> <p>Lec-3: Racemic mixture concept; enantiomeric excess (ee) idea (intro) + practice problems.</p>	
Week 17	Terminal Examination	

CHM-5503		
Inorganic Chemistry –I		Credit Hrs. 4(3-1)
Week	Lecture Contents	Events
Week 1	A brief history of concept of chemical bond. Nature and types of chemical bonding, Lewis concepts, ionic, covalent, coordinate covalent bond.	
Week 2	VSEPR model followed by VB theory (Hybridization and Resonance concept) to explain the structure of molecules of various types	
Week 3	VSEPR model followed by VB theory (Hybridization and Resonance concept) to explain the structure of molecules of various types	
Week 4	VSEPR model followed by VB theory (Hybridization and Resonance concept) to explain the structure of molecules of various types	Assignment-1.
Week 5	Molecular orbital approach as applied to diatomic and polyatomic molecules.	
Week 6	Molecular orbital approach as applied to diatomic and polyatomic molecules.	Quiz 1
Week 7	Molecular orbital approach as applied to diatomic and polyatomic molecules.	
Week 8	Midterm	
Week 9	Molecular orbital approach as applied to diatomic and polyatomic molecules.	Assignment-II
Week 10	Bonding in electron deficient compounds.	
Week 11	Hydrogen bonding. Theories of metal bonds, conductors, semi-conductors and insulators. Effect of temperature and impurities on conductivity	Quiz #2
Week 12	Theories of metal bonds, conductors, semi-conductors and insulators. Effect of temperature and impurities on conductivity	

Week 13	Chemistry of Lanthanides and Actinides Element: Electronic structure, position in the periodic table, oxidation states, occurrence, extraction- separation, General properties, complex formation, Lanthanide and Actinide contraction, Applications.	
Week 14	Chemistry of Lanthanides and Actinides Element: Electronic structure, position in the periodic table, oxidation states, occurrence, extraction- separation, General properties, complex formation, Lanthanide and Actinide contraction, Applications.	
Week 15	Chemistry of Lanthanides and Actinides Element: Electronic structure, position in the periodic table, oxidation states, occurrence, extraction- separation, General properties, complex formation, Lanthanide and Actinide contraction, Applications.	
Week 16	Chemistry of Lanthanides and Actinides Element: Electronic structure, position in the periodic table, oxidation states, occurrence, extraction- separation, General properties, complex formation, Lanthanide and Actinide contraction, Applications.	
Week 17	Terminal Examination	

CHM-5504 Biochemistry-1		Credit Hrs. 4(3-1)
Weeks	Topic of lecture	Activity
1 st	Digestion, absorption and transport of sugars into cells Glycolysis TCA cycle	
2 nd	Gluconeogenesis Glycogenolysis	
3 rd	HMP Pathway Uronic acid Pathway	
4 th	Glycogenesis Digestion, absorption and transport of lipids	Assignmet#1
5 th	Glycolysis TCA cycle	
6 th	oxidation of saturated and unsaturated fatty acid biosynthesis of fatty acids	Quiz #1
7 th	Phospholipids Tryiglycerides	
8 th	Mid Term Exam	
9 th	Steroids Bile acids Digestion of proteins	Assignment #2
10 th	absorption and transport of amino acids to cells Decarboxylation Transamination	
11 th	Metabolism of essential amino acids Creatine Urea cycle Uric acid synthesis	Quiz #2
12 th	Bioenergetics Oxidative phosphorylation Substrate level phosphorylation	
13 th	Electron transport chain Chemiosmotic theory Purines and pyrimidines	

14th	Catabolism of pyrimidines Regulation of purines	
16th	Regulation of pyrimidines Nitrogen cycle Nucleotide overview	
17th	Terminal Exam	

CHM-5505 Analytical Chemistry		Credit Hrs. 4(3-1)
Weeks	Topic of Lecture	Activity
1 st	Introduction to Analytical Chemistry	
	Quantitative and Qualitative analysis with examples	
	Chemical analysis, Types of Chemical Analysis.	
2 nd	Classical methods of Analysis (volumetric method)	
	Classical methods of Analysis (gravimetric method)	
	Introduction to instrumental methods of analysis	
3 rd	Types of instrumental methods of analysis, Brief introduction to optical methods	
	Different types of optical methods	
	Brief introduction to electroanalytical methods	
4 th	Brief introduction to electroanalytical methods continue....	Assignment # 1
	Brief introduction to separation methods	
	Brief introduction to separation methods continue.....	
	The steps of a chemical Analysis and Applications of chemical analysis.	
5 th	Error in a chemical analysis, Types of Error, 1- Systematic error, Types and Sources of systematic error,	
	Estimation of systematic error,	
	2- Random error explained	
6 th	Accuracy, Precision, difference between Accuracy and precision	Quiz #1
	Mean, Median, Mode, variance, coefficient of variance	
	Practice examples of standard deviation, Variance	
7 th	Limit of detection, signal to noise ratio	
	Measuring apparatus, and their uses in chemical analysis	
	Sampling	
8 th	Mid Term	
9 th	Sampling continue....	Assignment #2
	Expression of quantities and concentrations (Molarity/Formality)	
	Expression of quantities and concentrations (Normality, Molality)	
10 th	ppm and ppt solutions preparation	
	Percent solutions (w/v, v/w)	
	Percent solutions (w/w and v/v)	
11 th	practice examples of Percent solutions	Quiz #2
	Primary and Secondary standards reagents/chemicals and their properties	
	Use of primary and secondary standards	
12 th	Solution, solubility, saturated, unsaturated, super saturated solution	
	Solubility product K _{sp} and its Numerials	
	Basic approach to equilibrium	
13 th	Continue.. Basic approach to equilibrium	
	Law of mass action	

	Le-chatelier's principle	
14 th	Titration, titant, titrand, and its types	
	Indicator and its uses in titrations	
	Acid-base titration and its types	
15 th	Continue types of Acid Base titration	
	Complexometric Titration	
	Complexing agent; EDTA, properties of EDTA,	
16 th	Indicators use in complexometric titration, buffers	
	Introduction to Redox reactions, oxidation and reduction	
	Redox titration	
	Gravimetric analysis Applications of gravimetric analysis	
17 th	Terminal Examinations	

7th Semester

CHM-6733		Introductory Stereochemistry	Credit Hours: 3(3-0)
WEEK	Teaching Activities		
1st	Brief Introduction Of Isomerism And Its Types Introduction To Stereochemistry: Stereoisomerism And Its Types, Conformational Isomerism In Ethane, Propane, n-Butane And		
2nd	Cyclohexane Configurational Isomerism And Its Types, Geometrical Isomerism and their configuration Cis-Trans, EZ, Syn-Anti Optical Isomerism, Optical Activity, Chirality And Optical Activity,		
3rd	Enantiomers, Diastereoisomers, Meso Compounds Relative And Absolute Configuration(DL and RS)RS Configuration-Practice Problems		
4th	Optical Isomerism In Cyclic Compounds Chirality And Elements Of Chirality: Centre Of Chirality, Axis Of Chirality, Plane Of Chirality, Halices, Chirality And Asymmetry		Assignment#1
5th	Symmetry And Elements Of Symmetry, Plane Of Symmetry, Centre Of Symmetry, Axis Of Symmetry, Practice To Find Symmetry Elements In Order To Differentiate Between Chiral and Achiral Molecules.		
6th	Racemization and Epimerization, Resolution of Racemic Mixtures(enantiomers)-Brief Methods Structure And Symmetry: Symmetry Elements And Point Groups,		Quiz #1
7th	Practice To Identify Point Groups In Small Molecules Selectivity And Its Types: Chemo-Selectivity, Regio-Selectivity, Stereo-Selectivity, Stereo-Specificity		
8th	Midterm Examination		
9th	Stereochemical Reactions: Stereospecific Reactions, Stereoselective Reactions Stereoselective Reactions, Enantioselective Reactions, Diastereoselective Reactions		Assignment#2
10th	Stereochemistry of SN ₁ and SN ₂ Ractions, Addition Of Halogens In Alkenes- Syn And Anti-Addition, Hydroxylation in Alkenes with KMnO ₄ (Syn-addition) and HCO ₂ OH(Anti-Addition)		
11th	Topicity : Homomorphic Groups, Ligands, Atoms, Homotopic And Heterotopic Groups, Ligands and Atoms Hetrotopic (Enantiotopic And Diastereotopic) Relationships,		Quiz #1
12th	Criteria Used to Check Topic Relationship In Homomorphic Groups, Ligands, Atoms. Substitution-Addition Criteria,		
13th	Symmetry Criteria, Symmetry Criteria, Prochiral Centre, Re-Face, Si-Face, Pro-S, Pro-R		
14th	Principle of Asymmetric Synthesis or Stereoselectivity, Energy Level Diagram of an Enantioselective Reaction.		

15th	Asymmetric Synthesis And Asymmetric Induction, Percentage Enantiomeric Excess-%Ee And Diastereomeric Excess-%De.	
16th	Strategies Used in Stereoselective Synthesis or Asymmetric Synthesis	
17th	Terminal Exams	

CHM-6732		Spectroscopy-I	Credit Hrs.3(3-0)
Weeks	Topic of lecture	Activity	
1 st	Theory of Nuclear Magnetic Resonance spectrophotometer		
	Theory of Nuclear Magnetic Resonance spectrophotometer		
	Principles of Nuclear Magnetic Resonance spectrophotometer		
2 nd	Principles of Nuclear Magnetic Resonance spectrophotometer		
	Spectral parameters of Nuclear Magnetic Resonance spectrophotometer		
	Spectral parameters of Nuclear Magnetic Resonance spectrophotometer		
3 rd	Spectral studies of Nuclear Magnetic Resonance spectrophotometer		
	Spectral studies of Nuclear Magnetic Resonance spectrophotometer		
	Theory of Mass spectrophotometer		
4 th	Theory of Mass spectrophotometer	Assignment#1	
	Principles of Mass spectrophotometer		
	Principles of Mass spectrophotometer		
5 th	Spectral parameters of Mass spectrophotometer	Quiz #1	
	Spectral parameters of Mass spectrophotometer		
	Spectral studies of Mass spectrophotometer		
6 th	Spectral studies of Mass spectrophotometer		
	Special problems of NMR		
	Special problems of NMR		
7 th	Special problems of Mass spectrometry		
	Special problems of Mass spectrometry		
	Instrumentation of NMR		

8 th	Midterm	
9 th	Instrumentation of NMR	Assignment
	Instrumentation of Mass spectrometry	
	Instrumentation of Mass spectrometry	
10 th	General Discussion of spectroscopy	
	General Discussion of spectroscopy	
	General Discussion of NMR spectrometry	Quiz
11 th	General Discussion of NMR spectrometry	
	General Discussion of Mass spectrometry	
	General Discussion of Mass spectrometry	
12 th	Nuclear Maganetic Resonance spectrometry	
	Nuclear Maganetic Resonance spectrometry	
	Mass spectrometry	
13 th	Mass spectrometry	
14 th		
15 th	Terminal	

CHM-6717		Environmental chemistry	Credit Hrs. 3(3-0)
Weeks	Lecture No	Topic of Lecture	Activity
Week 1	1	Introduction to environmental chemistry	
	2	Basics definitions of terms used in environmental chemistry	
	3	Human environment	
Week 2	4	Lithosphere	
	5	Lithosphere Contin...	
	6	Hydrosphere	
Week 3	7	Hydrosphere Contin...	
	8	Biosphere	
	9	Biosphere Contin...	
Week 4	10	Types of environment	
	11	The nature and composition of natural water	
	12	The nature and composition of natural water Contin...	
Week 5	13	Water pollution	
	14	Water pollution Contin...	
	15	Water pollution Contin...	
Week 6	16	Introduction of atmosphere	
	17	Composition of atmosphere	
	18	Chemistry of soil	
Week 7	19	Soil pollution	
	20	Major sources	
	21	Prevention and control of soil pollution	
Week 8	Mid Term Exam		
Week 9	22	Oxides of carbon	Assignment # 2
	23	Sources	
	24	Harmful effects of oxides of carbon	
Week 10	25	Air pollution	
	26	Sources of air pollution	
	27	Control of air pollution	
Week 11	28	Control of air pollution Contin...	Quiz # 2
	29	Oxides of sulphur in air pollution	
	30	Sources of SO_x	
Week 12	31	Harmful Effect of SO_x	
	32	Oxides of nitrogen in air pollution	
	33	Sources of NO_x	
	34	Harmful Effect of NO_x	
	35	Photochemical smog	

	36	Smog, Acid rain	
Week 13	37	Adverse effect of Acid rain	
	38	Atmospheric monitoring	
	39	Control of oxides of carbon	
Week 14	40	Oxides of sulphur	
	41	Control of organic and inorganic pollutants	
	42	Control of organic and inorganic pollutants	
Week 15	43	Instrumental methods of environmental chemistry	
	44	Advance analytical techniques used to detect and quantify trace levels of contaminants in air, water, soil and biological samples	
	45	Chromatography (GC, HPLC) for organic pollutants	
Week 16	46	Spectroscopy (AAS, ICP-MS) for metals	
	47	Spectroscopy (AAS, ICP-MS) for metals contin...	
	48	Mass spectrometry for identification	
Week 17	Terminal Exam		

CHM-6731		Reaction Mechanism-I	Credit Hrs. 3(3-0)
Week	Lecture Contents (3 lectures/week)	Events	
Week 1	Lec-1: Course orientation; what is a reaction mechanism; types of mechanistic evidence. Lec-2: Energy profiles and reaction-coordinate diagrams; intermediates vs transition states; rate-determining step. Lec-3: Hammond postulate; using energy diagrams to rationalize selectivity and rate trends.		
Week 2	Lec-1: Kinetics fundamentals: rate laws, units, and experimental determination of rate. Lec-2: Order vs molecularity; integrated rate laws (zero/first/second); half-life; pseudo-first-order conditions. Lec-3: Temperature dependence: Arrhenius plot (E_a) and an introduction to activation parameters (ΔH^\ddagger , ΔS^\ddagger).		
Week 3	Lec-1: Kinetics of complex reactions: consecutive, parallel, and reversible reactions; pre-equilibrium approximation. Lec-2: Steady-state approximation: derivation and worked examples for multi-step mechanisms. Lec-3: Catalysis as mechanistic evidence: general acid/base catalysis; kinetic signatures and rate laws.		
Week 4	Lec-1: Kinetic isotope effects (KIE): primary vs secondary; normal vs inverse; what KIE reveals about bond changes. Lec-2: Solvent effects in mechanistic interpretation: polarity, ionizing power, and nucleophilicity of solvent systems. Lec-3: Linear free-energy relationships (brief): Hammett/Taft concepts and how substituent effects support a mechanism.	Assignment-I	
Week 5	Lec-1: Non-kinetic approach I - product studies: regioselectivity, stereoselectivity, and rearrangements as mechanistic clues. Lec-2: Trapping and testing intermediates: radical/carbocation/carbanion traps; design of control experiments. Lec-3: Physical detection of intermediates: spectroscopic/fast-kinetics overview (NMR/IR/UV-Vis/EPR; stopped-flow).		
Week 6	Lec-1: Crossover experiments: purpose, design, and interpretation; distinguishing intra- vs intermolecular pathways. Lec-2: Isotopic labelling: where/why to label; interpreting labelled products; common pitfalls. Lec-3: Stereochemical studies as evidence:	Quiz 1	

	inversion/retention/racemization; using chiral probes to infer pathways.	
Week 7	Lec-1: Aliphatic nucleophilic substitution overview: mechanistic map (SN1, SN2, SNi, ion-pair pathways). Lec-2: SN2 mechanism: kinetics, transition state, stereochemical inversion; substrate/nucleophile/solvent effects. Lec-3: Quantifying leaving groups and nucleophilicity; role of polar protic vs polar aprotic solvents.	Mid-Term Exam
Week 8	Lec-1: SN1 mechanism: carbocation formation, kinetics, rearrangements; solvent and leaving-group effects. Lec-2: Ion-pair mechanisms in solvolysis: intimate vs solvent-separated ion pairs; internal return; common-ion effects. Lec-3: SNi mechanism (retention): concept of internal return and solvent participation; classic alcohol-to-chloride case study.	
Week 9	Lec-1: Allylic substitution: SN1' and SN2' pathways; product distributions and mechanistic differentiation. Lec-2: Neighboring-group participation (anchimeric assistance): rate acceleration, stereochemical outcomes, and evidence. Lec-3: Competition between substitution and elimination - first principles (substrate/base/solvent/temperature).	Assignment-II
Week 10	Lec-1: Effects of substrate structure on SN pathways: 1°/2°/3°, allylic/benzylic, steric effects, and rearrangement propensity. Lec-2: Effects of leaving group on rate: pKa-based logic; sulfonates vs halides; solvent effects on ionization. Lec-3: Effects of nucleophile/base and solvent system on both mechanism and rate; HSAB and solvation concepts (applied).	
Week 11	Lec-1: Elimination reactions overview: E1, E2, E1CB; kinetic signatures and energy profiles. Lec-2: E2 mechanism: concerted pathway; anti-periplanar requirement; stereochemical outcomes (E/Z). Lec-3: Regioselectivity: Zaitsev vs Hofmann; influence of base size, substrate structure, and leaving group.	Quiz 2
Week 12	Lec-1: E1 mechanism: carbocation formation; rearrangements; solvent effects; temperature dependence. Lec-2: Substitution vs elimination competition: predictive framework for secondary/tertiary substrates. Lec-3: Solvent and base/nucleophile effects in E1/E2 vs SN1/SN2 competition; worked synthesis-style problems.	
Week 13	Lec-1: E1CB mechanism: carbanion formation; when E1CB is favored; kinetic criteria. Lec-2: Classic E1CB examples: beta-hydroxy carbonyl dehydration; nitro and sulfone eliminations (mechanistic	

	<p>logic).</p> <p>Lec-3: Using isotope effects and labelling to distinguish E2 vs E1CB; mechanistic case studies.</p>	
Week 14	<p>Lec-1: Orientation of double bond: kinetic vs thermodynamic control; conjugation effects; Zaitsev/Hofmann revisited.</p> <p>Lec-2: Elimination stereochemistry in cyclic systems: conformational requirement in cyclohexanes; trans-diaxial eliminations.</p> <p>Lec-3: Advanced/related eliminations (brief enrichment): E2' and syn eliminations (conceptual overview).</p>	
Week 15	<p>Lec-1: Reaction catalysis and medium effects in substitution/elimination: Lewis acid, phase-transfer, and salt effects (overview).</p> <p>Lec-2: Mechanistic problem set workshop: designing experiments to distinguish competing pathways.</p> <p>Lec-3: Literature-style examples: interpreting rate data, product ratios, and stereochemical outcomes to justify mechanisms.</p>	
Week 16	<p>Lec-1: Integrated methodology: a stepwise workflow for determining an unknown mechanism (kinetic + non-kinetic evidence).</p> <p>Lec-2: Multi-step mechanisms: rate-determining vs product-determining steps; kinetic vs thermodynamic selectivity.</p> <p>Lec-3: Advanced practice: mechanism proposals + critical evaluation (student-led).</p>	
Week 17	<p>Lec-1: Intermediates and transition states: stability/reactivity of carbocations, carbanions, and radicals (mechanistic relevance).</p> <p>Lec-2: Consolidation: ion pairs, solvent participation, neighboring-group effects across substitution and elimination.</p> <p>Lec-3: Comprehensive review of key mechanistic patterns and common pitfalls; exam-focused practice questions.</p>	
Week 18	<p>Lec-1: Final revision: kinetics toolbox (SSA, KIE, LFER), substitution and elimination - connections and contrasts.</p> <p>Lec-2: Past-paper style problem solving + discussion of marking scheme expectations.</p> <p>Lec-3: Wrap-up: linking mechanistic reasoning to synthesis and research; final Q&A.</p>	
Week 19	Terminal Examination	