BOT-3101	Cell Biology	Credit Hrs. 3(2-1)
Week	**Theory Topics / Contents**	
1	Introduction to Cell Biology: history, scope, cell theory	
2	Prokaryotic vs. eukaryotic cells; plant cell vs. animal cell	
3	Cell wall composition and function; plasma membrane structure	
4	Selective permeability; passive transport (diffusion, osmosis)	Assignment
5	Active transport; endocytosis and exocytosis	
6	Cytoplasm and nucleus; chromatin organization	Quiz
7	Chloroplasts: structure and function	
8	Midterm	
9	Mitochondria: structure and energy production	Assignment
10	Endoplasmic reticulum, Golgi apparatus, ribosomes	
11	Vacuoles, tonoplast, plasmodesmata	Quiz
12	Biomolecules: carbohydrates, proteins, lipids, nucleic acids	
13	Macromolecular assemblies; cell signaling	
14	Transport in plant tissues: symplastic and apoplastic pathways	
15	Cell cycle and mitosis, Cytokinesis and meiosis	
16	Control of cell division; microscopy techniques	
17	Terminal	

BOT 3102 Diversity of plants		Credit Hrs. 3(2-1)
Weeks	**Topic of Lecture**	
1st	Origin, diversity, and evolution of life	
	Origin, diversity, and evolution of life	
2nd	life forms, structure, reproduction, and ecological significance of: Viruses	
	life forms, structure, reproduction, and ecological significance of: Viruses,	
3rd	life forms, structure, reproduction, and ecological significance of: Bacteria	
	life forms, structure, reproduction, and ecological significance of: Bacteria	
4th	life forms, structure, reproduction, and ecological significance of: cyanobacteria	Assignment #1
	life forms, structure, reproduction, and ecological significance of: cyanobacteria	
5th	life forms, structure, reproduction, and ecological significance of: Fungi	
	life forms, structure, reproduction, and ecological significance of: Fungi	
6th	life forms, structure, reproduction, and ecological significance of: Algae	Quiz #1
	life forms, structure, reproduction, and ecological significance of: Algae	
7th	Diversity and adaptation of Bryophytes on land environment	
	Diversity and adaptation of Bryophytes on land environment	
8th	Midterm	
9th	Habit, habitat, and reproduction of Hepaticopsida (Liverworts)	
	Habit, habitat, and reproduction of Hepaticopsida (Marchantia)	
10th	Habit, habitat, and reproduction of Anthoceropsida (Anthoceros)	Assignment #2
	Habit, habitat, and reproduction of Anthoceropsida (Anthoceros)	
11th	Habit, habitat, and reproduction of Funaria	
	Habit, habitat, and reproduction of Funaria	
12th	Pteridophytes (Fossils and fossilization)	Quiz #2
	Psilopsida (Psilotum)	
13th	Lycopsida (Selaginella)	
	Lycopsida (Selaginella)	

14th	Sphenopsida (Equisetum)	
	Sphenopsida (Equisetum)	
15th	Pteropsida (Marsilea)	
	Seed habit and evolution of the leaf	
16th	Distinguishing features, diversity, and life cycle of gymnosperms	
	Distinguishing features, diversity, and life cycle of angiosperms	
17th	Terminal Eamination	

GEN-3103	Quantitative Reasoning-I	Credit Hrs. 3(3-0)
Week	**Topics**	**Assignment/Quiz**
Week 1	• Number systems and basic arithmetic operations	
Week 2	• Units, unit conversions, dimensions	
Week 3	• Area, perimeter, and volume calculations	
Week 4	• Rates, ratios, proportions, and percentages	**Assignment#1**
Week 5	• Types and sources of data; measurement scales	
Week 6	• Tabular and graphical presentation of data; exercises on number knowledge	**Quiz #1**
Week 7	• Basics of geometry: lines, angles, circles	
Week 8	Midterm	
Week 9	• Basics of geometry: polygons and their properties	**Assignment#2**
Week 10	• Sets and set operations • Relations, functions, and their graphs	
Week 11	• Exponents, factoring, and simplifying algebraic expressions	**Quiz #2**
Week 12	• Population, sample, measures of central tendency	
Week 13	• Measures of dispersion and data interpretation	
Week 14	• Rules of counting: multiplication principle, permutations, combinations	
Week 15	• Basic probability theory and examples	
Week 16	• Introduction to random variables and their probability distributions	
Week 17	Terminal Examination	

GEN-3104 Introduction to Environmental Science Credit Hrs. 3(2-1)		
Week	**Topics**	**Assignment/Quiz**
Week 1	**1. The human environment:** The litho, bio, and hydro spheres,	
Week 2	the nature and composition of natural waters,	
Week 3	2. **Pollution:** definition, classification, and impact on habitats	
Week 4	i. Air pollution**:** Sources and effects of various pollutants (inorganic, organic),	**Assignment#1**
Week 5	ii. control, and remediation	
Week 6	iii. . Photochemical smog, Smog,	**Quiz #1**
Week 7	iv. Acid rain: 1. Theory of acid rain, 2. Adverse effects of acid rain. Chlorofluorocarbons and their effects.	
Week 8	Midterm	
Week 9	v. Water pollution: Major sources of water pollution and its impact.	**Assignment#2**
Week 10	vi. Prevention, control remediation, Heavy metal pollution. Tanneries. Hospital waste, Treatments of sewage, sludge, and polluted waters.	
Week 11	Soil pollution: major sources of soil pollution and its impact. Prevention, control remediation. Noise pollution.	**Quiz #2**
Week 12	Sources of Noise pollution, remedies of noise pollution	
Week 13	3. **Ozone layer:** Formation	
Week 14	Mechanism of depletion Effects of ozone depletion	
Week 15	**Greenhouse effect:** causes,	
Week 16	impacts	
Week 17	Terminal Examination	

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, Complex, Compound-Complex; Types by Function: Declarative, Interrogative, Imperative, Exclamatory	Assignment#1
	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 pf Clause: Independant 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	• قران پاک کا تعارف،فضائل ، اعجاز	
	Lecture 2	• قرآن پاک کا نزول قرآن ، جمع و تدوین	
Week 2	Lecture 3	• علوم قرآن: علم تفسیر ، ماخذ تفیسر	
	Lecture 4	• علم اسباب نزول، علم ناسخ و منسوخ	
Week 3	Lecture 5	• سورہ حجرات آیت (01 تا ۰۹)	
	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 ۱-۰۵	
Week 6	Lecture 11	• منتخب متون احادیث کا مطالعہ: حدیث نمبر 5-10	**Quiz # 01**
	Lecture 12	• منتخب متون احادیث کا مطالعہ: حدیث نمبر۱۵ ۱۰	
Week 7	Lecture 13	□ منتخب متون احادیث کا مطالعہ: حدیث نمبر ۲۰-۱۵	
	Lecture 14	□ پیدائش سے بعثت تک نبی کریمﷺ کی زندگی کے اہم واقعات	
Week 8	**Midterm**		
Week 09	Lecture 15	□ نبی پاکﷺ کی مکی زندگی کے اہم واقعات	

	Lecture 16	ﷺ نبی پاک 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 بالاخرت)(الف)	**Quiz # 02**
	Lecture 20	عقائد :ایمانیات ثلاثہ (ایمان باللہ ، ایمان بالرسالت اور ایمان بالاخرت)(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	زکوۃ : اہمیت ، مسائل زکوۃ	
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)	
Week17	**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 recognization and idea generation** Opportunity identification, evaluation and exploitation Innovation, idea generation techniques for entrepreneurial ventures	
Week 06	Lecture 11	**Marketing and sales** ● Target market identification and segmentation	**Quiz #1**

	Lecture12	●Four P's of Marketing	
Week 07	Lecture 13 Lecture 14	Developing a marketing strategy Branding	
Week 08		**Mid Term**	
Week 09	Lecture 15 Lecture 16	**<u>Financial Literacy:</u>** 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	**<u>Team Building for Startups:</u>** 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	• Introduction to logic; importance of logical reasoning	
Week 2	• Inductive, deductive, and abductive reasoning approaches	
Week 3	• Propositions, arguments (valid and invalid)	
Week 4	• Logical connectives, truth tables	**Assignment#1**
Week 5	• Propositional equivalences and logical fallacies	
Week 6	• Venn diagrams; predicates and quantifiers; reasoning exercises	**Quiz #1**
Week 7	• Introduction to deterministic models	
Week 8	• Midterm	
Week 9	• Using linear functions for real-world modeling	**Assignment#2**
Week 10	• Modeling with systems of linear equations and solutions	
Week 11	• Elementary introduction to derivatives in modeling	**Quiz #2**
Week 12	• Linear growth and decay models • Exponential growth and decay models	
Week 13	• Introduction to probabilistic models; bivariate analysis and scatter plots	
Week 14	• Simple linear regression model and correlation analysis	
Week 15	• Basics of estimation and confidence intervals • Hypothesis testing: z-test and t-test basics	
Week 16	• Statistical inference in decision making	
Week 17	• 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	
	Parenchyma & Collenchyma	

10	Sclerenchyma, trichomes & stomatal types	Assignment #2
	Xylem — structure & function	
11	Phloem — structure & function	
	Meristems: types, stem & root apices	
12	Primary structure: root, stem & leaf	Quiz #2
	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: *Capsella bursa-pastoris*	
	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,1st, 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**
1st	**Cell Division:** • Cell cycles • Mitosis and meiosis-----	
2nd	• Mitosis and meiosis • control of the cell cycle.	
3rd	**Inheritance Patterns:** • Mendelian genetics • Inheritance patterns	
4th	• Inheritance patterns	**Assignment #1**
5th	• gene, structure, chemical composition and types	
6th	**Chromosomes and Gene Linkage:** • Eukaryotic chromosomes; linkage and crossing over	**Quiz #1**
7th	• Chromosomal aberrations.	
8th	Midterm Examination	
9th	**Molecular Genetics:** Cellular Control: DNA: the genetic material	**Assignment #2**
10th	DNA replication in prokaryotes and eukaryotes Control of gene expression in eukaryotes	
11th	gene mutation recombinant DNA and applications of genetic technologies	Quiz #2
12th	**Animal Behaviour:** • Behavior and its types, proximate and ultimate causes • Anthropomorphism • development of behavior; learning; factors controlling animal behavior	

	• communication • behavioral ecology social behavior	
13th	**Evolution:** • Historical Perspective: Theories of evolution: Lamarckism and natural selection, neo larmarckism, Darwinism, and neo-Darwinian	
14th	**Evolution and Gene Frequencies:** • Hardy-Weinberg principle • evolutionary mechanisms: population size, genetic drift, gene flow	
15th	• de Vries mutation theory and rates of evolution, • polymorphism; species and speciation • molecular evolution • mosaic evolution	
16th	**Terminal**	
17th		

5th Semester

BOT-5501	**Bacteriology And Virology**	**Credit Hrs. 3(2-1)**
Weeks	**Topic of Lecture**	**Activity**
1st	Introduction to course (Principles of Animal Life-I)	
2nd	**Scope of Zoology:** Introduction; significance and applications of zoology animal diversity; the scientific method Environment and world resources	
3rd	**The Chemical Basis of Animal Life:**Brief introduction to biomolecules; carbohydrates, lipids Proteins and nucleic acids.	
4th	**Cellular Organization:** Structure of animal cells, cell membrane, cytoplasm and its organelles ribosomes, endoplasmic reticulum, Golgi apparatus, lysosomes	Assignment #1
5th	mitochondria, cytoskeleton, cilia and flagella, centrioles and microtubules, and vacuoles; ribosomes endoplasmic reticulum, the nucleus: nuclear envelope, chromosomes and nucleolus	
6th	**Animal tissues:** Types: epithelial, connective, muscle tissue Nervous tissue; organs and organ systems.	Quiz #1
7th	**Enzymes:** Structure, types Function and cofactors and coenzymes. factors affecting their activity **Energy Harvesting:** Aerobic and anaerobic respiration:	
8th	**Mid Term Exam**	

9th	glycolysis, citric acid cycle electron transport chain	Assignment #2
10th	Fermentation, the major source of ATP. **Reproduction and Development:** Types; asexual and sexual	
11th	gametogenesis, fertilization, metamorphosis Zygote and early development.	Quiz #2
12th	**Ecological Concepts:** Individuals and Populations: Animals and their abiotic environment populations and limiting factors	
13th	Communities and Ecosystems: Community structure and diversity; interspecific interactions	
14th	Ecosystem, types, homeostasis, biomes, food chain, food web, energy flow	
15th	Thermodynamics, biogeochemical cycles; Ecological problems (Presentations)	
16th .	human population growth, pollution Resource depletion and biodiversity.	
17th	Terminal	

BOT-5502	Diversity of Vascular plants	Credit Hrs. 3(2-1)
Weeks	**Topic of Lecture**	Activity
1st	Introduction, origin, history, features and a generalized life cycle	
	Introduction, origin, history, features and a generalized life cycle	
2nd	Methods of fossilization, types of fossils, geological time scale and importance of paleobotany.	
	Methods of fossilization, types of fossils, geological time scale and importance of paleobotany.	
3rd	Methods of fossilization, types of fossils, geological time scale and importance of paleobotany.	
	First vascular plant - Rhyniophyta e.g. *Cooksonia* General Characters, classification, affinities and comparative account of evolutionary trends	
4th	First vascular plant - Rhyniophyta e.g. *Cooksonia* General Characters, classification, affinities and comparative account of evolutionary trends	Assignment
	General Characters, classification, affinities and comparative account of evolutionary trends of the following phyla: Psilopsida Psilotum)	
5th	General Characters, classification, affinities and comparative account of evolutionary trends of the following phyla: Psilopsida Psilotum)	
	General Characters, classification, affinities and comparative account of evolutionary trends of the following phyla: Lycopsida (Lycopodium)	
6th	General Characters, classification, affinities and comparative account of evolutionary trends of the following phyla: Lycopsida (Lycopodium)	Quiz
	General Characters, classification, affinities and comparative account of evolutionary trends of the following phyla: Selaginella with emphasis on origin and evolution of seed habit	
7th	General Characters, classification, affinities and comparative account of evolutionary trends of the following phyla: Selaginella with emphasis on origin and evolution of seed habit	
	Sphenopsida (Equisetum)	
8th	Midterm	
9th	Pteropsida (*Ophioglossum)*	Assignment
	Pteropsida (*Dryopteris*).	
10th	Pteropsida (*Azolla/Marsilea*)	
	Geological history, origin, distribution, morphology, anatomy, classification and affinities of Cycadofillicales,	
11th	Origin, distribution, morphology, anatomy, classification and affinities of Bennettitales,	Quiz
	Origin, distribution, morphology, anatomy, classification and affinities of Ginkgoales	

12th	Origin, distribution, morphology, anatomy, classification and affinities of Cycadales	
	Origin, distribution, morphology, anatomy, classification and affinities of Gnetales	
13th	Distribution of gymnosperms in Pakistan. Economic importance of gymnosperms. An introduction to the Gondwana flora of world.	
	Distribution of gymnosperms in Pakistan. Economic importance of gymnosperms. An introduction to the Gondwana flora of world.	
14th	Angiosperms Origin, general characteristics, Importance, and life cycle of angiosperms	
	Angiosperms Origin, general characteristics, Importance, and life cycle of angiosperms	
15th	Angiosperms Origin, general characteristics, Importance, and life cycle of angiosperms	
	Angiosperms Origin, general characteristics, Importance, and life cycle of angiosperms	
16th	**Palynology:** Basic information about the nomenclature, morphology and classification of living and fossil pollen and spores.	
	Palynology: Basic information about the nomenclature, morphology and classification of living and fossil pollen and spores.	
17th	Terminal	

BOT-5503	Phycology and Bryology	Credit Hrs. 3(2-1)
Week	**Topics**	
Week 1	• Course introduction • Scope Phycology & Bryology • Importance of Phycology & Bryology	•
	• General characteristics of alga • Thallus organization • Reproduction of algae	•
Week 2	• Evolution of algae • Classification of algae (overview) • Basis of classification	•
	• Biochemistry of algae • Pigments • Reserve food	•
Week 3	• Chlorophyta • General account • Classification	•
	• Morphology in Chlorophyta • Reproduction in Chlorophyta • Economic importance of Chlorophyta	•
Week 4	• Charophyta • General account • Characteristics	Assignment#1
	• Xanthophyta • Structural orgnization • Reproduction in Xanthophyta	•
Week 5	• Bacillariophyta • Structural organization in Xanthophyta • Reproduction and importance of Baccilariophyta	•
	• Phaeophyta • Morphology • Life cycle	•
Week 6	• Rhodophyta • Structural organization • Reproduction	Quiz #1
	• Economic importance of algae • Economic importance of algae • Ecology of algae	•
Week 7	• Introduction to Bryophytes • General characteristics Plant body organization	•
	• Classification of bryophytes	•

	• Basis of classification • Difference of various classes	
Week 8	• Midterm	
Week 9	• Theories of origin of bryophytes • Evolution of bryophytes • General affinities with various groups	Assignment #2
	• Reproduction in Bryophytes • Types of reproduction • Alternation of generations in bryophytes	•
Week 10	• Hepaticopsida • General account of Hepaticopsida • Reproduction in Hepaticopsida	•
	• Study of *Pellia* • Structural organization in *Pellia* • Reproduction in *Pellia*	•
Week 11	• Study of *Porella* • Structural organization in *Porella* • Reproduction in *Porella*	Quiz #2
	• Anthoceropsida • General account of Anthoceropsisa • General account of Anthoceropsisa	•
Week 12	• Study of *Anthoceros* • General account of Anthoceros • Structural organization of Anthoceros	•
	• Bryopsida • General characteristics • Structural organization	•
Week 13	• Study of *Polytrichum* (gametophyte) • General account • Gametophyte study of *Polytrichum*	•
	• Sporophyte of *Polytrichum* • Sporophytic generation •	•
Week 14	• Comparative account of bryophyte classes • Comparative account of bryophyte classes • Comparative account of bryophyte classes	•
	• Economic importance of bryophytes • Ecological importance of bryophytes • Significance role with ecosystem	•
Week 15	**Terminal Examination**	

BOT-5504	**Mycology and Plant Pathology**	**Credit Hrs. 3(2-1)**
Weeks	**Topic of Lecture**	Activity
1st	Introduction**:** General characters of fungi	
	Introduction**:** General characters of fungi	
2nd	Thallus, cell structure and ultrastructure of fungi.	
	Reproduction: Asexual and sexual reproduction and reproduction structures	
3rd	Reproduction: Asexual and sexual reproduction and reproduction structures	
	Life cycle of fungi ,Classification of fungi	
4th	life cycle and reproduction of Myxomycota	Assignment# 1
	Chytridiomycota	
5th	Chytridiomycota	
	Zygomycota (Mucar)	
6th	Zygomycota (Mucar)	Quiz#1
	Oomycota	
7th	Midterm	
	Oomycota	
8th	Midterm	
9th	Ascomycota	Assignment# 2
	Ascomycota	
10th	Basidiomycota	
	Basidiomycota	
11th	Basidiomycota	Quiz#2
	Basidiomycota	
12th	Deuteromycetes	
	Symbiotic relationships of fungi with other organisms (lichens and mycorrhiza) and their significance	
13th	Importance of fungi in human affairs with special reference to Industry and Agriculture	
	Introduction and classification of plant diseases	
14th	Symptoms, causes and development of plant diseases, loss assessment and diseases control	
	Important diseases of crop plants and fruit trees in Pakistan caused by fungi, e.g. damping off, red rot of sugarcane	

15th	Important diseases of crop plants and fruit trees in Pakistan caused by fungi, e.g. mildews and dieback	
	Important diseases of crop plants and fruit trees in Pakistan caused by fungi, e.g. rusts	
16th	Plant defense strategies, systemic resistance, induced systematic resistance (ISR), Acquired Systematic resistance (ASR)	
17th	Terminal	

BOT-5505	Cell Biology	Credit Hrs. 3(2-1)
Week	**Topics**	**Assessment**
Week 1	Life Begins with Cells: Diversity and commonality of cells	
Week 2	Molecules of a cell; Work of cells	
Week 3	Investigating cells; Genome perspective on evolution	
Week 4	Cell theory; Structure of plant cell	**Assignment #1**
Week 5	Prokaryotic and eukaryotic cells	
Week 6	Physico-chemical nature of plasma membrane and cytoplasm	**Quiz #1**
Week 7	Cell wall; Endoplasmic reticulum	
Week 8	**Midterm Examination**	
Week 9	Plastids, mitochondria, ribosomes, dictyosomes	**Assignment #2**
Week 10	Vacuole; Microbodies (glyoxysomes, peroxisomes)	
Week 11	Nucleus: Nuclear membrane and nucleolus	**Quiz #2**
Week 12	Chromosomes: Morphology, ultrastructure, karyotype analysis	
Week 13	Prokaryotic vs eukaryotic chromosomes; Histones & HMG proteins	
Week 14	Cell surface signaling: Signaling molecules and receptors	
Week 15	Intracellular signal transduction	
Week 16	Cell cycle: Mitosis, meiosis, chromosomal aberrations	
Week 17	**Terminal Examination**	

7th Semester

BOT-6701	Plant Ecology-II	Credit Hrs. 3(2-1)
Week	**Topics**	**Assessment**
Week 1	Introduction to Plant Ecology-II; Scope and relevance to mankind	
Week 2	Plant community concepts: Discrete and continuum concepts; modern synthesis	
Week 3	Community attributes I: Leaf spectra, life form distribution, Raunkiaer's law	
Week 4	Community attributes II: Periodicity, phenology, fidelity, constancy, age classes	**Assignment #1**
Week 5	Homogeneity and heterogeneity in plant communities	
Week 6	Species diversity: concepts, indices and ecological significance	**Quiz #1**
Week 7	Plant community structure: vertical and horizontal stratification	
Week 8	**Midterm Examination**	
Week 9	Plant community dynamics: Succession, types and mechanisms	**Assignment #2**
Week 10	Methods of sampling plant communities: Quadrat, line intercept methods	
Week 11	Point-centered quarter method; merits and limitations of sampling techniques	**Quiz #2**
Week 12	Quantitative community description: Gradient analysis and ordination techniques	
Week 13	Classification of vegetation; applications in ecology	
Week 14	Productivity: Concept, measurement of biomass and NPP	
Week 15	Energy flow in ecosystems; trophic efficiency	

Week 16	Flora of Azad Jammu and Kashmir; local ecosystems and conservation	
Week 17	Terminal Examination	

BOT-6702	**Genetics – I**	**Credit Hrs. 3(2-1)**
Week	**Topics**	
Week 1	• Course introduction • Nature of genetic material • Scope and importance of Genetics	
	• Mendelian principles (recap) • Extensions of Mendelian analysis • Variations on dominance	
Week 2	• Multiple alleles • Lethal alleles • Several genes affecting the same character	
	• Penetrance • Expressivity • Pleiotropy	
Week 3	• Concept of linkage • Discovery of linkage • Linkage symbolism	
	• Recombination • Sex-linked inheritance • X-chromosome linkage	
Week 4	• Linkage maps • Recombination frequency • Map units	Assignment #1
	• Three-point test cross • Gene order determination • Interference and coincidence	
Week 5	• Linkage mapping in humans • Pedigree analysis • Applications of linkage mapping	
	• Large map distances • Mapping functions • Calculation of recombination values	
Week 6	• Single meiosis analysis • Mitotic segregation • Mitotic recombination	Quiz #1
	• Human chromosome mapping • Special eukaryotic mapping techniques • Applications	

Week 7	• Concept of mutation • Types of mutations • Somatic vs germinal mutation	
	• Occurrence of mutations • Mutagens • Genetic disorders	
Week 8	Midterm	
Week 9	• Mutation and cancer • Mutation breeding • Evolutionary significance of mutation	Assignment #2
	• Bacterial chromosome • Bacterial conjugation • Gene transfer	
Week 10	• Bacterial recombination • *E. coli* chromosome mapping • Recombination mechanisms	
	• Bacterial transformation • Mechanism of transformation • Applications	
Week 11	• Bacteriophage genetics • Transduction • Phage mapping	Quiz #2
	• Bacterial gene transfer • Mapping bacterial chromosomes • Applications	
Week 12	• DNA as genetic material • Evidence for DNA as genetic material • Structure of DNA	
	• DNA replication in eukaryotes • Enzymes involved • DNA and the gene	
Week 13	• Nature of the gene • Gene–protein relationship • One gene–one enzyme hypothesis	
	• Genetic fine structure • Mutational sites • Complementation	
Week 14	• Transcription • Translation • Genetic code	

	• Protein synthesis • Eukaryotic RNA • Universality of genetic information	
Week 15	• Extranuclear genome • Cytoplasmic inheritance • Organelle genetics	
	• Developmental genetics • Gene regulation • Differentiation	
Week 16	• Population genetics • Gene frequencies • Hardy–Weinberg law	
	• Factors affecting gene equilibrium • Applications of population genetics • Course revision	
Week 17	**Terminal Examination**	

BOT-6703	Research Methodology	Credit Hrs.3(2-1)
Week	**Topics**	**Assignment / Quiz**
Week 1	Introduction to research: Meaning, objectives, and types of research	
Week 2	Research methods: Planning research, selecting methods, reporting results	
Week 3	Research process: Identification of research problem and formulation of research questions	
Week 4	Sampling techniques: Probability and non-probability sampling	**Assignment #1**
Week 5	Data collection methods: Surveys, interviews, case studies	
Week 6	Documents, records, observation techniques	**Quiz #1**
Week 7	Measurement of data: Scaling techniques, quantitative and qualitative data	
Week 8	Midterm	
Week 9	Research design: Experimental and quasi-experimental designs	**Assignment #2**
Week 10	Descriptive and unobtrusive measurement techniques	
Week 11	Data analysis: Quantitative data analysis methods	**Quiz #2**
Week 12	Qualitative data analysis methods	
Week 13	Writing a research paper: Structure and basic steps	
Week 14	Validity and reliability in research	
Week 15	Ethical issues in research	
Week 16	Thesis writing, plagiarism, referencing styles	
Week 17	**Terminal Examination**	

BOT-6704	Plant Biochemistry-II	Credit Hrs. 3(2-1)
Weeks	**Topic of Lecture**	Activity
1st	Bioenergetics: Energy, laws about energy changes. Oxidation and redu in living systems	
	Bioenergetics: Energy, laws about energy changes. Oxidation and reduction in living systems	
2nd	Biosynthesis, degradation and regulation of sucrose and starch	
	Biosynthesis, degradation and regulation of sucrose and starch	
3rd	Biosynthesis, degradation and regulation of sucrose and starch	
	Breakdown of fats with special reference to beta-oxidation and its energy balance. Biosynthesis of fats.	
4th	Breakdown of fats with special reference to beta-oxidation and its energy balance. Biosynthesis of fats.	Assignment
	Replication of DNA	
5th	Reverse transcription	Quiz
	Reverse transcription	
6th	Biosynthesis of DNA and RNA	
	Protein synthesis: initiation, elongation and termination.	
7th	Protein synthesis: initiation, elongation and termination.	
	Genetic code	
8th	Midterm	
9th	Alkaloids: Occurrence, physiological effects, chemical nature	Assignment
	Alkaloids: Occurrence, physiological effects, chemical nature	
10th	Occurrence, physiological effects, chemical nature with special reference to solanine	Quiz
	Occurrence, physiological effects, chemical nature with special reference to nicotine	
11th	Occurrence, physiological effects, chemical nature with special reference to morphine	
	Occurrence, physiological effects, chemical nature with special reference to theine and caffeine	
12th	Occurrence, physiological effects, chemical nature with special reference to theine and caffeine	
	Aflatoxins, their nature and role	
13th	Terpenoids: Classification: monoterpenes, sesquiterpenes	
	Terpenoids: Classification: monoterpenes, sesquiterpenes	

14th	Diterpenes, triterpenes, tetraterpenes, polyterpenes and their chemical constitution and biosynthesis	
	Diterpenes, triterpenes, tetraterpenes, polyterpenes and their chemical constitution and biosynthesis	
15th	Diterpenes, triterpenes, tetraterpenes, polyterpenes and their chemical constitution and biosynthesis	
	Vitamins, General properties	
16th	Vitamins role in metabolism	
	Vitamins role in metabolism	
17th	Terminal	

BOT-6705	**Plant Physiology-II**	**Credit Hrs. 3(2-1)**
Week	**Topics**	**Assessment**
Week 1	Introduction to Plant Physiology-II; Overview of plant growth regulators	
Week 2	Auxins: structure, biosynthesis, transport, physiological effects	
Week 3	Gibberellins and Cytokinins: bioassays, mode of action, signaling	
Week 4	Abscisic acid and Ethylene: synthesis, transport, physiological roles	**Assignment #1**
Week 5	Polyamines, Brassinosteroids, Jasmonates, Salicylic acid	
Week 6	Soil-Plant-Atmosphere Continuum (SPAC); Structure and properties of water	**Quiz #1**
Week 7	Water in soil and plant cells; Water absorption pathways; Aquaporins	
Week 8	**Midterm Examination**	
Week 9	Cell water relations; Hofler diagram; Hydraulic conductivity	**Assignment #2**
Week 10	Measurement of water, osmotic and turgor potentials	
Week 11	Mineral nutrition: Inorganic composition of plants and soil; Nutrient uptake	**Quiz #2**
Week 12	Ion transport mechanisms; Membrane carriers, channels and pumps	
Week 13	Essential and beneficial elements; Deficiency symptoms; Fertilizers	
Week 14	Phytochromes and cryptochromes; Light perception and gene expression	
Week 15	Control of flowering: Photoperiodism, circadian rhythms, vernalization	

Week 16	Floral meristem development; ABC model; Gene regulation & signal transduction	
Week 17	Terminal Examination	**Terminal Examination**