CURRICULUM
OF
AGRICULTURAL CHEMISTRY
BS/B.Sc (Hons.)

2010

HIGHER EDUCATION COMMISSION
H-9, ISLAMABAD
CURRICULUM DIVISION, HEC

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PREFACE

The curriculum of subject is described as a throbbing pulse of a nation. By viewing curriculum one can judge the stage of development and its pace of socio-economic development of a nation. With the advent of new technology, the world has turned into a global village. In view of tremendous research taking place world over new ideas and information pours in like of a stream of fresh water, making it imperative to update the curricula after regular intervals, for introducing latest development and innovation in the relevant field of knowledge.

In exercise of the powers conferred under Section 3 Sub-Section 2 (ii) of Act of Parliament No. X of 1976 titled “Supervision of Curricula and Textbooks and Maintenance of Standard of Education” the erstwhile University Grants Commission was designated as competent authority to develop review and revise curricula beyond Class-XII. With the repeal of UGC Act, the same function was assigned to the Higher Education Commission under its Ordinance of 2002 Section 10 Sub-Section 1 (v).

In compliance with the above provisions, the HEC undertakes revamping and refurbishing of curricula after regular intervals in a democratic manner involving universities/DAIs, research and development institutions and local Chamber of Commerce and Industry. The intellectual inputs by expatriate Pakistanis working in universities and R&D institutions of technically advanced countries are also invited to contribute and their views are incorporated where considered appropriate by the National Curriculum Revision Committee (NCRC).

To bring international compatibility to qualifications held from Pakistani universities/DAIs for promotion of students mobility and job seekers around the globe, a Committee comprising of Conveners of the National Curriculum Revision Committee of HEC met in 2009 and developed a unified template for standardized 4-years/8-semesters BS degree programmes. This unified template was aimed to inculcate broader base of knowledge in the subjects like English, Sociology, Philosophy, Economics etc in addition to major discipline of study. The Bachelor (BS) degree course requires to be completed in 4-years/8-semesters, and shall require qualifying of 130-140 credit hours of which 77% of the curriculum will constitute discipline specific and remaining 23% will comprise compulsory and general courses.

In line with above, NCRC comprising senior university faculty and experts from various stakeholders and the respective accreditation councils has finalized the curriculum for BS and MS (Agricultural Chemistry). The same is being recommended for adoption by the universities/DAIs channelizing through relevant statutory bodies of the universities.

PROF. DR. ALTAF ALI G. SHAIKH
Member Academics

March 2010
Abbreviations Used:
NCRC. National Curriculum Revision Committee
VCC. Vice-Chancellor’s Committee
EXP. Experts
COL. Colleges
UNI. Universities
PREP. Preparation
REC. Recommendations
LI Learning Innovation
R&D Research & Development Organization
HEC Higher Education Commission
INTRODUCTION

The final meeting of National Curriculum Revision Committee (NCRC) in Agricultural Chemistry was held on March 29-31, 2010 to finalize the draft curriculum developed in the first meeting of the committee (November 02-04, 2009) at Higher Education Commission, Regional Centre Lahore. The meetings were attended by the following experts:

1. Prof. Dr. Hamid Ullah Shah  
   Dean, Faculty of Nutrition Sciences  
   NWFP Agricultural University  
   Peshawar

2. Prof. Dr. Fahim uddin  
   Ex-Convener NCRC and Advisor to  
   Vice Chancellor (Acad)  
   Department of Chemistry  
   University of Karachi  
   Karachi

3. Prof. Dr. Muhammad Saeed Khattak  
   Department of Agricultural Chemistry  
   Faculty of Agriculture  
   Gomal University, Dera Ismail Khan,  
   NWFP

4. Dr. Saghir Ahmed Sheikh  
   Professor and Director, Institute of  
   Food Sciences and Technology  
   Sindh Agriculture University, Tandojam

5. Dr. Tahira Shafiq  
   Chief Scientific Officer, and Head  
   Department of Environment  
   PCSIR Labs Complex  
   Ferozepur Road, Lahore

6. Prof. Dr. M. Jamil Ahmed  
   Chairman, Department of Horticulture  
   Faculty of Agriculture, Rawalakot  
   University of AJandK, Muzaffarabad

7. Dr. Fahim Ashraf Qureshi  
   Assistant Professor,  
   Department of Chemistry  
   G.C. University, Lahore
8. Dr. M. Zafar-ul-Hye Gondal  
   Assistant Professor of Soil Science  
   Department of Agronomy and Soil Science  
   B.Z. University, Multan

9. Dr. Maazullah Khan  
   Principal Engineer,  
   Food Science Division  
   Nuclear Institute for Food and Agriculture (NIFA) Tarnab, Peshawar

10. Dr. Barkat Ali Khan  
    Senior Research Officer  
    Agricultural Research Institute  
    Tarnab, Peshawar

11. M. Fakhar-U-Zaman Akhtar  
    Lecturer, Department of Soil Science  
    University College of Agriculture and Environmental Sciences  
    The Islamia University of Bahawalpur

12. Dr. Muhammad Akmal  
    Assistant Professor,  
    Department of Soil Science and Soil Water Conservation,  
    PMAS- Arid Agriculture University, Rawalpindi

13. Dr. Ismat Naeem  
    Professor,  
    Department of Chemistry  
    Lahore College for Women University,  
    Jail Road Lahore

The proceedings started with recitation of The Holy Quran. Mr. Mohammad Bashir, Director Regional Centre, HEC Lahore welcomed the participants for attending the meeting in Lahore. Mr. Shafiullah, Deputy Director (Curriculum), HEC, Islamabad welcomed the participants and briefed them the objectives of the meeting and the obligations of the Higher Education Commission for review, revision and development of curricula.

He further informed the members that Higher Education Commission is striving hard to enhance the quality of education in public sector Universities/Institutions by developing curricula and making it more compatible with international standards, job oriented and in line with the needs of the society. He distributed the template of the 4 years B.Sc
(Hons) in Agriculture disciplines among the members as a guideline for developing Agricultural Chemistry curriculum. He suggested that Internship of full semester be reduced to a four credit hour course and contact hours of practical be increased from 2 to 3 hours. The four year degree program should be of 130 to 140 credit hours.

The convener Prof. Dr. Hamid Ullah Shah welcomed all the members and thanked the participants for attending the meeting. He informed the members that the curriculum of Agricultural Chemistry is being taught in only two universities of Pakistan. After thorough discussions and deliberations, the proposed draft of curricula of B.Sc. (Hons) Agricultural Chemistry was developed.

Prof. Dr. Hamid Ullah Shah thanked all the members for attending the meeting and their contributions. The meeting ended with a vote of thanks.

At the end, all the members thanked Mr. Muhammad Bashir, Director, Regional Center, Lahore for their comfortable stay at the Regional Center, HEC, Lahore.
AIMS AND OBJECTIVES

- Upgrade and update the knowledge regarding the progress in Agricultural Chemistry and related disciplines
- Bring uniformity in curricula taught in different universities offering Agricultural Chemistry as major
- Provide recent trends and skills to help in an agricultural system which can meet the need of our country and contribute to global requirement as well
- Encourage students to broaden their knowledge and develop their own capabilities and self confidence
- Advance communication and interpersonal skills, both verbal and written particularly in the context of the Agricultural Chemistry.
- Achieve the highest possible standards in teaching and research in Agricultural Chemistry and related disciplines.
Template for 4-Year BS/B.Sc. (Hons) in Agricultural Disciplines

1. Compulsory Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics / Biology (2 courses)</td>
<td>6</td>
<td>(3-0) (2-1)</td>
</tr>
<tr>
<td>Statistics 1 &amp; 2</td>
<td>6</td>
<td>(3-0) (3-0)</td>
</tr>
<tr>
<td>Computers / IT</td>
<td>3</td>
<td>(2-1)</td>
</tr>
<tr>
<td>Pakistan Studies</td>
<td>2</td>
<td>(2-0)</td>
</tr>
<tr>
<td>Islamic Studies</td>
<td>2</td>
<td>(2-0)</td>
</tr>
<tr>
<td>Communications Skills</td>
<td>3</td>
<td>(3-0)</td>
</tr>
<tr>
<td>English</td>
<td>3</td>
<td>(3-0)</td>
</tr>
<tr>
<td>Basic Agriculture</td>
<td></td>
<td>(2-1)</td>
</tr>
</tbody>
</table>

Sub-Total 28

2. Interdisciplinary Foundation Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agronomy</td>
<td>3</td>
<td>(2-1)</td>
</tr>
<tr>
<td>Plant Breeding &amp; Genetics</td>
<td>3</td>
<td>(2-1)</td>
</tr>
<tr>
<td>Entomology</td>
<td>3</td>
<td>(2-1)</td>
</tr>
<tr>
<td>Plant Pathology</td>
<td>3</td>
<td>(2-1)</td>
</tr>
<tr>
<td>Food Technology</td>
<td>3</td>
<td>(2-1)</td>
</tr>
<tr>
<td>Horticulture</td>
<td>3</td>
<td>(2-1)</td>
</tr>
<tr>
<td>Soil Sciences</td>
<td>3</td>
<td>(2-1)</td>
</tr>
<tr>
<td>Agriculture Economics</td>
<td>3</td>
<td>(2-1)</td>
</tr>
</tbody>
</table>

Sub-Total 24

3. Supporting Courses {6-8 courses (3 Cr. hr) amongst below}

Agriculture Extension
Forestry & Range Management
Animal Science
Marketing & Agri Business
Rural Development
Human Nutrition
Agriculture Chemistry
Agriculture Engineering
Water Management
Any other discipline recommended by the university

Sub-Total 18-24

Sub-Total during the first four semesters  70-76
Semester 5, 6, 7 & 8                          56-60
Project / Internship                         04
Grand Total                                  130-140

- 1 credit of theory = one contact hour per week for 16-18 weeks and 1 practical/Lab hour = 3 contact hours per week for 16-18 weeks.
• In case of non availability of department of supporting courses, courses from foundation courses can be opted.
### SCHEME OF STUDIES

**BS/B.Sc. (HONS) AGRICULTURE**  
*(MAJOR IN AGRICULTURAL CHEMISTRY)*

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Courses Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Introduction to Agricultural Chemistry (supporting course)</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>2.</td>
<td>Principles of Biochemistry</td>
<td>4(3-1)</td>
</tr>
<tr>
<td>3.</td>
<td>Vitamins and Minerals</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>4.</td>
<td>Chemistry of Lipids</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>5.</td>
<td>Bio-organic Chemistry</td>
<td>4(3-1)</td>
</tr>
<tr>
<td>6.</td>
<td>Bio-Physical Chemistry</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>7.</td>
<td>Protein Chemistry</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>8.</td>
<td>Principles of Food Security</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>9.</td>
<td>Environmental Chemistry</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>10.</td>
<td>Plant Biochemistry</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>11.</td>
<td>Clinical Biochemistry</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>12.</td>
<td>Agricultural Microbiology</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>13.</td>
<td>Applied Biochemistry</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>14.</td>
<td>Introduction to Organic Chemistry</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>15.</td>
<td>Pesticide Chemistry</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>16.</td>
<td>Fundamentals of Phytochemistry</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>17.</td>
<td>Analytical Chemistry</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>18.</td>
<td>Molecular Biology</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>19.</td>
<td>Soil Chemistry</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>20.</td>
<td>Food Chemistry</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>21.</td>
<td>Preparation of Research Project and Scientific Writing</td>
<td>2(2-0)</td>
</tr>
<tr>
<td>22.</td>
<td>Seminar</td>
<td>1(1-0)</td>
</tr>
<tr>
<td>23.</td>
<td>Internship</td>
<td>4(0-4)</td>
</tr>
</tbody>
</table>
DETAIL OF COURSES FOR
BS/BSc (HONS) IN AGRICULTURE CHEMISTRY

COURSE TITLE: INTRODUCTION TO AGRICULTURAL CHEMISTRY

Credit Hours: 3(2-1)

OBJECTIVES
The students will learn about:
- Discipline of Agricultural Chemistry and its applications
- Concepts of acids and bases
- Importance of carbohydrates, proteins, lipids and enzymes

COURSE OUTLINE


PRACTICALS

Laboratory equipment and apparatus, name and use, general lab instructions
Preparation and standardization of solutions
Determination of moisture and ash contents
Qualitative tests of carbohydrates and protein
Determination of reducing and non-reducing sugars
Determination of protein by Kjeldahl method

BOOKS RECOMMENDED:
10. James, Finlay, Weir and Johnston., 2008, Elements of Agricultural Chemistry and Geology. Biblio Bazaar, USA.

COURSE TITLE: PRINCIPLES OF BIOCHEMISTRY

Credit Hours: 4(3-1)

OBJECTIVES

The students will learn about:
- Metabolism of carbohydrates, lipids and proteins
- Metabolism and bio energetics of macro molecules
- Enzyme kinetics

COURSE OUTLINE


PRACTICALS

Quantitative analysis of carbohydrates
Quantitative analysis of proteins
Quantitative analysis of lipids
Purification of enzymes
BOOKS RECOMMENDED:


COURSE TITLE: VITAMINS AND MINERALS

Credit Hours: 3(2-1)

OBJECTIVES

The students will learn about:

- Physiological functions and deficiency symptoms of vitamins
- Macro and micro nutrients
- Diseases associated with deficiency

COURSE OUTLINE

Vitamins: Historical review, classification, structure, physiological functions, deficiency symptoms, sources and recommended dietary allowances (RDA), hypo and hypervitaminosis

Minerals: Macro and micro nutrients, their role, interaction, sources and deficiency symptoms

Methods of determination:

Vitamins (A and C) and minerals.

PRACTICALS

Determination of vitamin A by spectrophotometer/HPLC.
Determination of vitamin C by dye reduction method.
Determination of phosphorus by spectrophotometer.
Determination of micronutrients by atomic absorption spectrophotometer.
Determination of Na and K by flame photometer.

BOOKS RECOMMENDED:


COURSE TITLE: CHEMISTRY OF LIPIDS

Credit Hours: 3(2-1)

OBJECTIVES

The students will learn about:

- The nature of fatty acids, oils and lipids
- Physical properties and metabolism of fats and oils
- Role of dietary fat in health

COURSE OUTLINE

Introduction: Composition and classification of dietary fats and oils.
Fatty acids: Nomenclature, saturated and unsaturated fatty acids, essential fatty acids. Properties of fats and oils: Melting point, refractive index, hydrogenation, hydrolysis, halogenation, saponification and rancidity of fats and oils. Metabolism of fats and oils: Digestion, absorption and transport of fats, oxidation of fatty acids, formation of ketone bodies, biosynthesis of fats, phospholipids and cholesterol. Dietary fat and health: Plasma lipoproteins, low-density lipoprotein (LDL) and high-density lipoprotein (HDL), their association with coronary heart diseases (CHD), effect of dietary fat on health such as obesity, hypertension, diabetes, cancer etc. and immune response system, recommended level of different types of dietary fat.

PRACTICALS

Determination of iodine value
Determination of R.M. and Polenske value
Determination of melting point of fat
Fatty acid determination by GLC
Cholesterol determination by spectrophotometer

BOOKS RECOMMENDED:


COURSE TITLE: BIO-ORGANIC CHEMISTRY

Credit Hours: 4(3-1)

OBJECTIVES

The students will learn about:

- Organic chemistry of chemical compounds commonly found in plants
- Stereo chemistry of complex natural products
- Chemistry of bio-macromolecules and their applications

COURSE OUTLINE

Introduction: Chemistry of natural products (alkaloids, flavonoids and terpenes), organic matter (cellulose, hemicellulose, humic, fulvic acids and lignin) and biosynthesis. Stereochemistry: Classification, absolute configuration and conformational analysis. Chemistry of bio-macromolecules: Carbohydrates, nucleic acid and protein. Chemistry and application: Protective groups, phosphorus containing compounds, amino acid and lipids.

PRACTICALS

Preparation of iodoform
Preparation of aspirin
Measurement of optical activity by polarimeter
Qualitative and quantitative determination of alkaloids (nicotine, caffeine etc)
Qualitative tests of naphthalene, quinone etc

BOOKS RECOMMENDED:


COURSE TITLE: BIO-PHYSICAL CHEMISTRY

Credit Hours: 3(2-1)

OBJECTIVES

The students will learn about:

- The physical aspects of bio-macromolecules
- Purification and separation techniques of bio-macromolecules
- Molecular weight determination

COURSE OUTLINE

**Acids, bases:** Introduction and scope, modern concepts of acids and bases, pH measurement, buffers and their role in biological system.

**Thermodynamics:** Laws of thermodynamic, entropy, free energy and enthalpy. **Diffusion and osmosis:** Introduction, differentiation, osmotic pressure in isotonic, hypotonic, and hypertonic solutions, role of osmotic pressure in fluid exchange of biological system.

**Colloids and polymers:** Introduction, types, nature and characteristics, purification and application, methods for the determination of molecular weights.

**Biophysical phenomena:** Adsorption isotherms (Langmuir and Freundlich), viscosity (Newtonian and non Newtonian fluids), surface tension.

**PRACTICALS**

Determination of molecular weight by osmometry
Determination of viscosity
Determination of surface tension
Determination of pH
Adsorption of acetic acid on charcoal
Preparation of colloidal solution and purification

**BOOKS RECOMMENDED:**

3. Atkins, P. and J. de Paula, 2005, Physical Chemistry for the Life Sciences. Freeman, USA.

COURSE TITLE: PROTEIN CHEMISTRY

Credit Hours: 3(2-1)

OBJECTIVES
The students will learn about:

- Types of proteins and amino acids
- Functions in living organisms
- Protein quality evaluation

COURSE OUTLINE

Introduction: Structural and functional proteins, importance of proteins. Amino Acids: Structure, classification and properties, essential and non essential, occurrence in animals and plants. Protein: Characteristics, properties and reactions, solubility, optical activity, dialysis, ultra centrifugation, electrophoresis, precipitation and hydrolysis. Protein quality evaluation: Amino acid score with reference to FAO/WHO, deficient amino acids score in food, protein efficiency ratio (PER), net protein utilization (NPU), biological value (BV) and nitrogen balance (NB).

PRACTICALS

Protein determination by different methods
Preparation of protein hydrolysate for amino acid analysis
Amino acid determination by paper and ion exchange chromatography
Qualitative tests of protein and amino acid

BOOKS RECOMMENDED:


COURSE TITLE: **PRINCIPLES OF FOOD SECURITY**

*Credit Hours: 3(2-1)*

**OBJECTIVES**

The students will learn about:

- Food security in relation to food production in Pakistan
- Policies and plans to ensure food security
- Post harvest management

**COURSE OUTLINE**

**Introduction:** Food security, international commitment to end hunger and malnutrition. **Food security and human rights:** Conceptual understanding of food security, nutrition security, household food security. **Factors affecting food security:** Determinants/dimensions, nutrition linkages and millennium development goals, postharvest technology and food security. **Food safety and food quality.** Food laws in Pakistan, quality control and quality assurance system in Pakistan. food trade, WTO and Codex Alimentarius. **Food insecurity and its measurement:** Chronic, transitory and seasonal food insecurity, FIVIMS, meeting the challenges of food security in Pakistan, the role of agriculture.

**PRACTICALS**

Use of food composition tables
Determination of dietary intake through questionnaire
Use of questionnaire to measure household food security
Designing home gardens for food security
Determination of food insecurity in terms of malnutrition

**BOOKS RECOMMENDED:**


COURSE TITLE: ENVIRONMENTAL CHEMISTRY

Credit Hours: 3(2-1)

OBJECTIVES

The students will learn about:
- Various sources and types of environmental pollution
- Health hazards caused by environmental pollution
- Global warming and climate changes

COURSE OUTLINE

Introduction: Anthropogenic activities. Atmospheric and Air pollution: Vehicular exhausts and industrial emissions, atmospheric photochemical reactions and ozone depletion, emission of toxic gases and heavy metals. Contaminants of soil and water: Organic and inorganic sources, health hazards, water quality parameters and limits of water quality according to WHO standards, purification of water/wastewater, primary, secondary and tertiary treatment at source. Global warming and climate change: Green house effect, role and atmospheric concentrations of emission gases i.e., CO₂, CH₄, N₂O, CFC’s, and O₃. Agrochemical pollution: Impact of fertilizer and pesticide industry, residual effect of pesticide, plant response to metals in soil and water, biosorption of metals, bioremediation. Fossil Fuel and Energy Sources: Origin and development of coal, origin of petroleum and natural gas, composition and classification of petroleum, environmental problems associated with petroleum, nuclear fusion and reactors.

PRACTICALS

Qualitative and quantitative analysis of irrigation water
Qualitative and quantitative analysis of drinking water
Determination of BOD and COD in waste water
Estimation of heavy metals in soil/plants and wastewater
BOOKS RECOMMENDED:


COURSE TITLE: PLANT BIOCHEMISTRY

Credit Hours: 3(2-1)

OBJECTIVES

The students will learn about:

- The structure and composition of cell
- Secondary metabolites and their nature
- Functions of plant hormones along with photosynthetic pathways

COURSE OUTLINE


PRACTICALS

Microscopic examination of cell
Determination of phytic acid in cereal and legume
Determination of gluten
Ripening of fruits by application of different hormones
Detection of Alkaloids in *Alloe vera*

**BOOKS RECOMMENDED:**


**COURSE TITLE:** CLINICAL BIOCHEMISTRY

*Credit Hours:* 3(2-1)

**OBJECTIVES**

The students will learn about:

- Chemistry and functions of blood
- Bio chemical processes causing different diseases
- Different techniques of clinical diagnosis and treatments

**COURSE OUTLINE**

**Introduction:** Role of clinical Biochemistry in health and diseases, factors causing diseases. **Biochemistry of blood:** Chemistry and function of blood, blood plasma, serum protein, red blood cell, white blood cell, platelet, structure and function of hemoglobin, coagulation and its mechanism. **Chemistry of gastrointestinal tract:** Enzymatic and hormonal mechanism, liver function test, CSF, clinical significant, **Immunology:** Definition, myeloma hybridoma and immunoglobulin, immune system and its abnormalities, allergy and inflammation and compliment system, immune diagnostics. **Biochemical aspects of cancer:** Etiology, clinical diagnosis and treatment, oncogenesis. **Infection and infestation:** Chemical and physical agents, genetic and constitutional factors, diseases of organs. **Diagnostic Tools:** Radio isotopes, PCR based diagnostic test.

**PRACTICALS**

Determination of blood urea
Determination of total cholesterol in blood
Determination of lipid profile
Determination of bilirubin in blood serum
Determination of calcium, phosphorus, uric acid
Analysis of normal and pathogenic urine

BOOKS RECOMMENDED:


COURSE TITLE: AGRICULTURAL MICROBIOLOGY

Credit Hours: 3(2-1)

OBJECTIVES

The students will learn about:

- Isolation and identification of microbes
- Biological nitrogen fixation and PGPR
- Microbial transformations

COURSE OUTLINE


PRACTICALS

Preparation of culture media for microbes, routine and selective media. Isolation, morphological and bio-chemical identification of microbes.
Staining Techniques: Simple, negative, ground, acid fast, spore, capsule staining and motility.
Microbial tests for drinking water quality.

BOOKS RECOMMENDED:


COURSE TITLE: APPLIED BIOCHEMISTRY

Credit Hours: 3(2-1)

OBJECTIVES

The students will learn about:

- Basic biochemical processes
- Structures of common chemicals of biological importance
- Processes involved in different industries

COURSE OUTLINE

**Fermentation:** Aerobic and anaerobic fermentation, production of biofuels. **Pulp and Paper Industry:** Sulfite, sulfate pulp, types of paper and production processes. **Oils and Ghee Industry:** Importance, sources, extraction, refining, hydrogenation and Ni, Pt and Ag catalysis. **Soap Industry:** Types, uses and production processes. **Sugar and Starch industry:** Production from Sugarcane and sugar beet, by-products of sugar industry and its utilization. **Starch:** Sources, production and uses. **Fertilizer Industry:** Types and composition, manufacturing processes, application and bio-fertilizer.

PRACTICALS

Determination of saponification value and acid value
Fermentation of milk
Identification of sugars
Extraction of crude oil from oil seeds
Ethanol production from corn
BOOKS RECOMMENDED:


COURSE TITLE: INTRODUCTION TO ORGANIC CHEMISTRY

Credit Hours: 3(2-1)

OBJECTIVES

The students will learn about:

- Basic concepts in chemical bonding
- Characteristics of organic molecules
- Reactions of organic compounds and chemistry of functional groups

COURSE OUTLINE


PRACTICALS

Qualitative determination of organic compounds containing groups (COOH, OH, NH₂ and C=O)
Purification techniques (solvent extraction, distillation and recrystalization)
Chemical reactions of benzene.
Qualitative and quantitative determination of starch.
Preparation of methyl salicylate (ester)

BOOKS RECOMMENDED:

COURSE TITLE:  PESTICIDE CHEMISTRY

*Credit Hours:* 3(2-1)

OBJECTIVES

The students will learn about:
- Different classes of pesticides and their mode of action
- Types of pesticide formulations
- Hazards of pesticides in environment

COURSE OUTLINE

**Introduction:** History, importance, current application status, international concern about pesticide usage, role of pesticides in agriculture.

**Formulation of Pesticides:** Common pesticide formulations (liquid, dry, specialized pesticides), solvent selection, surfactants and adjuvants.

**Groups of Pesticides:** Organochlorine, organophosphate, carbamate, pyrethroids and bio-pesticides, classification, mode of action (MRL, lethal dose).

**Herbicides:** Types, application and mode of action. **Fungicides:** Types, application and mode of action, chemical protection measures.

**Pheromones:** Introduction, chemistry, method of application, mode of action and protection measures. **Environmental Hazards of Pesticides:** Pesticide poisoning, occupational hazards, water contamination, toxicity and safety measures.

PRACTICALS

Sampling procedures for pesticide analysis
Determination of emulsification characteristics of emulsifiable concentrate pesticides
Wet sieve analysis of wetable powder formulations
Dry sieve analysis of granular formulations

BOOKS RECOMMENDED:


COURSE TITLE: FUNDAMENTALS OF PHYTOCHEMISTRY

Credit Hours: 3(2-1)

OBJECTIVES

The students will learn about:
- Taxonomy of medicinal plants
- Essential chemical components of medicinal herbs, including appropriate extraction and quantitation methods, and strategies for structure elucidation
- Biosyntheses and synthetic methodologies, involved in deriving the active components of medicinal herbs.

COURSE OUTLINE

Introduction: History, scope and development of phytochemistry. Plant taxonomy: Study of following families with special reference to important medicinal plants of apocynaceae, solanaceae, rutaceae, umbelliferae, leguminosae and liliaceae. Record keeping (Herbarium): Collection, identification, processing and storage of medicinal plants. The classification and nomenclature of important medicinal herbs: Senna, ephedra, hyoscyamus, atropa, datura, catharanthus. aconite, rheum, belladonna, rauwolfia. podophyllum, sanguineria. mentha, digitalis, eucalyptus. clove, fennel, castor and coriander. Factors influencing cultivation of medicinal plants: Types of soils and fertilizers of common use, pest management and natural pest control agents. Study of important chemical classes found in medicinal herbs (including their role and ecological function): Alkaloids, terpenoids and phenylpropane derivatives, glycosides, lignin.
PRACTICALS

Preliminary Screening of Natural Products: Preliminary chemical tests for the detection of carbohydrates, tannins, alkaloids, glycosides, steroids, saponins, terpenes and flavonoids

- Alkaloids: Mayer's reagent test, Wagner's reagent test, Dragendorff's reagent test
- Glycosides: Kedde reagent test, Keller killiani test
- Saponins: haemolysis test, froth test, Leibermann-Burchard test
- Sterols: Salkoawaski test
- Flavonoids: colour test, cyanidin test. UV detection
- Tannins: ferric chlorides test, lead acetate test

Macroscopic Examination of Natural Products:
- Over ground parts: Seed: Melia, Cucumis, Psoralea, Ricinus, Lallementia, Ipomea,

Microscopic Examination of Natural Products:
- Powdered drug examination: Cinnamon bark, nux vomica seeds, clove flower bud, senna leaf, coriander, cardamon

BOOKS RECOMMENDED:


COURSE TITLE: ANALYTICAL CHEMISTRY

Credit Hours: 3(2-1)

OBJECTIVES

The students will learn about:

- Laboratory management, safety and quality control
- Chromatography and electrophoresis
- Spectroscopy and microscopy

COURSE OUTLINE

COSHH: Control of substances hazardous to health (COSHH) and regulations. Laboratory Management: Sampling, collection techniques, use of balances, preservation of various chemicals, safety measurements. Quality Control: Calibration and standardization of instruments.
**Chromatography:** Various types, paper, thin layer, ion exchange, liquid (HPLC) and gas (GC). **Electrophoresis:** Principle, theory and uses. **Spectroscopy:** Uses of FTIR spectrophotometer, UV/VIS spectrophotometer, flame photometer, atomic absorption spectrophotometer, nuclear magnetic resonance (NMR) spectrophotometer, mass-spectrophotometer, ICP, polarimeter and refractometer. **Microscopy:** Types, principle and operation. **Centrifugation:** Cell fractionation.

**PRACTICALS**

Study of sampling techniques  
Calibration and standardization of instruments  
Determination of concentration of samples by spectrophotometer  
Determination of concentration of samples by refractometer  
Determination of cell fractionation by centrifugation  
Determination of various proteins by electrophoresis with respect to their molecular weigh  
Determination of various sugars and amino acids by paper and thin layer chromatography

**BOOKS RECOMMENDED:**

6. Harris, D.C. 2006. Quantitative Chemical Analysis. 7th Ed. Freeman, USA.  

**COURSE TITLE:** MOLECULAR BIOLOGY  

Credit Hours: 3(2-1)  

**OBJECTIVES**

The students will learn about:  
- The genes and genome of living organisms  
- The biochemistry of DNA and RNA.  
- Regulation of gene expression in living organisms
COURSE OUTLINE

**Introduction:** History, contribution and scope. **Cell:** Structure, chromosomes, genes and genome, mitosis, meiosis; **DNA:** Structure, replication, mutability, repair and recombination. **RNA:** Structure, synthesis and splicing. **Proteins:** Structures, synthesis, proteomics, targeting and turnover. **Genes regulation:** Genes expression in prokaryotes and eukaryotes, post transcriptional modification in eukaryotes.

**PRACTICALS**

Estimation of proteins in serum by sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE)  
Determination of UV absorption spectra of proteins  
Polymerase Chain Reaction (PCR)  
Separation of nucleotide by HPLC  
Extraction of DNA and RNA  
Measurement of DNA, RNA and protein concentration

**BOOKS RECOMMENDED:**


**COURSE TITLE:** SOIL CHEMISTRY

**Credit Hours:** 3(2-1)

**OBJECTIVES**

The students will learn about:

- Chemical and physical properties of elements, soil, colloids and minerals
- Ion exchange equations
- Absorption and desorption of ions in soil

**COURSE OUTLINE**

**Soil:** Definition, type and composition. **Nature of soil elements:** Occurrence, electronic configuration, and chemical and physical properties
of nitrogen, phosphorus, potassium, hydrogen, oxygen, carbon, calcium, magnesium, sulphur, boron, chlorine, copper, iron, manganese, molybdenum and zinc. **Properties of soil:** Structure, texture, color, temperature, consistency, inorganic soil colloids and minerals, layer silicate clays, cation and anion exchanges and their significance, ion exchange equations, soil pH and buffering capacity, soil redox potential, base saturation percentage of soil, adsorption and desorption of ions in soil.

**PRACTICALS**

Collection and preparation of soil sample
Determination of electrical conductivity (EC) of saturated soil extract
Determination of soluble cations and anions in saturated soil extract
Determination of extractable cations in saturated soil extract
Determination of soil cation exchange capacity (CEC)
Determination of soil pH
Determination of soil micro nutrients (Fe, B, Cu and Zn)

**BOOKS RECOMMENDED:**


**COURSE TITLE:** FOOD CHEMISTRY

**Credit Hours:** \(3(2-1)\)

**OBJECTIVES**

The students will learn about:

- Composition and properties of food
- Methods of improving the quality of food
- Natural toxins in food and their detoxification

**COURSE OUTLINE**

*Introduction:* Color, flavor and taste of foods, sensory evaluation of foods. **Composition of Foods:** Chemical nature and role of fats, risk factors, carbohydrates and dietary fiber, their role in food system, proteins and amino acids, and their influence on the quality of foods. **Methods of improving protein quality of food:** Protein quality, essential amino acids,
scoring pattern-supplementation and complementation. **Enzymes and vitamins:** Enzymes and co-enzymes and their role in digestion, vitamins in food, water-soluble and fat-soluble vitamins, their occurrence, physiological functions and daily requirements. **Mineral elements:** Essential mineral elements in food, heavy metal contamination. **Food additives and value addition:** Introduction and significance. **Toxicity of food:** Natural toxins in food, methods of detoxification. **Water activity:** Definition, role of water activity in food storage.

**PRACTICALS**

Qualitative tests for carbohydrates and proteins
Organoleptic assessment of food
Proximate analysis of food
Determination of water activity
Estimation of total dietary fiber
Separation of natural food colors

**BOOKS RECOMMENDED:**


**COURSE TITLE:** PREPERATION OF RESEARCH PROJECT AND SCIENTIFIC WRITTING

**Credit Hours:** 2(2-0)

**OBJECTIVES**

The students will learn about:

- Literature survey
- Synopsis and scientific paper writing
- Delivering oral presentation.
COURSE OUTLINE

Scientific presentation: Types, review of literature from printed and electronic sources, organizing literature, initiating write up and writing review of literature, synopsis, thesis, writing scientific paper, quoting references in text and in bibliography, delivering oral presentation and writing internship report.

BOOK

DETAILS OF COMPULSORY COURSES

COMPULSORY COURSES IN ENGLISH FOR
Undergraduate Level

English I (Functional English)  Credit Hrs. 3

Objectives: Enhance language skills and develop critical thinking.

Course Contents

Basics of Grammar
Parts of speech and use of articles
Sentence structure, active and passive voice
Practice in unified sentence
Analysis of phrase, clause and sentence structure
Transitive and intransitive verbs
Punctuation and spelling

Comprehension
Answers to questions on a given text

Discussion
General topics and every-day conversation (topics for discussion to be at
the discretion of the teacher keeping in view the level of students)

Listening
To be improved by showing documentaries/films carefully selected by
subject teachers

Translation skills
Urdu to English

Paragraph writing
Topics to be chosen at the discretion of the teacher

Presentation skills
Introduction

Note: Extensive reading is required for vocabulary building

Recommended books:

1. Functional English
   a) Grammar
         0194313492
         0194313506
b) Writing

c) Reading/Comprehension

d) Speaking

**English II (Communication Skills) Credit Hrs. 3**

**Objectives:** Enable the students to meet their real life communication needs.

**Course Contents**

**Paragraph writing**
Practice in writing a good, unified and coherent paragraph

**Essay writing**
Introduction

**CV and job application**
Translation skills
Urdu to English

**Study skills**
Skimming and scanning, intensive and extensive, and speed reading, summary and précis writing and comprehension

**Academic skills**
Letter/memo writing, minutes of meetings, use of library and internet

**Presentation skills**
Personality development (emphasis on content, style and pronunciation)

*Note: documentaries to be shown for discussion and review*

**Recommended books:**

**Communication Skills**

a) Grammar

b) Writing
c) Reading
   2. Reading and Study Skills by John Langan
   3. Study Skills by Riachard Yorky.

English III (Technical Writing and Presentation Skills) Crh. 3

Objectives: Enhance language skills and develop critical thinking

Course Contents

Presentation skills

Essay writing
Descriptive, narrative, discursive, argumentative

Academic writing
How to write a proposal for research paper/term paper
How to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency)

Technical Report writing

Progress report writing

Note: Extensive reading is required for vocabulary building

Recommended books:

Technical Writing and Presentation Skills

a) Essay Writing and Academic Writing

b) Presentation Skills

c) Reading
The Mercury Reader. A Custom Publication. Compiled by norther Illinois University. General Editors: Janice Neulib; Kathleen Shine Cain; Stephen Ruffus and Maurice Scharton. (A reader which will give students exposure to the best of twentieth century literature, without taxing the taste of engineering students).
ISLAMIC STUDIES
(Compulsory)

Objectives:
This course is aimed at:
1. To provide basic information about Islamic Studies
2. To enhance understanding of the students regarding Islamic Civilization
3. To improve students' skill to perform prayers and other worships
4. To enhance the skill of the students for understanding of issues related to faith and religious life.

Detail of Courses

Introduction to Quranic Studies
1) Basic Concepts of Quran
2) History of Quran
3) Uloom-ul-Quran

Study of Selected Text of Holy Quran
1) Verses of Surah Al-Baqra Related to Faith (Verse No. 284-286)
2) Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No.1-18)
3) Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No. 1-11)
4) Verses of Surah al-Furqan Related to Social Ethics (Verse No. 63-77)
5) Verses of Surah Al-Inam Related to Ihkam (Verse No. 152-154)

Study of Selected Text of Holy Quran
1) Verses of Surah Al-Ihzab Related to Adab al-Nabi (Verse No. 6,12,40,56,57,58.)
2) Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment
3) Verses of Surah Al-Saf Related to Tafakar, Tadabar (Verse No. 1,14)

Seerat of Holy Prophet (S.A.W) I
1) Life of Muhammad Bin Abdullah (Before Prophet Hood)
2) Life of Holy Prophet (S.A.W) in Makkah
3) Important Lessons Derived from the life of Holy Prophet in Makkah

Seerat of Holy Prophet (S.A.W) II
1) Life of Holy Prophet (S.A.W) in Madina
2) Important Events of Life Holy Prophet in Madina
3) Important Lessons Derived from the life of Holy Prophet in Madina

Introduction To Sunnah
1) Basic Concepts of Hadith
2) History of Hadith
3) Kinds of Hadith
4) Uloom –ul-Hadith
5) Sunnah & Hadith
6) Legal Position of Sunnah

**Selected Study from Text of Hadith**

**Introduction To Islamic Law & Jurisprudence**
1) Basic Concepts of Islamic Law & Jurisprudence
2) History & Importance of Islamic Law & Jurisprudence
3) Sources of Islamic Law & Jurisprudence
4) Nature of Differences in Islamic Law
5) Islam and Sectarianism

**Islamic Culture & Civilization**
1) Basic Concepts of Islamic Culture & Civilization
2) Historical Development of Islamic Culture & Civilization
3) Characteristics of Islamic Culture & Civilization
4) Islamic Culture & Civilization and Contemporary Issues

**Islam & Science**
1) Basic Concepts of Islam & Science
2) Contributions of Muslims in the Development of Science
3) Quranic & Science

**Islamic Economic System**
1) Basic Concepts of Islamic Economic System
2) Means of Distribution of wealth in Islamic Economics
3) Islamic Concept of Riba
4) Islamic Ways of Trade & Commerce

**Political System of Islam**
1) Basic Concepts of Islamic Political System
2) Islamic Concept of Sovereignty
3) Basic Institutions of Govt. in Islam

**Islamic History**
1) Period of Khlaft-E-Rashida
2) Period of Ummayyads
3) Period of Abbasids

**Social System of Islam**
1) Basic Concepts of Social System of Islam
2) Elements of Family
3) Ethical Values of Islam

**Reference Books:**
1) Hameed ullah Muhammad, “Emergence of Islam”, IRI, Islamabad
2) Hameed ullah Muhammad, “Muslim Conduct of State”
3) Hameed ullah Muhammad, ‘Introduction to Islam
4) Mulana Muhammad Yousaf Islahi,”
6) Ahmad Hasan, “Principles of Islamic Jurisprudence” Islamic Research Institute, International Islamic University, Islamabad (1993)
7) Mir Waliullah, “Muslim Jrisprudence and the Quranic Law of Crimes”
   Islamic Book Service (1982)
    Publications New Delhi (1989)
9) Dr. Muhammad Zia-ul-Haq, “Introduction to Al Sharia Al Islamia” Allama
    Iqbal Open University, Islamabad (2001)
Pakistan Studies (Compulsory)

Introduction/Objectives

- Develop vision of historical perspective, government, politics, contemporary Pakistan, ideological background of Pakistan.
- Study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.

Course Outline

1. Historical Perspective
   b. Factors leading to Muslim separatism
   c. People and Land
      i. Indus Civilization
      ii. Muslim advent
      iii. Location and geo-physical features.

2. Government and Politics in Pakistan
   Political and constitutional phases:
   a. 1947-58
   b. 1958-71
   c. 1971-77
   d. 1977-88
   e. 1988-99
   f. 1999 onward

3. Contemporary Pakistan
   a. Economic institutions and issues
   b. Society and social structure
   c. Ethnicity
   d. Foreign policy of Pakistan and challenges
   e. Futuristic outlook of Pakistan

Books Recommended

1. MATHEMATICS I (ALGEBRA)

Prerequisite(s): Mathematics at secondary level
Credit Hours: 3 + 0

Specific Objectives of the Course: To prepare the students, not majoring in mathematics, with the essential tools of algebra to apply the concepts and the techniques in their respective disciplines.

Course Outline:

Preliminaries: Real-number system, complex numbers, introduction to sets, set operations, functions, types of functions.

Matrices: Introduction to matrices, types, matrix inverse, determinants, system of linear equations, Cramer’s rule.

Quadratic Equations: Solution of quadratic equations, qualitative analysis of roots of a quadratic equations, equations reducible to quadratic equations, cube roots of unity, relation between roots and coefficients of quadratic equations.

Sequences and Series: Arithmetic progression, geometric progression, harmonic progression.

Binomial Theorem: Introduction to mathematical induction, binomial theorem with rational and irrational indices.

Trigonometry: Fundamentals of trigonometry, trigonometric identities.

Recommended Books:

Dolciani MP, Wooton W, Beckenback EF, Sharron S, Algebra 2 and Trigonometry, 1978, Houghton & Mifflin,

Boston (suggested text)

Kaufmann JE, College Algebra and Trigonometry, 1987, PWS-Kent Company, Boston

2. **MATHEMATICS II (CALCULUS)**

**Prerequisite(s):** Mathematics I (Algebra)

**Credit Hours:** 3 + 0

**Specific Objectives of the Course:** To prepare the students, not majoring in mathematics, with the essential tools of calculus to apply the concepts and the techniques in their respective disciplines.

**Course Outline:**

*Preliminaries:* Real-number line, functions and their graphs, solution of equations involving absolute values, inequalities.

*Limits and Continuity:* Limit of a function, left-hand and right-hand limits, continuity, continuous functions.

*Derivatives and their Applications:* Differentiable functions, differentiation of polynomial, rational and transcendental functions, derivatives.

*Integration and Definite Integrals:* Techniques of evaluating indefinite integrals, integration by substitution, integration by parts, change of variables in indefinite integrals.

**Recommended Books:**

Thomas GB, Finney AR, *Calculus* (11th edition), 2005, Addison-Wesley, Reading, Ma, USA

3. **MATHEMATICS III (GEOMETRY)**

**Prerequisite(s):** Mathematics II (Calculus)

**Credit Hours:** 3 + 0

**Specific Objectives of the Course:** To prepare the students, not majoring in mathematics, with the essential tools of geometry to apply the concepts and the techniques in their respective disciplines.

**Course Outline:**

*Geometry in Two Dimensions:* Cartesian-coördinate mesh, slope of a line, equation of a line, parallel and perpendicular lines, various forms of equation of a line, intersection of two lines, angle between two lines, distance between two points, distance between a point and a line.

*Circle:* Equation of a circle, circles determined by various conditions, intersection of lines and circles, locus of a point in various conditions.

*Conic Sections:* Parabola, ellipse, hyperbola, the general-second-degree equation
Recommended Books:
Kaufmann JE, College *Algebra and Trigonometry*, 1987, PWS-Kent Company, Boston

**Note:**
1. *Two courses will be selected from the following three courses of Mathematics.*
2. *Universities may make necessary changes in the courses according to the requirement as decided by the Board of Studies.*
Annexure - E

Statistics-I

Definition and importance of Statistics in Agriculture, Data Different types of data and variables

Classification and Tabulation of data, Frequency distribution, stem-and-Leaf diagram, Graphical representation of data Histogram, frequency polygon, frequency curve.

Measure of Central tendency, Definition and calculation of Arithmetic mean, Geometric mean, Harmonic mean, Median quantiles and Mode in grouped and ungrouped data.

Measure of Dispersion, Definition and Calculation of Range, Quartile deviation, Mean deviation, Standard deviation and variance, coefficient of variation.

Practicals
a. Frequency Distribution
b. Stem-and-Leaf diagram
c. Various types of Graphs
d. Mean, Geometric mean Harmonic Mean,
e. Median, Quartiles Deviation, mean Deviation.
f. Standard Deviation, Variance, Coefficient of variation,
g. Skewness and kinesis

Book Recommended
1. Introduction to Statistical Theory Part- I by Sher Muhammad and Dr. Shahid Kamal (Latest Edition)
2. Statistical Methods and Data Analysis by Dr. Faquir Muhammad
Statistics-II

Sampling Probability and non-Probability Sampling, Simple random sampling stratified random sampling Systematic sampling error, Sampling distribution of mean and difference between two means. Interference Theory: Estimation and testing of hypothesis, Type—I and type-II error, Testing of hypothesis about mean and difference between two means using Z-test and t-test, Paired t-test, Test of association of attributes using X2 (chi-square) Testing hypothesis about variance.

Practicals

a. Sampling random sampling  
b. Stratified random sampling  
c. Sampling distribution of mean  
d. Testing of hypotheses regarding population mean  
e. Testing of hypotheses about the difference between population means  
f. Chi-square test  
g. Testing of Correlation Coefficient  
h. Fitting of simple linear regression  
i. One-way ANOVA  
j. Two-way ANOVA

Book Recommended

1. Introduction to Statistical Theory Part-II by Sher Muhammad and Dr. Shahid Kamal (Latest Edition)  
2. Statistical Methods and Data Analysis by Dr. Faquir Muhammad  

Note: Universities may make necessary changes in the courses according to the requirement as decided by the Board of Studies.
Course Name: Introduction to Information and Communication Technologies

Course Structure:
Lectures: 2  Labs: 1  Credit Hours: 3  
Pre-requisite: None  Semester: 1

Course Description:
This is an introductory course on Information and Communication Technologies. Topics include ICT terminologies, hardware and software components, the internet and world wide web, and ICT based applications. After completing this course, a student will be able to:

- Understand different terms associated with ICT
- Identify various components of a computer system
- Identify the various categories of software and their usage
- Define the basic terms associated with communications and networking
- Understand different terms associated with the Internet and World Wide Web.
- Use various web tools including Web Browsers, E-mail clients and search utilities.
- Use text processing, spreadsheets and presentation tools
- Understand the enabling/pervasive features of ICT

Course Contents:
- Basic Definitions & Concepts
- Hardware: Computer Systems & Components
- Storage Devices, Number Systems
- Software: Operating Systems, Programming and Application Software
- Introduction to Programming, Databases and Information Systems
- Networks
- Data Communication
- The Internet, Browsers and Search Engines
- The Internet: Email, Collaborative Computing and Social Networking
- The Internet: E-Commerce
- IT Security and other issues
- Project Week
- Review Week

Text Books/Reference Books:
Introduction to Computers by Peter Norton, 6th International Edition (McGraw HILL)
Computers, Communications & information: A user’s introduction by Sarah E. Hutchinson, Stacey C. Swayer
Functional Biology-I
Credit Hours 3+0

Biological Methods

- Principles of Cellular Life
- Chemical Basis
- Structure and Function
- Principles of Metabolism
- Energy Acquisition

Principles of Inheritance
- Mitosis and Meiosis
- Chromosomes
- Observable Inheritance Patterns
- DNA Structure and Function
- RNA and Proteins
- Genes
- Genetic Engineering and Biotechnology

Biodiversity
- Fundamental Concept of Biodiversity
- One or two examples of each of the following from commonly found organism
- Prions
- Viruses
- Bacteria
- Protistans
- Algae
- Fungi
- Plants
- Crops
- Animals
- Invertebrates
- Vertebrates

Reading
Functional Biology-II

Credit Hours 3+0

Myths and Realities of Evolution
Microevolution
Speciation
Macroevolution

Level of Organization
Plants
   Tissues
   Nutrition and Transport
   Reproduction
   Growth and Development

Animals
   Tissue, Organ System and Homeostasis
   Information Flow and Neuron
   Nervous System
   Circulation and Immunity
   Nutrition and Respiration
   Reproduction and Development

Ecology and Behavior
   Ecosystems
   Biosphere
   Social Interactions
   Community Interactions
   Human Impact on Biosphere
   Environment Conservation

Reading

Note: Universities may make necessary changes in the courses according to the requirement as decided by the Board of Studies.
RECOMMENDATIONS

The existing curriculum of the degree in Agricultural Chemistry was revised / updated and a new comprehensive agriculture oriented curriculum at graduate levels was developed.

Keeping in view the significance of Agriculture in Pakistan, following recommendations were unanimously made:-

- Such degree programme of B.Sc (Hons.) in Agricultural Chemistry, may also be initiated in other Universities of Pakistan, on the pattern of NWFP Agricultural University, Peshawar and Gomal University, Dera Ismail Khan

- Graduates of Agricultural Chemistry should be placed in agriculture sector and other related disciplines/industries and fields by HEC or any other relevant Government Authority

- Refresher courses/workshops pertaining to in-service teacher’s training in relevant fields may also be arranged on priority basis to improve the teaching standards of the Faculty.

- Curriculum revision exercise of the HEC was very much appreciated and such exercise should continue in future

- Job opportunities to agricultural chemists must be provided in relevant provincial and federal departments, export promotion bureau, PASSCO, Pakistan Standard Quality Control Authority and Agro-based Industry on priority basis

- The Departments of Agricultural Chemistry should be strengthened and modernized by funding, hiring of experienced faculty members, purchase of laboratory equipment and up-gradation of library facilities to meet the RandD requirements of the present time.