**The Islamia University of Bahawalpur**

**Department of Zoology**

**BS (Hons), 2nd Semester**

**Course: General Chemistry (3 Credit hours)**

**Course code:**

**PURPOSE OF THE COURSE AND APPROACH TO THE SUBJECT:**

The course will focus on introduction to the techniques commonly used in chemistry research and investigations for the separation of proteins from their sources. Techniques used for analysis of proteins and carbohydrates. It will also include the biochemistry of metabolism of different biomolecules.

**TEACHING METHODOLOGY:**

The class will be conducted in a lecture and discussion environment. The instructor will deliver the lecture and students will be encouraged to critically evaluate the information and participate by asking questions. Most importantly students will be given experimental problems and encouraged to discuss and figure out solutions.

**GRADING AND EXAMS:**

As per policy of the University.

**COURSE CONTENTS (Theory lectures)**

**Mid-term syllabus**

Introduction to chemistry, **techniques for separation of mixtures** (Decantation, Filtration, Evaporation, Distillation, Crystallization, Sublimation). Introduction to proteins structure. Edmans degradation and X-ray diffraction techniques used to determine the protein structure. Isolation and purification of proteins from cells. Techniques used for cell lysis; **mechanical methods** (bead mills, mortar and pestle, sonication, liquid nitrogen, homogenizers, freeze-thaw cycles, high temperature and pressure), **non-mechanical methods** including chemical methods employing detergents and organic solvents and enzymatic methods. **Principles of chromatography techniques** (ion exchange chromatography **(IEC)**, size exclusion chromatography **(SEC)**, affinity chromatography **(AC)**, immobilized metal affinity chromatography **(IMAC),** hydrophobic interaction chromatography **(HIC)**. Difference between gas chromatography **(GC)** and liquid chromatography **(LC)**, normal-phase chromatography **(NPC)**, high-pressure liquid chromatography **(HPLC)**. Principle of sodium dodecyl sulfate polyacrylamide gel electrophoresis **(SDS-PAGE)**. **Stages of protein purification**: Extraction, Capture, Intermediate purification and polishing. Protein properties used during purification (data in Table). Design a strategy for purification of proteins with low solubility (flow sheet). Design strategy for purification of clear or very dilute samples (flow sheet). Working, instrumentation and principle of **mass spectrometry (MS).**

**Final-term syllabus**

Principle, working and applications of techniques; Fourier-transform infrared spectroscopy **(FTIR)** and Nuclear magnetic resonance **(NMR)**, Principle, working and applications of **Spectrophotometry**, **Metabolism of proteins**.Fate of carbon skeleton and amino portions of amino acids in body with special emphasis on urea cycle. Synthesis of acetyl-CoA and use of acetyl-CoA in body, **Introduction to carbohydrates:** structure, types **(**monosaccharides, oligosaccharides and polysaccharides), function, steriomerism, **Metabolism of carbohydrates** including Glycolysis, Krebs cycle, Gluconeogenesis, Glycogenolysis and Glycogenesis, Brief overview of **techniques used in carbohydrate analysis**. Chromatographic and Electrophoretic methods, Chemical methods (Titration, Gravimetry, Colorimetry), Enzymatic methods including D-glucose/D-fructose and Maltose/Sucrose, Physical methods including Polarimetry, Refractive index, Density, Infra-red), Immunoassays.

**COURSE CONTENTS (Practicals)**

**Lab 1:** Separate the mixture of ethanol and water by distillation.

**Lab 2:** Separate a mixture of water and n-hexane through a separating funnel.

**Lab 3:** Use of micropipette to measure small volumes.

**Lab 4:** Identification and characterization of peptides using mass spectrometry through mascot software.

**Lab 5:** Prepare a 10% solution of NaCl.

**Lab 6:** Quantitative Chemistry: Concept of standard solution and concentration of solutions.

**Lab 7:** Concept of making dilutions

**Lab 8:** Quantitative Chemistry: Quantitative chemistry: Problems for practice of concept of molarity.

**Lab 9:** Estimate the concentration of protein in given sample using Bradford Reagent Assay.

**Lab 10:** Qualitative analysis of carbohydrates: Fehlings test, Benedicts test, Tollens test, Iodine test, Molisch test.

**Lab 11:** Qualitative analysis of proteins: Ninhydrin test, Millons test, Biuret test, Xanthoproteic test.

**BOOKS RECOMMENDED: (Hawkins 1985; Brown 1986; Glover 1986; Freifelder 1987; Sheeler and Bianchi 1987; Paolella 1998; Schalkhammer 2002; Seidman 2008; Srivastava 2008; Sheehan 2009)**

1. Nichols L. Organic Chemistry Lab Techniques.
2. Alexander P, Block RJ. 1960. The separation and isolation of proteins. Elsevier.
3. Lodish, H, Berk A, Zipursky SL. 2000. Molecular Cell Biology.4th Edition. New York: W. H. Freeman.
4. Gouglitz G, Vo-Dinh T. 2003. Handbook of Spectroscopy. WILEY-VCH Verlag GmbH & Co.
5. Rassi Z EI. 1994. Carbohydrate Analysis. Elsevier.
6. Mushtaq Ahmed. 2008. Essentials of Medical Biochemistry. Merit Publishers.