School of Chemistry
University of the Punjab, Lahore

Course Outline

Semester-VII

Programme	BS Chemistry	Course Code	Chem-476	Credit Hours	2
Course Title	Lipid Biochemistry		Course Type	Major (Elective)	

Course Introduction

This course demonstrates in-depth knowledge on occurrence, classification, chemical structure, physical properties, functions, metabolism, and biological importance of different types of lipids. It includes the study of lipid biochemistry, lipid signaling, and the role of lipids in health and disease. The course will also explore the latest research and technological advances in lipid science.

Nature, structure and classification of lipids. Structure and chemical properties of triglycerides, phospholipids, glycolipids, sphingolipids and steroids. Lipids with specific biological activities. Acid value, Saponification value and Iodine value of lipids/fats. Properties of lipid aggregates: Micelles and Bilayers. Structure and function of prostaglandins. Structure and assembly of Biological membranes and membrane proteins. Fluid Mosaic model. The erythrocyte membrane. Digestion and absorption of Lipids. Detailed Synthesis and Oxidation of fatty acids. Involving of Acyl carrier protein and Carnitine carriers. Metabolism of essential fatty acids and their metabolic disorders. Control of fatty acid Metabolism. Ketone Bodies.

Learning Outcomes

On the completion of the course, the students will:

1. Understand the structure, classification, and importance of lipids.
2. Study the biochemical pathways of lipid metabolism.
3. Explore the functional roles of lipids in biological membranes.

	Course Content	Assignments/Readings
Week 1	Introduction to Lipids Overview of lipid functions Nature and Classification of lipids	Class base learning/Test
	Structure and Function of Lipids Physical and chemical properties of lipids Classification, nomenclature, structures, and properties of fatty acids	Class base learning/Test
Week 2	Triglycerides Structure of simple and mixed triglycerides and waxes Chemical Properties and specific biological activities	Class base learning/Test
	Phospholipids Structure of Phospholipids Chemical Properties and specific biological activities	Class base learning/Test
Week 3	Glycolipids Structure and Phospholipids Chemical Properties and specific biological activities	Class base learning/Test

	Sphingolipids Structure of Sphingolipids Chemical Properties and specific biological activities	Class base learning/Test
Week 4	steroids Structure of Steroids Chemical Properties and specific biological activities	Class base learning/Test
	Biologically active lipids Lipids with Specific Biological Activities Role in Signaling and Metabolism Class quiz and discussion	Class base learning/Test
Week 5	Lipid Analysis Acid Value and Saponification Value Iodine Value of Lipids/Fats	Class base learning/Test
	Lipid Aggregates Properties of Lipid Aggregates Micelles and Bilayers	Class base learning/Test
Week 6	Biological Membranes and Membrane lipids Structure and Assembly of Biological Membranes Membrane Proteins	Class base learning/Test
	The Fluid Mosaic Model Overview of the Fluid Mosaic Model Membrane Dynamics	Class base learning/Test
Week 7	The Erythrocyte Membrane Structure of Erythrocyte Membranes Function and Characteristics of Erythrocyte Membranes	Class base learning/Test
	Lipid Signaling Lipid-derived signaling molecules. Eicosanoids: prostaglandins, thromboxanes, and leukotrienes Sphingolipids and their signaling roles. Lipid rafts and cell signaling	Class base learning/Test
Week 8	Class discussion	-
	Midterm assessment	-
Week 9	Digestion and Absorption of Lipids Digestive Processes for Lipids Absorption Mechanisms	Class base learning/Test
	METABOLIM of Fatty Acids oxidation of fatty acids synthesis of fatty acids	Class base learning/Test
Week 10	Triacylglycerol and Phospholipid Metabolism Synthesis and breakdown of triacylglycerols Phospholipid metabolism	Class base learning/Test
	Cholesterol metabolism Cholesterol synthesis Regulation	Class base learning/Test

Week 11	Lipoproteins types of Lipoproteins structure and function	Class base learning/Test
	Role of Acyl Carrier Protein Function in Fatty Acid Synthesis Mechanism of Action	Class base learning/Test
Week 12	Role of Carnitine Carriers Function in Fatty Acid Transport Mechanism of Action	Class base learning/Test
	Metabolism of Essential Fatty Acids Pathways of Metabolism Importance of Essential Fatty Acids Class quiz and discussion (Give marks, if necessary, from assignment)	Class base learning/Test
Week 13	Metabolic Disordersof lipids Common Disorders Clinical Implications	Class base learning/Test
	Regulation of lipid Metabolism Hormonal Regulation Enzymatic Control	Class base learning/Test
Week 14	Ketone Bodies Formation of Ketone BodiesFunctions and Usesand Role in Energy Metabolism Metabolism of Ketone Bodies	Class base learning/Test
	Clinical Aspects of Ketone Bodies Ketosis and Ketoacidosis Therapeutic Uses	Class base learning/Test
Week 15	Lipids and Health Impact on Health and Disease Lipid-Related Disorders	Class base learning/Test
	Control of Lipid Metabolism Integration with Other Metabolic Pathways	Class base learning/Test
Week 16	Submission of assignments. If required, then discussion the whole chapter for final term exams preparation	
	Final term assessment	

Reading Materials

1. Lehninger, A. L., Nelson, D. L., & Cox, M. M. (2020). Principles of biochemistry (8th ed.). W. H. Freeman and Company.
2. Voet, D. J., Voet, G. J., & Pratt, C. W. (2023). Fundamentals of biochemistry (5th ed.). Wiley.
3. Styer, L. (2021). Biochemistry (9th ed.). W. H. Freeman and Company.
4. Murray, R. K., Bender, D. A., Botham, K. M., Kennelly, P. J., & Rodwell, V. W. (2018). Harper's biochemistry (32nd ed.). McGraw-Hill Education.
5. Champ, C., Harvey, R. A., & Ferrie, D. R. (2021). Lippincott's biochemistry (6th ed.). Wolters Kluwer.

Teaching Learning Strategies
1. Lecturingwhite/black board/Multimedia 2. Written Assignments/ quiz/task/presentation 3. Class activities and discussion 4. Class quiz **5.** Presentations
Assignments: Types and Number with Calendar
Assignment, Quiz, Task, Presentation, etc.

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Semester-VII					
Programme	**BS Chemistry**	**Course Code**	**Chem-477**	**Credit Hours**	1
Course Title	**Lipids -Lab**		**Course Type**	**Major (Elective)**	

Course Introduction

This study will assist students for qualitative and quantitative determination of different lipids. Extraction of lipids from animal and plant sources. Students will be able to learn acid value, saponification value and Iodine value of fats.

Qualitative tests for lipids and fatty acids, sterols, and phospholipids. Extraction and Thin layer chromatography (TLC) of Lipids from animal and plant sources. Acid value, Saponification Value and Iodine Value of fats.

Learning Outcomes

- This study will help students in understanding of practical grounds of lipids and phospholipids.
- Students will be able to perfume thin layer chromatography.
- Students will be able to calculate acid value and iodine value for fats.

Course Content		Assignments/Readings
Week 1	Qualitative tests for lipids	Class base learning/Test
Week 2	Qualitative tests for fatty acids	Class base learning/Test
Week 3	Qualitative tests for sterols	Class base learning/Test
Week 4	Qualitative tests for phospholipids	Class base learning/Test
Week 5	Extraction of Lipids from animal source	Class base learning/Test
Week 6	Thin layer chromatography (TLC) of Lipids from animal source	Class base learning/Test
Week 7	Discussion the practical and if need then repeat it	-
Week 8	Mid term Exams	-
Week 9	Thin layer chromatography (TLC) of Lipids from animal source	Class base learning/Test
Week 10	Extraction of fats from plant source	Class base learning/Test
Week 11	Thin layer chromatography (TLC) of Lipids from plant source	Class base learning/Test
Week 12	Estimation of Acid value of fats	Class base learning/Test
Week 13	Estimation of saponification Value of fats	Class base learning/Test
Week 14	Calculation of Iodine Value of fats	Class base learning/Test
Week 15	Discussion all practicals if need then repeat	-
Week 16	Final Term	-

Reading Materials

1. Wilson, K., & Walker, J. (2018). Principles and Techniques of Biochemistry and Molecular Biology (8th ed.). Cambridge University Press.
2. Voet, D., Voet, J. G., & Pratt, C. W. (2019). Fundamentals of Biochemistry: Life at the Molecular Level (6th ed.). Wiley.
3. Robyt, J. F., & White, B. J. (2017). Biochemical Techniques: Theory and Practice. Waveland Press.
4. Switzer, R. L., & Garrity, L. F. (1999). Experimental Biochemistry. W. H. Freeman.
5. Boyer, R. F. (2012). Biochemistry Laboratory: Modern Theory and Techniques (2nd ed.). Pearson Education.
6. Varley, H., Gowanlock, A. H., McMurray, J. R., & McLauchlan, D. M. (1988). Varley Practical Clinical Biochemistry (6th ed.). Heinemann Medical Books (Open Library).
7. Sambrook, J., & Russell, D. W. (2001). Molecular Cloning: A Laboratory Manual (3rd ed.). Cold Spring Harbor Laboratory Press.

Teaching Learning Strategies

1. Lecturing using white/black board/Multimedia
2. Written Assignments
3. Discussion about practical
4. Checking the results and discussion

Assignments: Types and Number with Calendar

Assignment, Quiz, Task, Presentation, etc.

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Semester-VII					
Programme	**BS Chemistry**	**Course Code**	**Chem-478**	**Credit Hours**	**2**
Course Title	**Enzymes**		**Course Type**	**Major Elective**	

Course Introduction

After studying these course students will be able to understand types of enzymes. It will also help to understand the factors affecting enzyme activity and Chemical kinetics of enzymes. In-depth knowledge about the nature of enzymes, catalysis and catalytic mechanisms
Chemical nature, nomenclature and classification of enzymes. Cofactors and Coenzymes. Concepts of active site and substrate specificity. Factors affecting the enzyme activity. Kinetics of single substrate enzymatic reactions. Competitive, non competitive and irreversible enzyme inhibition. Mechanism of enzyme inhibition. Regulatory, allosteric, immobilized enzymes, zymogens, isoenzyme and multienzyme system.

Learning Outcomes

On the completion of the course, the students will:

- Understand the catalytic properties and mechanisms of enzyme action.
- Understand and analyze kinetics of enzyme catalyzed reactions.
- Evaluate effect of different types of inhibitors on enzyme activity
- Perform enzyme assay.

	Course Content	**Assignments/Readings**
Week 1	Introduction to Enzymes Overview of enzyme structure and function Classification and nomenclature of enzymes	Class base learning/Test
	Types and roles of cofactors Coenzyme functions and examples	Class base learning/Test
Week 2	Enzyme Classification Classification based on the type of reaction catalyzed IUBMB enzyme classification system Enzyme Nomenclature Systematic naming conventions Examples of commonly used enzyme names	Class base learning/Test
	Enzyme Structure and Active Sites Primary, secondary, tertiary, and quaternary structures Importance of enzyme structure for function	Class base learning/Test
Week 3	Active Sites and Substrate Specificity Concepts of active site architecture Mechanisms of substrate binding and specificity	Class base learning/Test
	Enzyme Kinetics: Single Substrate Reactions Introduction to Enzyme Kinetics Michaelis-Menten kinetics	Class base learning/Test
Week 4	Determining Kinetic Parameters Calculation of Vmax and Km Lineweaver-Burk plot and other graphical methods	Class base learning/Test
	Quiz	-
Week 5	Enzyme Inhibition	Class base learning/Test

	Competitive inhibition Non-competitive inhibition Irreversible Inhibition Mechanisms and examples Effects on enzyme activity	
	Class discussion	-
Week 6	Factors Affecting Enzyme Activity Environmental Factors Temperature, pH, and ionic strength Effects of substrate concentration and enzyme concentration	Class base learning/Test
	Inhibitors and Activators Role of inhibitors and activators in regulating enzyme activity Examples of physiological and synthetic inhibitors	Class base learning/Test
Week 7	Class discussion	-
	Regulation of Enzyme Activity Allosteric Regulation Concepts of allosteric sites and modulators Examples of allosteric enzymes	Class base learning/Test
Week 8	Covalent Modification Phosphorylation and other chemical modifications Impact on enzyme activity and regulation	Class base learning/Test
	MID TERM ASSESMENT	-
Week 9	Immobilized Enzymes Techniques for Enzyme Immobilization Methods of enzyme immobilization Advantages and limitations of immobilized enzymes	Class base learning/Test
	Applications of Immobilized Enzymes Industrial and clinical applications Case studies of enzyme immobilization	Class base learning/Test
Week 10	Zymogens and Proenzymes Activation mechanisms and examples Role of zymogens in physiological processes	Class base learning/Test
	Conversion to Active Enzymes Activation pathways and regulation Case studies of zymogen activation	Class base learning/Test
Week 11	Isoenzymes and Multienzyme Systems Definition and examples of isoenzymes Functional significance and clinical relevance	Class base learning/Test
	Structure and function of multienzyme complexes Examples and application	Class base learning/Test
Week 12	Enzyme Engineering and Design Methods for engineering enzyme properties Directed evolution and rational design	Class base learning/Test
	Applications in Biotechnology Enzyme engineering for industrial processes Case studies of engineered enzymes	Class base learning/Test

Week 13	CLASS DISCUSSION	-
	Enzyme Dynamics and Mechanisms Conformational changes and dynamics in enzyme function Molecular dynamics simulations of enzyme behaviour Detailed mechanisms of specific enzyme reactions Experimental approaches to studying mechanisms	Class base learning/Test
Week 14	Enzyme Assays and Measurement Techniques Techniques for measuring enzyme activity Advantages and limitations of different assay methods Methods for analyzing enzyme kinetic data Interpretation of experimental results	Class base learning/Test
	Class discussion	-
Week 15	Clinical and Industrial Applications of Enzymes Enzymes in diagnostics and therapeutics Case studies of enzyme-based treatments	Class base learning/Test
	Industrial Applications Enzymes in manufacturing and agriculture Environmental and economic impacts	Class base learning/Test
Week 16	Submission of assignments. If required then discussion the whole chapter for final term exams preparation Final term assessment	

Reading Materials

1. Lehninger, A. L., Nelson, D. L., & Cox, M. M. (2020). Principles of biochemistry (8th ed.). W. H. Freeman and Company.
2. Voet, D. J., Voet, G. J., & Pratt, C. W. (2023). Fundamentals of biochemistry (5th ed.). Wiley.
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Teaching Learning Strategies

1. Lecturing using white/black board/Multimedia
2. Written Assignments
3. Class activities and discussion
4. Quiz about last lecture

Assignments: Types and Number with Calendar			
Assignment, Quiz, Task, Presentation, etc.			
Assessment			
Sr. No.	**Elements**	**Weightage**	**Details**
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessmentincludes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Semester-VII					
Programme	**BS Chemistry**	**Course Code**	**Chem-479**	**Credit Hours**	1
Course Title	**Enzymology lab**		**Course Type**	**Major (Elective)**	

Course Introduction

The Enzymology Practical Course offers hands-on experience in studying enzymes, focusing on their properties and roles in biochemical reactions. It includes techniques for enzyme extraction, purification, and characterization, along with assays for measuring enzyme activity and analyzing enzyme kinetics and inhibition. Students will explore the applications of enzymology in medicine, biotechnology, and pharmaceuticals. By the end, students will be skilled in laboratory techniques and data analysis, ready for advanced research or professional roles in biochemical and clinical fields.

Isolation of enzyme from different sources. Study of different factors like temperature, pH, Concentration of substrate on the properties of Alkaline Phosphatase and LDH. Determination of the kinetic parameters of the enzymes and their mode of inhibition using UV / Visible Spectrophotometer. Estimation of Clinically important enzymes like alkaline phosphatase, acid phosphatase, SGPT, SGOT, creatine kinase, etc by using specific assay methods Agglutination tests; Enzyme linked immunosorbent assay (ELISA), Western blotting.

Learning Outcomes

On the completion of the course, the students will have:

- Proficiency in Enzyme Isolation and Characterization: Students will be able to isolate enzymes from various biological sources, and effectively characterize their activity, stability, and effects of environmental factors such as temperature and pH.
- Understanding of Enzyme Kinetics and Inhibition: Students will be adept at determining enzyme kinetic parameters and analyzing different modes of enzyme inhibition using spectrophotometric techniques.
- Application of Clinical and Immunological Techniques: Students will gain hands-on experience with clinical enzyme assays and immunological methods, including ELISA and Western blotting, to evaluate enzyme activity and diagnose related diseases.

Course Content		Assignments/Readings
Week 1	**Laboratory safety measure and quality control**	Class base learning/Test
Week 2	Experiment: Isolation of enzyme from plant sources. Key Concepts: Basic techniques of enzyme extraction and purification.	Class base learning/Test
Week 3	Experiment: Isolation of enzyme from animal tissues. Key Concepts: Comparison of enzyme isolation from different biological sources.	Class base learning/Test
Week 4	Experiment: Study the effect of temperature on the activity of Alkaline Phosphatase. Key Concepts: Enzyme stability and optimal temperature range.	Class base learning/Test
Week 5	Experiment: Study the effect of pH on the activity of Alkaline Phosphatase. Key Concepts: Enzyme activity in different pH	Class base learning/Test

	environments.	
Week 6	Experiment: Study the effect of substrate concentration on the activity of LDH. Key Concepts: Michaelis-Menten kinetics and enzyme saturation.	Class base learning/Test
Week 7	Experiment: Determination of kinetic parameters of Alkaline Phosphatase. Key Concepts: Calculation of Km and Vmax using spectrophotometry.	Class base learning/Test
Week 8	Mid term	
Week 9	Experiment: Study the mode of inhibition of LDH using UV/Visible Spectrophotometer. Key Concepts: Competitive, non-competitive, and uncompetitive inhibition.	Class base learning/Test
Week 10	Experiment: Estimation of alkaline phosphatase levels using specific assay methods. Key Concepts: Clinical significance and assay procedures for enzyme levels.	Class base learning/Test
Week 11	Experiment: Estimation of acid phosphatase levels using specific assay methods. Key Concepts: Diagnostic applications and assay techniques for enzyme activity.	Class base learning/Test
Week 12	Experiment: Estimation of SGPT and SGOT levels using specific assay methods. Key Concepts: Role of liver enzymes in clinical diagnostics.	Class base learning/Test
Week 13	Experiment: Estimation of creatine kinase levels using specific assay methods. Key Concepts: Enzymes in cardiac health and disease.	Class base learning/Test
Week 14	Experiment: Perform an Enzyme Linked Immunosorbent Assay (ELISA). Key Concepts: Principles of ELISA and its application in enzyme studies. Experiment: Conduct agglutination tests using enzyme-linked immunosorbent methods. Key Concepts: Overview of immunological techniques and course review.	Class base learning/Test
Week 15	Experiment: Perform Western blotting to detect specific enzymes. Key Concepts: Protein separation and identification techniques.	Class base learning/Test
Week 16	Final TERM	

Reading Materials

1. Wilson, K., & Walker, J. (2018). Principles and Techniques of Biochemistry and Molecular Biology (8th ed.). Cambridge University Press.
2. Voet, D., Voet, J. G., & Pratt, C. W. (2019). Fundamentals of Biochemistry: Life at the Molecular Level (6th ed.). Wiley.
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5. Boyer, R. F. (2012). Biochemistry Laboratory: Modern Theory and Techniques (2nd ed.). Pearson Education.
6. Varley, H., Gowanlock, A. H., McMurray, J. R., & McLauchlan, D. M. (1988). Varley Practical Clinical Biochemistry (6th ed.). Heinemann Medical Books (Open Library).
7. Sambrook, J., & Russell, D. W. (2001). Molecular Cloning: A Laboratory Manual (3rd ed.). Cold Spring Harbor Laboratory Press.

Teaching Learning Strategies

1. Lecturing using white/black board/Multimedia
2. Written Assignments
3. Discussion about practical
4. Checking the results and discussion

Assignments: Types and Number with Calendar

Assignment, Quiz, Task, Presentation, etc.

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Semester-VII					
Programme	**BS Chemistry**	**Course Code**	**Chem-480**	**Credit Hours**	**2**
Course Title	**Human physiology**		**Course Type**	**Major (Elective)**	

Course Introduction

After studying this course, students will be able to understand human physiology and body fluids. It will help to understand composition of blood and CSF. It will also help to explain the structure and function of liver and kidney. Students will learn the major components of the endocrine system and describe their functions. The mechanisms of hormone action and the role hormones play in body.

Introduction to human physiology. Body fluids; General composition of Blood and blood plasma. Biosynthesis and metabolism of Porphyrin and Hemoglobin. Coagulation and anti-coagulating agents of blood. Composition and Biochemical effects of urine. Composition and importance of CSF. Structure and detoxification function of liver and Kidney. Introduction to Endocrine system. Mechanisms of action, and Biological functions of Pancreatic, Pituitary, Gonadal, Adrenal, Thyroid and Parathyroid hormones. Pheromones.

Learning Outcomes

After completing this course students should be able to;

- Gain a comprehensive understanding of the foundational principles of human physiology, including the structure and function of body fluids, blood, and plasma.
- Examine the biosynthesis and metabolism of key blood components like porphyrin and hemoglobin and understand the biochemical effects and composition of urine.
- Evaluate the structure and detoxification functions of the liver and kidneys, and their contributions to overall physiological balance.
- Learn about the endocrine system, major glands and hormones, including their mechanisms of action and their biological roles in regulating various physiological processes.

	Course Content	Assignments/Readings
Week 1	Introduction to Human Physiology Overview of Human Physiology Definition and scope of physiology Key physiological concepts and systems	Class base learning/Test
	Body Fluids Types and distribution of body fluids Functions and regulation of body fluids	Class base learning/Test
Week 2	Blood and Plasma Components of blood: cells, plasma, and proteins Functions of different blood components Blood Plasma Composition Key plasma proteins and their functions Plasma electrolytes and their roles	Class base learning/Test
	Class Discussion	-
Week 3	Porphyrin and Haemoglobin Biosynthesis of Porphyrins Pathways of porphyrin synthesis Disorders related to porphyrin metabolism	Class base learning/Test
	Hemoglobin Metabolism	Class base learning/Test

	Structure and function of hemoglobin Hemoglobin synthesis and degradation	
Week 4	Blood Coagulation Coagulation Mechanisms Overview of the coagulation cascade Key factors and processes in blood clotting Types and mechanisms of anti-coagulants Clinical applications and side effects	Class base learning/Test
	QUIZ	-
Week 5	Urine Composition and Biochemical Effects Composition of Urine Key components and their concentrations Normal and abnormal urine composition	Class base learning/Test
	Biochemical Effects of Urine Role of urine in homeostasis Clinical significance of urine analysis	Class base learning/Test
Week 6	Cerebrospinal Fluid (CSF) Composition of CSF Components and functions of CSF Production and circulation of CSF	Class base learning/Test
	Importance of CSF Protective and nutritive roles of CSF Clinical significance of CSF abnormalities	Class base learning/Test
Week 7	Liver Function and Detoxification Liver Structure and Function Anatomy and physiological functions of the liver Metabolic processes in the liver Pathways of detoxification Liver role in drug metabolism and detoxification	Class base learning/Test
	CLASS discussion	
Week 8	Kidney Function and Detoxification Kidney Structure and Function Anatomy and physiological functions of the kidneys Urine formation and regulation	Class base learning/Test
	Detoxification Mechanisms Renal clearance and excretion Kidney role in maintaining electrolyte balance	Class base learning/Test
Week 9	Mid term assessment	
	Introduction to the Endocrine System Overview of Endocrine System Major endocrine glands and their functions Hormone types and their roles	Class base learning/Test
Week 10	Hormone Mechanisms of Action Mechanisms of hormone action at the cellular level Receptor types and signal transduction Pancreatic Hormones Insulin and Glucagon	Class base learning/Test
	Functions and regulation of insulin and glucagon Role in glucose metabolism and homeostasis Pathophysiology of Pancreatic Disorders	Class base learning/Test

	Diabetes mellitus and other pancreatic disorders Clinical management and treatment option	
Week 11	Class Discussion	
	Pituitary Hormones Anterior Pituitary Hormones Functions of ACTH, TSH, GH, and other hormones Regulation and feedback mechanisms	Class base learning/Test
Week 12	Posterior Pituitary Hormones Functions of ADH and oxytocin Clinical relevance and disorders	Class base learning/Test
	Quiz	-
Week 13	Adrenal Hormones Adrenal Cortex Hormones Functions of cortisol, aldosterone, and androgens Regulation of stress and metabolism	Class base learning/Test
	Adrenal Medulla Hormones Role of adrenaline and noradrenaline Effects on cardiovascular and metabolic functions	Class base learning/Test
Week 14	Thyroid and Parathyroid Hormones Thyroid Hormones Functions of T3 and T4 Regulation of metabolism and growth	Class base learning/Test
	Parathyroid Hormones Role of parathyroid hormone in calcium homeostasis Disorders related to calcium metabolism.	Class base learning/Test
Week 15	Pheromones Definition and Function of Pheromones Types of pheromones and their roles in behaviour Mechanisms of pheromone detection and response Research and applications in human health	Class base learning/Test
	Class discussion	
Week 16	Submission of assignments. Presentation If required then discussion the whole chapter for final term exams preparation Final term assessment	

Reading Materials

1. Guyton, A. C., & Hall, J. E. (2016). *Textbook of Medical Physiology* (13th ed.).
2. Silverthorn, D. U. (2018). *Human Physiology: An Integrated Approach* (8th ed.). Pearson.
3. Voet, D., Voet, J. G., & Pratt, C. W. (2019). Fundamentals of Biochemistry: Life at the Molecular Level (6th ed.). Wiley.
4. Lehninger, A. L., Nelson, D. L., & Cox, M. M. (2017). *Principles of Biochemistry* (7th ed.). Worth Publishers.
5. Fox, S. I. (2015). *Human Physiology* (14th ed.). McGraw-Hill Education.Sherwood, L. (2015). *Human Physiology: From Cells to Systems* (9th ed.). Brooks Cole, W. B. Saunders Company.

Teaching Learning Strategies
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Assignments: Types and Number with Calendar
Assignment, Quiz, Task, Presentation, etc.

Assessment

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2.	Formative Assessment	25%	Continuous assessmentincludes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
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Semester-VII					
Programme	**BS Chemistry**	**Course Code**	**Chem-481**	**Credit Hours**	**1**
Course Title	**Human physiology lab**		**Course Type**	**Major (Elective)**	

Course Introduction

This practical course in human physiology is designed to provide students with hands-on experience in analyzing key organic and inorganic components of blood. It focuses on the methods used for the determination of minerals, such as calcium, magnesium, sodium, potassium, and trace elements, using techniques like atomic absorption spectroscopy, flame photometry, and titration.

Analysis of organic constituents of blood. Mineral determination such as calcium and magnesium by titration and atomic absorption spectroscopy. Mineral determination of sodium and potassium by flame photometry. Mineral determination of zinc, phosphate and cobalt by atomic absorption spectroscopy. Analysis of Urea, creatinine, cholesterol, triglycerides and Biliuribin by chemical method. Determination of blood groups.

Learning Outcomes

After completing this course students should be able to;

1. Master Analytical Techniques: Develop proficiency in using various analytical techniques such as atomic absorption spectroscopy, flame photometry, and chemical assays for the determination of blood constituents and minerals.
2. Conduct Accurate Measurements: Accurately measure and analyze the concentration of blood components including calcium, magnesium, sodium, potassium, zinc, phosphate, and cobalt, as well as clinically significant substances like urea, creatinine, cholesterol, triglycerides, and bilirubin.
3. Understand Clinical Relevance: Gain a comprehensive understanding of the clinical significance of different blood tests and mineral determinations, and apply this knowledge to interpret results and assess patient health.

	Course Content	**Assignments/Readings**
Week 1	Overview of course objectives and experimental techniques. Laboratory safety procedures and equipment introduction.	Class base learning/Test
Week 2	Experiment: Techniques for blood sample collection and preparation. Hands-on practice with sample handling and initial analysis..	Class base learning/Test
Week 3	Experiment on determining calcium levels in blood using titration. Preparation of reagents and titration techniques.	Class base learning/Test
Week 4	Determination of magnesium levels using titration methods. Calibration and result analysis.	Class base learning/Test
Week 5	Use of AAS to determine calcium and magnesium levels. Sample preparation and instrument calibration..	Class base learning/Test
Week 6	Experiment on measuring sodium and potassium levels using flame photometry.	Class base learning/Test

	Calibration and interpretation of results.	
Week 7	Experiment: Alternative method using AAS for sodium and potassium analysis. Comparison with flame photometry results.	Class base learning/Test
Week 8	Mid term	
Week 9	Experiment: Determination of zinc and phosphate levels using AAS. Sample preparation and data analysis.	Class base learning/Test
Week 10	Experiment: Analysis of cobalt levels in blood using AAS. Interpretation of experimental results.	Class base learning/Test
Week 11	Experiments for determining urea and creatinine levels using chemical methods. Hands-on practice with reagents and analysis.	Class base learning/Test
Week 12	Methods for measuring cholesterol and triglycerides in blood samples. Laboratory techniques and result interpretation.	Class base learning/Test
Week 13	Determination of bilirubin levels in blood using chemical assays. Understanding bilirubinclinical significance.	Class base learning/Test
Week 14	Experimental techniques for blood typing and serological testing. Hands-on practice with blood group determination.	Class base learning/Test
Week 15	Analysis of experimental data from previous weeks. Interpretation of results and correlation with clinical significance.	Class base learning/Test
Week 16	Final TERM	

Reading Materials

1. Rhoades, R. A., & Bell, D. R. (2017). *Medical Physiology: Principles for Clinical Medicine* (5th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.
2. Silverthorn, D. U. (2018). *Human Physiology: An Integrated Approach* (8th ed.). Hoboken, NJ: Pearson.
3. Hall, J. E. (2016). *Guyton and Hall Textbook of Medical Physiology* (13th ed.). Philadelphia, PA: Elsevier.
4. Costanzo, L. S. (2018). *Physiology* (7th ed.). Philadelphia, PA: Elsevier.
5. Koeppen, B. M., & Stanton, B. A. (2018). *Berne and Levy Physiology* (7th ed.). Philadelphia, PA: Elsevier.
6. Vijaya Doss, M. M. (n.d.). *Practical Physiology Book*. New Delhi, India: Elsevier.
7. Feher, J. J. (2017). *Quantitative Human Physiology: An Introduction* (2nd ed.). Cambridge, MA: Academic Press.
8. Schoen, B. J. (n.d.). *Physiology of the Human Body*. St. Louis, MO: Elsevier.
9. Fox, S. I., & Bolek, M. M. (n.d.). *Human Physiology: Laboratory Manual*. New York, NY: McGraw-Hill Education.
10. Sembulingam, K., & Sembulingam, P. (n.d.). *Essentials of Medical Physiology*. New Delhi, India: Jaypee Brothers Medical Publishers.

Teaching Learning Strategies
1. Lecturing using white/black board/Multimedia 2. Written Assignments 3. Discussion about practical 4. Checking the results and discussion
Assignments: Types and Number with Calendar
Assignment, Quiz, Task, Presentation, etc.

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Semester-VII					
Programme	**BS Chemistry**	**Course Code**	**Chem-482**	**Credit Hours**	**3**
Course Title	**Nutrition**		**Course Type**	**Major (Elective)**	

Course Introduction

This advanced course in nutrition aims to provide an in-depth understanding of essential vitamins, energy metabolism, and nutritional needs under various physiological conditions. Students will explore the biochemical nature and physiological roles of vitamins, methods for assessing energy expenditure, and the nutritional status of food in different contexts, particularly focusing on Pakistan.

Importance physiological function and requirement of micro and macro minerals for life and their deficiency symptoms. Introduction and history of vitamins. Classification of vitamins. A discussion of the occurrence, Chemistry, Physiological function, deficiency symptoms, and requirements of Vitamins A, B-Complex, C, D, E and K

Learning Outcomes

Upon completion of the course, students will be able to:

- Understand the history, classification, chemistry physiological functions, deficiency symptoms, and dietary requirements of essential micro and microminerals.
- Understand the history, classification, chemistry physiological functions, deficiency symptoms, and dietary requirements of essential vitamins.

	Course Content	Assignments/Readings
Week 1	History and Introduction to minerals Importance and physiological function of minerals requirement of micro and macro minerals for life and their deficiency symptoms. Recommended dietary allowance (RDA), adequate intake (AI), tolerable upper intake level, dietary reference intakes for macronutrients and micronutrients	Class base learning/Test
Week 2	Classification and microminerals	Class base learning/Test
Week 3	Classification and macrominerals Common deficiency symptoms Recommended dietary allowances and sources. Toxicity RDA and Safety Levels Class Discussion	Class base learning/Test
Week 4	Overview introduction and History of Vitamins Discovery and historical perspective of vitamins Evolution of vitamin research and understanding	Class base learning/Test
Week 5	Classification of Vitamins Fat-soluble vs. water-soluble vitamins Key characteristics and distinctions Class Quiz	Class base learning/Test

Week 6	Vitamin A Chemical structure and sources of vitamin A Natural and synthetic forms of vitamin A Physiological Functions Roles in vision, growth, and immune function Symptoms and health issues related to deficiency Toxicity RDA and Safety Levels of Vitamin A	Class base learning/Test
Week 7	Vitamin C Chemistry and Physiological Functions Dietary sources and daily requirements Impact on collagen synthesis and antioxidant defence Symptoms of deficiency (e.g., scurvy) Toxicity and Safety Levels	Class base learning/Test
Week 8	Midterm assessment	
Week 9	Vitamin E Structure and sources of vitamin E Forms and bioavailability Antioxidant roles and impact on cell membranes Symptoms of deficiency and health implications Toxicity RDA and Safety Levels of Vitamin	Class base learning/Test
Week 10	Vitamin D Sources, synthesis, and chemical structure Vitamin D metabolism in the body Roles in bone health and calcium metabolism Health issues related to deficiency (e.g., rickets, osteomalacia) Toxicity and Safety Levels	Class base learning/Test
Week 11	Vitamin K Chemical structure and forms of vitamin K Role in blood clotting and bone health Symptoms and disorders of deficiency (e.g., bleeding disorders) Dietary sources and nutritional value Toxicity RDA and Safety Levels of Vitamin k	Class base learning/Test
Week 12	Classification of vitamin B complex and vitamin B1 Chemical structure and forms of vitamin B Symptoms and disorders of deficiency Dietary sources and nutritional value Toxicity RDA and Safety Levels of Vitamin B	Class base learning/Test
Week 13	Vitamin B 2 Chemical structure and forms of vitamin B2 Symptoms and disorders of deficiency Dietary sources and nutritional value Toxicity RDA and Safety Levels of Vitamin B2	Class base learning/Test

Week 14	Vitamin B 3 Chemical structure and forms of vitamin B3 Symptoms and disorders of deficiency Dietary sources and nutritional value Toxicity RDA and Safety Levels of Vitamin B3	Class base learning/Test
Week 15	Vitamin B 6 and vitamin B 12 Chemical structure and forms of vitamin B6 &B12 Symptoms and disorders of deficiency Dietary sources and nutritional value Toxicity RDA and Safety Levels of Vitamin B6 &B12	Class base learning/Test
Week 16	Submission of assignments. Presentations If required, then discussion of the whole chapter for final term exams preparation Final term assessment	- -

Reading Materials

1. Gropper, S. S., Smith, J. L., & Carr, T. P. (2022). Advanced Nutrition and Human Metabolism (8th ed.). Cengage Learning. ISBN: 9780357449813.
2. Mahan, L. K., & Escott-Stump, S. (2020). Krause's Food & the Nutrition Care Process (15th ed.). Saunders. ISBN: 9780323636551.
3. Whitney, E. N., & Rolfes, S. R. (2021). Understanding Nutrition (16th ed.). Cengage Learning. ISBN: 9780357447512.
4. Brody, T. (2019). Nutritional Biochemistry (3rd ed.). Academic Press. ISBN: 9780128045373.
5. Voet, D., Voet, J. G., & Pratt, C. W. (2019). Fundamentals of Biochemistry: Life at the Molecular Level (6th ed.). Wiley.

Teaching Learning Strategies

1. Lecturing using white/black board/Multimedia
2. Written Assignments
3. Class activities and discussion
4. Quiz about last lecture

Assignments: Types and Number with Calendar

Assignment, Quiz, Task, Presentation, etc.

Assessment			
Sr. No.	**Elements**	**Weightage**	**Details**
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessmentincludes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.