

Department of Biochemistry
 Sher-e-Bangla Agricultural University
 Sher-e-Bangla Nagar, Dhaka-1207.
 Curricula and Courses for M. S. in Biochemistry

January-June Semester

Course Code	Title	Course type	Credit Hour
BIOC 506	Intermediary metabolism and its regulation	Compulsory	3
BIOC 508	Molecular biology of genes	Compulsory	3
BIOC 513	Principles of Recombinant DNA Technology	Compulsory	3
BIOC 514	Animal Hormones	Elective	3
BIOC 503	Principles of Biochemical Techniques	Elective	3
BIOC 505	Comparative Biochemistry	Elective	3
BIOC 507	Special Topics in Biochemistry	Elective	3

July-December Semester

Course Code	Course Title	Course type	Credit Hour
BIOC 501	Advanced Chemistry of Carbohydrates, Lipids and Nucleic acids.	Compulsory	3
BIOC 502	Advanced chemistry of proteins and enzymes.	Compulsory	3
BIOC 509	Biochemistry of Plant Hormones and Biocides.	Compulsory	3
BIOC 512	Current Topics in Nutrition.	Elective	3
BIOC 504	Bioenergetics.	Elective	3
BIOC 510	Soil Biochemistry	Elective	3
BIOC 515	Biochemistry of Fishes	Elective	3

Research Semester

BIOC 598	Seminar	1
BIOC 599	Research Work (Thesis)	16
Total		47

Note: Every semester includes five courses

Course code: BIOC 501 Course title: Advanced Chemistry of Carbohydrate, Lipids and Nucleic acids(Compulsory)	Credit Hours:03	Degree: MS in Biochemistry	Semester: July-December
Rationale: The course is designed to provide knowledge on the chemistry of Carbohydrate, Lipids, Nucleic acids and their biological significance.			
Course Outcomes: - Acquire knowledge about Carbohydrate, Lipids and Nucleic acids - Use of the acquired knowledge in solving problem of real life in relation to chemistry of lipid and protein			
Intended Learning Outcome (ILOs) The student will be able to-	Course content	Teaching-Learning Strategies	Assessment Strategies
- Define carbohydrate - Classify different carbohydrates - Differentiate monosaccharides and their biochemical importance - Discuss chemical nature of oligosaccharides - Compare different polysaccharides - Describe the importance of glycosides and glycosaminoglycans - Explain chemical nature of glycolipids and glycoproteins	Carbohydrates: Chemistry of naturally occurring monosaccharides and their biochemical important derivatives: Deoxy and amino sugars. sugar acids and alcohol's. Determination of complete structure of glucose Chemistry of oligosaccharides Chemistry of polysaccharides: storage and structural polysaccharides Plant and bacterial cell wall polysaccharides Chemistry and biological significance of naturally occurring glycosides and glycosaminoglycans Chemistry and function of glycolipids and glycoproteins	Lecture, Discussion, Visual presentation, Assignment	Quiz/MCQ, Short answer, Descriptive answer, Report
- Discuss function of different lipid and their chemical nature - Compare different lipids - Discuss technique of extraction. separation and purification of various lipid - Explain reason of lipid rancidity and preventive measure - Compare lipids present in prokaryotes and eukaryotes.	Lipids: Chemistry and function of saturated and unsaturated fatty acids, triacylglycerols. glycerophospholipids and sphingolipids, terpenoids, sterols, carotenoids, tocopherols. Prostaglandin's and thromboxanes. Principles of extraction. separation and purification of various lipid fractions.	Lecture, Discussion, Visual presentation, Assignment	Quiz/MCQ, Short answer, Descriptive answer, Report

	Chemistry of lipid rancidity Lipoproteins and membrane lipids Comparative distribution of lipids in prokaryotes and eukaryotes.		
▪ Compare different types of DNA and their structural features ▪ Discuss structure of DNA ▪ Explain heredity is controlled by DNA ▪ Describe different Physicochemical properties of DNA ▪ Classify different RNA ▪ Discuss structure and function of RNA ▪ Explain cleavage of nucleic acids ▪ Discuss different method of sequencing of nucleotides ▪ Compare different blotting techniques ▪ Explain DNA fingerprinting	Nucleic acids: Eukaryotic and prokaryotic DNA and their structural features. Circular DNA structure Watson-crick model. Structural deviation from the Model: A and Z, DNA. Satellite DNA and their significance. DNA as genetic material: experimental evidence, Physicochemical properties of DNA including optical properties, denaturation, annealing and supercoiling. Histones in DNA staking. Effects of UV light and chemical mutagens on base composition. Types, structure and function of RNA: sedimentation characteristics of different RNAs. Catalytic and other functions of RNA: plasmids, viral nucleic acids. Enzyme cleavage of nucleic acids. Maxam- Gilbert and Sanger's method of sequencing of nucleotides, Southern, Northern and Western blotting, Restriction Fragment Length Polymorphism (REL P) and Polymerase Chain Reactions (PCL).	Lecture, Discussion, Visual presentation, Assignment	Quiz/MCQ, Short answer, Descriptive answer, Report

Recommended Books

1. Nelson, D. L and Cox, M. M. 2008. Lehningers Principles of Biochemistry, 5th Ed. W. H. Freeman and company, New York.
2. Voet, D. and Voet, J. G. 2011. Biochemistry, 4th Ed. John Wiley and Son Inc.
3. Coon, E. E., Stumpf, P. K., Roy, G. B and Doi, H. 1987. Outlines of Biochemistry. John. Wiley and Son Inc.
4. Berg, J. M., Tymoczko, J. L. and Stryer, L. 2012. Biochemistry, 7th ed. W. H. Freeman and Company.
5. Baldwin, E. 1973. Dynamic aspect of Biochemistry. Oxford University Press,
6. Bonner, J. and Varner, J. E. 1975. Plant Biochemistry. Academic Press
7. Daves, D.D. 1975. Plant Biochemistry. Black Well Sc Pub Oxford.
8. Elliot, W. H. and Elliot, D. C. 1997. Biochemistry and Molecular Biology. Oxford University Press.
9. Mahler, H. R. and Cordes, E. H. 1971. Biological chemistry, Harper and Harper.
10. West, E. S. and Todd, R. 1971. Text Book of Biochemistry, Semillon Co, N.Y.

Course code: BIOC 502 Course title: Advanced Chemistry of Proteins and Enzymes(Compulsory)	Credit Hours:03	Degree: MS in Biochemistry	Semester: July-December
Rationale: The course is designated to provide knowledge on advanced chemistry of proteins and enzymes			
Course outcomes - Acquire knowledge on protein and enzyme - Conceptualize mode of action of enzymes with different affecting factors			
Intended Learning Outcome (ILOs) The student will be able to-	Course content	Teaching-Learning Strategies	Assessment Strategies
- Discuss physical and chemical nature of proteins - Describe function of biologically active natural peptides - Explain different level of structure of proteins - Compare different Plasma proteins - Describe the importance of lipoproteins and glycoprotein - Explain chemical nature of toxic plant proteins	Proteins: Physicochemical properties of proteins with special reference to colloidal and electrolytic behavior. Structure and biochemical function of biologically active natural peptides Organizational levels of native protein and determination of primary structure Plasma proteins with special reference to lipoproteins and glycoprotein and their biological functions. Cytochromes, Actomyosin, Interferons. Characteristics and functions of seed storage proteins, Lectins and other toxic plant proteins.	Lecture, Discussion, Visual presentation, Assignment	Quiz/MCQ, Short answer, Descriptive answer, Report
- Summarize enzymes according to specificity, mode of action - Differentiate zymogens and active enzyme - Outline reason for catalytic efficiency of enzymes. - explain factors affecting enzyme	Enzymes: Properties of enzymes with special reference to specificity, mode of action. activation and inhibition. Activation of zymogens. Factors contributing to catalytic efficiency of enzymes. Dependence of	Lecture, Discussion, Visual presentation, Assignment	Quiz/MCQ, Short questions, Descriptive answer, Report

action ▪ Discuss active site of enzyme ▪ Summarize different enzyme in relation with mechanism ▪ Illustrate mode of enzyme action	enzymatic velocity on substrate and enzyme concentrations. Kinetic treatment of the effect of inhibitors, pH and temperature. Mechanism of bisubstrate reactions. Concept of active site and its determination. Mechanisms of action lysozyme and carboxypeptidase. Allosteric enzymes and the models of their action mechanisms. Restriction enzymes, immobilized enzymes and Ribozyme.		
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Recommended Books

1. Nelson, D. L and Cox, M. M.2008. Lehningers Principles of Biochemistry, 5th Ed. W. H. Freeman and company, New York.
2. Voet, D. and Voet, J. G. 2011. Biochemistry, 4th Ed. John Wiley and Son Inc.
3. Coon, E. E., Stumpf, P. K., Roy, G. B and Doi, H. 1987. Outlines of Biochemistry. John. Wiley and Son Inc.
4. Berg, J. M., Tymoczko, J. L. and Stryer, L. 2012. Biochemistry, 7th ed. W. H. Freeman and Company.
5. Barrett, G.C. (Ed.) 1985. Chemistry and Biochemistry of amino acids, Chapman and Hall,
6. Dixon. M. and Webb. E.C. 1979. Enzymes. Academic Press.
7. Fersht, A. 1985. Emzyme Structure and Mechanism (2nd ed.) Freeman.
8. Murray, R. K., Grannes, D. K., Mays, P.A. and Rodwell, V.W. 1988. Harper's Biochemistry. Appleton and Lange. A Publishing Division of Prentice Hall,

Course code: BIOC 503 Course title: Principle of Biochemical Techniques (Compulsory)	Credit Hours:03	Degree: MS in Biochemistry	Semester: January-June
Rationale: The course is designed to provide knowledge on different techniques used in isolation, identification, estimation of biomolecules and investigation of biochemical processes at biological system.			
Course outcomes: - Acquire knowledge on tissue and cell culture - Implement different separation techniques of tissues - Use the acquired knowledge of different analytical method in investigating biomolecules - Conceptualize modern techniques using in recombinant DNA technology			
Intended Learning Outcome (ILOs) The student will be able to-	Course content	Teaching-Learning Strategies	Assessment Strategies
- Compare different techniques to study tissue - Discuss tissue and cell culture techniques - Describe cell homogenates - Explain method of cell fractionation.	General Principles of Biochemical Investigations: Whole animal studies. Perfusion of isolated organs. Use of plant material. Tissue and cell culture techniques. Preparation of tissue and cell homogenates. Method of cell fractionation	Lecture, Discussion, Visual presentation, Assignment	Quiz/MCQ, Short answer, Descriptive answer, Report
- Compare different Centrifugation Techniques - Identify suitable centrifugation method to determine protein purity - Categorize different Chromatographic techniques. - Recognize appropriate Chromatographic techniques to isolate a biochemical substance. - Understand the principle and use of different Electrophoretic techniques. - Understand the principle and application of	Separation methods: Centrifugation Techniques: Preparative centrifugation Isopycnic, Rate-zonal, Differential and equilibrium isodensity centrifugation, analytical ultracentrifugation Chromatographic techniques: adsorption chromatography, partition chromatography, ion-exchange chromatography, gas-liquid chromatography, permeation chromatography, affinity chromatography, High Performance liquid chromatography (HPLC) General techniques: Special electrophoresis-disc electrophoresis, immuno electrophoresis, isoelectric focusing, high voltage paper electrophoresis	Lecture, Discussion, Visual presentation, Assignment	Quiz/MCQ, Short questions, Descriptive Report

chromatographic technique			
- Understand principle of Spectroscopic techniques - Compare different types of Spectroscopic technique to measure a specific biomolecule. - Discuss Radioisotope techniques - Scrutinize a laboratory for working with radioisotopes. - Explain dialysis technique.	Analytical Methods: Spectroscopic techniques: Basic laws of light absorption, visible and ultraviolet spectrophotometry, Spectrofluorimetry, flame Spectrophotometry, Mass spectrometry, Nuclear Magnetic Resonance (NMR) Radioisotope techniques: Atomic Stability and radiation, Types of radioactive decay, Detection and measurement of radioactivity and safety aspects. Radioisotopes in biological Sciences. Manometric techniques; Dialysis. Freeze-drying, Polarimetry.	Lecture, Discussion, Visual presentation, Assignment	Quiz/MCQ, Short answer, Descriptive type, Report
- Exercise Recombinant DNA technology - Explain how DNA fingerprinting used in criminal identification - Recognize latest technology used in recombinant DNA technology	Bio techniques: Bioassay techniques: recombinant DNA technology – Biophysical and biochemical techniques used in recombinant DNA work, Restriction enzymes, Gene probes, Preparation of chimeric DNA molecules, Cloning, Blotting and Hybridization. DNA sequencing, Gene mapping	Lecture, Discussion, Visual presentation, Assignment	Quiz/MCQ, Short, Descriptive Report

Recommended Books

1. Pollister, A. W. (Ed.).1966.Physical Techniques in Biological Research 2nd Edition, New York. Academic Press.
2. Albanese, A.A. (Ed.). 1963. Newer methods of nutritional biochemistry with applications and interpretations. New York. Academic press.
3. Cann, J. R. (Ed.).1970.Interacting macromolecules, the theory and practice of their electrophoresis. ultracentrifugation and chromatography. New York. Academic press.
4. Goodwin, T.W. (Ed.).1967. Instrumentation in Biochemistry. Academic press inc.,USA
5. Draper, S. R. (Ed.).1976.Biochemical analysis in Crop Science. Oxford University press. London
6. Morris, J.G. 1974.A Biologists Physical chemistry. 2nd Ed. Edward Arnold. London.

Course code: BIOC 504 Course title: Bioenergetics (Compulsory)	Credit Hours:03	Degree: MS in Biochemistry	Semester: July-December
Rationale: The course is designed to provide knowledge on thermodynamics and energy production and use of energy in metabolism of biomolecules survival and maintenance of biological cell.			
Course outcomes - Acquire knowledge on application of thermodynamics to biochemical systems - Conceptualize energy production systems in organisms - Describe the movement of different molecules through cell			
Intended Learning Outcome (ILOs) The student will be able to-	Course content	Teaching-Learning Strategies	Assessment Strategies
- Describe laws of thermodynamics. - Explain free energy, enthalpy and entropy. Standard free energy change. - Discuss ATP-ADP cycle and its role in the transfer of high-energy phosphates.	Introduction to Bioenergetics: Laws of thermodynamics as applied to biochemical systems. Concept of free energy, enthalpy and entropy. Standard free energy change, conventions followed in Biochemistry. Exergonic and endergonic processes, Thermodynamically reversible and irreversible reactions. ATP-ADP cycle and its role in the transfer of high-energy phosphates	Lecture, Discussion, Visual presentation, Assignment	Quiz/MCQ, Short answer, Descriptive answer, Report
- Compare different energy rich compounds. - Explain how the energy compound provides energy on hydrolysis. Explain how ATP serves as Energy Currency of cells.	II. Energy-rich Compounds: Pyrophosphates, acylphosphates, enol phosphates, thiol esters, guanidium phosphates. Structural basis of their high free energy of hydrolysis. ATP as 'Energy Currency' of cells. Energy change and conservation, and storage of energy in cells. Concept of redox potential.	Lecture, Discussion, Visual presentation, Assignment	Quiz/MCQ, Short answer, Descriptive answer, Report
- Describe different components of electron transport chain. - Explain how electron pass through different component. - Explain how ATP produced through electron transport - Differentiate cyclic and non-cyclic photophosphorylation.	III. Electron Transport and Oxidative Phosphorylation: Components of electron transport chain. Mechanism and free energy change of electron transport reactions. Energetics of oxidative phosphorylation and sites of ATP formation. Inhibitors and uncouplers of electron transport chain. Theories of the mechanism of oxidative phosphorylation. Photophosphorylation: Cyclic and non-cyclic	Lecture, Discussion, Visual presentation, Assignment	Quiz/MCQ, Short answer, Descriptive answer, Report

▪ Summarize transport of molecules across cell membrane ▪ Explain how energy used in transport of molecules ▪ Classify different types of transporter ▪ Explain how saline save thousands of children lives.	IV. Energy-linked Transport Processes: Translocation of groups and energy-linked ion-transport. Active transport. Energetics and saturation kinetics of active transport, Genetic evidence for transport systems. Active transport systems in animal tissues and bacteria Na⁺-k⁺ pump. Active transport of glucose and amino acids. Intracellular transport of Ca²⁺ in animal cells. Action of ionophores	Lecture, Discussion, Visual presentation, Assignment	Quiz/MCQ, Short answer, Descriptive answer, Report
Recommended Books 1. Nelson, D. L and Cox, M. M.2008. Lehningers Principles of Biochemistry, 5th Ed. W. H. Freeman and company, New York. 2. Coon, E. E., Stumpf, P. K., Roy, G. B and Doi, H. 1987. Outlines of Biochemistry. John. Wiley and Son Inc. 3. Berg, J. M., Tymoczko, J. L. and Stryer, L. 2012. Biochemistry, 7th ed. W. H. Freeman and Company. 4. Murray, K. M., Granner, D.K., Mayes, P. A. and Rodwell,V. W. 1990. Harpers Biochemistry, 22ndedition, Prentice Hall Intl. Incorp. 5. Mahler, H. R. and Corder, E. H.1971. Biological Chemistry, Harper and Row, Publishers. 6. Lehninger, A. L. 1971.Bioenergetics, 2nd Ed. Benjamin, Menlo Park, California.			

Course Code: BIOC 505 Course Title: Comparative Biochemistry	Credit hour: 03	Degree: MS in Biochemistry	Semester: January - June
Rationale: The course is designated to provide knowledge on comparative Biochemistry of prokaryotes and eukaryotes.			
Course Outcomes: - Acquire knowledge on comparative Biochemistry of prokaryotes and eukaryotes. - Conceptualize the location, function and advance features of different cell organelle.			
Intended Learning Outcomes (ILOs) The student will be able to –	Course Content	Teaching Learning Strategies	Assessment Strategies
- Explain about Prokaryote and eukaryote cell and their organic location, function and activity. - Compare between prokaryotes and eukaryotes - Explain about energy flow in atmosphere	Comparative Biochemistry: Introduction and scope of comparative Biochemistry of prokaryotes and eukaryotes Flow of energy and materials in biosphere.	Lecture Discussion Visual presentation	MCQ Short answer Essay type answers
- Discuss similarities in Metabolic design in plant and animal - Explain about transduction transformation and utilization of free energy in metabolic system	Metabolic design: Basic similarity of metabolic design. Comparative biochemistry of free energy transduction, transformation and utilization.	Lecture Discussion Visual presentation	MCQ Short answer Essay type answers
- Differentiate about Nitrogen metabolism in plant and animal - Explain about nitrogen storage, creatinine in animal, plant and microorganism. - Illustrate the detail feature of protein synthesis - Compare the protein synthesis in eukaryotes and prokaryotes	Nitrogen metabolism & Protein: Comparative aspects of nitrogen storage and excretion in animal. Plant and microorganism. Salient feature of protein synthetic machinery of eukaryotic and prokaryotic organism.	Lecture Discussion Visual presentation	MCQ Short answer Essay type answers
- Differentiate the metabolic pathways of carbohydrates in plant and animals. - Explain about biosynthesis in higher	Carbohydrate metabolism: Basic differences in carbohydrate metabolism of animal. Plant and microorganism. Photosynthesis in higher and	Lecture Discussion Visual presentation	MCQ Short answer Essay type answers

and lower plants ▪ Differentiate between respiration and fermentation. ▪ Describe about glycolytic pathway, Pentose phosphate pathway	lower plants. Respiration vs fermentation. Glyoxylate pathway. Pentose phosphate pathway.		
▪ Compare different lipid metabolism in plant and animals and microorganism ▪ Explain liposome and glyoxysome ▪ Discuss about FA metabolic pathway ▪ Describe sterol metabolic pathway in plant and animal.	Lipid metabolism: Salient difference in lipid metabolism in plant, animal and microorganism. Liposome and Glyoxysome their metabolic activity. Fatty acid and sterol metabolism in plants and animals.	Lecture Discussion Visual presentation	MCQ Short answer Essay type answers
Recommended books: 1. Donald Voet, Judith G. Voet, Biochemistry. John Wiley and Sons. 1990. 2. J. H. Welsh. Comparative Endocrinology, Wiley Publishers. New York 1964. 3. Marcel Florkin and Howard S. Mason (ed).Comparative Biochemistry. Academic Press. New York. 1964. 4. R.K. Murray, D.K. Grannes, P.A. Mays and V.W. Rodwell. Rodwell. Harper's Biochemistry. Appleton and Lange. A Publishing Division of Prentice Hall. 1988.			

Course code: BIOC 506 Course title: Intermediary Metabolism and its Regulation(Compulsory)	Credit Hours:03	Degree: MS in Biochemistry	Semester: January-June
Rationale: The course is designed to provide knowledge of intermediary metabolism and its regulation			
Course outcomes: ▪ Conceptualize intermediary metabolism of biomolecules ▪ Acquire knowledge about regulation of metabolism ▪ Demonstrate energy production and consumption in plant and animal.			
Intended Learning Outcome (ILOs) The student will be able to-	Course content	Teaching-Learning Strategies	Assessment Strategies
▪ Describe metabolism and aspects of metabolic regulation ▪ Explain carbohydrate synthesis and energy production in different plants	Basic concept and design of metabolism. Experimental approaches in the study of metabolism. General aspects of metabolic regulation. Control of photosynthesis, Hatch-Slack pathway, Crassulacean acid metabolism, Photophosphorylation	Lecture, Discussion, Visual presentation, Assignment	Quiz/MCQ, Short answer, Descriptive answer, Report
▪ Discuss different carbohydrate metabolism pathways and their regulation ▪ Compare energy production and consumption in different pathways ▪ Explain muscle contraction mechanism	Glycolysis vs Fermentation, respiratory pathway. Energetics and regulation of glycolytic pathway. Glycogenesis. Glycogenolysis and gluconeogenesis and their regulation. Hexose monophosphate pathway, Biochemistry of muscle contraction	Lecture, Discussion, Visual presentation, Assignment	Quiz/MCQ, Short answer, Descriptive answer, Report
▪ Justify plant can produce carbohydrate from fat but animal cannot ▪ Explain Uranic acid pathway	Glyoxylate cycle and their regulations, Uranic acid pathway	Lecture, Discussion, Visual presentation, Assignment	Quiz/MCQ, Short answer, Descriptive answer, Report
▪ Summarize importance of TCA cycle in completion of oxidation of food and its amphibolic nature ▪ Compare different types of	Citric acid cycle: Experiments leading to its discovery, its amphibolic nature and regulation. Anaplerotic reactions. Electron transport system and mechanism of oxidative phosphorylation. Organization and site of phosphorylation. Comparative	Lecture, Discussion, Visual presentation, Assignment	Quiz/MCQ, Short answer, Descriptive answer, Report

phosphorylation	study of photophosphorylation and oxidative phosphorylation.		
- Interpret protein metabolism with respect to transformations of amino acids. - Explain nitrogen assimilation and excretion pathway	Nitrogen fixation; metabolic transformations of amino acids. Urea and uric acid synthesis and their regulation. Biosynthesis of essential of essential amino acids. Liposomes and glyoxysomes and their metabolic activity	Lecture, Discussion, Visual presentation, Assignment	Quiz/MCQ, Short answer, Descriptive, Report
- Compare fat metabolism in respect of alpha, beta and omega oxidation of fatty acids. - Explain cholesterol metabolism	Oxidative pathways of fatty acids. Biosynthesis of fatty acids. acyl glycerols, phospholipids and cholesterol.	Lecture, Discussion, Visual presentation, Assignment	Quiz/MCQ, Short answer, Descriptive answer, Report
Describe pathway of purine and pyrimidine bases synthesis	Biosynthesis of purine and pyrimidine bases and their regulation.	Lecture, Discussion, Visual presentation, Assignment	Quiz/MCQ, Short answer, Descriptive answer, Report
Summarize effect of different hormone on metabolism	Hormonal control of metabolism	Lecture, Discussion, Visual presentation, Assignment	Quiz/MCQ, Short answer, Descriptive answer, Report

Recommended Books

1. Nelson, D. L and Cox, M. M.2008. Lehningers Principles of Biochemistry, 5thEd.W. H. Freeman and company, New York.
2. Voet, D.andVoet, J. G. 2011.Biochemistry, 4th Ed. John Wiley and Son Inc.
3. Coon, E.E.,Stumpf, P.K.,Roy, G. BandDoi,H. 1987. Outlines of Biochemistry. John. Wiley and Son Inc.
4. Green, D. E. and Goldberger, R.F.1967.Molecular Insights into the Living Process. Academic. Press, New York,
5. Greenberg, D. M. (ed.) .1967.Metabolic pathways. 3rdEd. Academic Press. New York.
6. Korebs, H. A. and Komberg. H. L. 1957.Energy Transformation in Living Matter, Springer-Verlag, Berlin.
7. Berg, J. M., Tymoczko, J. L. and Stryer,L. 2012.Biochemistry, 7th ed. W. H. Freeman and Company.
8. Morowitz, H. J. 1968.Energy flow in Biology. Academic Press. Now York.

Course Code: BIOC 507 Course Title: Special Topics in Biochemistry	Credit hour: 03	Degree: MS in Biochemistry	Semester: January - June
Rationale: The course is planned to provide knowledge on some special topics in biochemistry.			
Course Outcomes: - Acquire knowledge on function of cell membrane and its biochemistry. - Gather knowledge on cell division process and different phases. - Conceptualize the function of different human delicate organ. - Acquire knowledge on contemporary disease like AIDS, Inborn error metabolism and memory loss.			
Intended Learning Outcomes (ILOs) The student will be able to –	Course Content	Teaching Learning Strategies	Assessment Strategies
- Discuss the definition, functions and structure of membrane. - Explain the membrane transport system. - Differentiate excitable membrane and sensory systems.	Biological membrane, Membrane transport system, Excitable membrane and sensory systems.	Lecture Discussion Visual presentation Assignment	MCQ Short answer Essay type answers Report
Describe the function and structure of hemoglobin and myoglobin.	Oxygen transporters: Hemoglobin and Myoglobin	Lecture Discussion Visual presentation	MCQ Short answer Essay type answers
- Describe the causes and important of cell differentiation. - Define cell communication. - Classify the types of cell communication. - Discuss the purpose of cell communication. - Explain how complement system work. - Discuss the major functions of the complement system. - Differentiate the components of complement system.	Biochemistry of cell differentiation, Cell communication, The complement system.	Lecture Discussion Visual presentation	MCQ Short answer Essay type answers
- Define atmospheric nitrogen fixation. - Describe the causes of nitrogen fixation.	Biochemistry of nitrogen fixation	Lecture Discussion Visual presentation Assignment	MCQ Short answer Essay type answers

• Discuss the types of nitrogen fixation. • Explain the importance of nitrogen fixation.			
• Discuss the types and role of cell cytoskeleton • Explain the molecular basis of cancer. ▪ Classify the cancer cell. ▪ Describe the characteristics of cancer cells. ▪ Discuss the biochemistry of aging and senescence. ▪ Explain the biochemistry of vision.	Cell cytoskeleton Molecular basis of cancer Biochemistry of aging and senescence Biochemistry of vision	Lecture Discussion Visual presentation	MCQ Short answer Essay type answers
• Define contractile elements. • Explain the function of contractile elements ▪ Discuss the bioluminescence. ▪ Explain the causes of Acquired Immune Deficiency Syndrome (AIDS) ▪ Discuss the causes of inborn error of metabolism ▪ Explain the biology, mechanism and importance of memory.	Biochemistry of contractile elements Bioluminescence Acquired Immune Deficiency Syndrome (AIDS) Inborn error of metabolism Biochemistry of memory	Lecture Discussion Visual presentation	MCQ Short answer Essay type answers

Books Recommended:

1. Albert Lehninger. Biochemistry. Worth Publishers, Inc. 1984.
2. Berridge, M. J. The molecular basis of communication within the cell. Sci. Am. 253 (4). 142-152. 1985.
3. Charles C. Richardson. Annual Review of Biochemistry. Annual Reviews Inc. 1992.
4. Donald Voet and Judith G. Voet. Biochemistry. John Wiley and Sons. N.Y. 1990.
5. G. P. Talwar. Text Book of Biochemistry and Human Biology. Prentice Hall of India. New Delhi. 1988.
6. Orme-Johnson, W. H. Molecular basis of nitrogen fixation. An. Rev. Biophys. Biophys. Chem. 14, 419-459. 1985.
7. Weinberg, R.A.A. Molecular Basis of Cancer. Sci. Am. 249(5), 126-142. 1983.

Course Code: BIOC 508 Molecular Biology of Genes (Compulsory)	Credit Hours: 03	Degree: MS in Biochemistry	Semester: January-June
Rationale: The course is designed to provide knowledge on different techniques for chromosome, chromatin and gene, Central dogma for the flow of information and regulation of gene expression.			
Course Outcome - Acquire knowledge on central dogma - Implement different replication techniques of gene - Use the acquired knowledge of different analytical method in gene regulation and gene expression - Conceptualize translation and transcription			
Intended Learning Outcome (ILOs)	Course content	Teaching-Learning Strategies	Assessment Strategies
At the end of the course student will be able to- - Describe different replication techniques. - Compare different methods related to the replication - Explain different steps and molecular tools related to the replication technique.	Replication of DNA. Semiconservative replication of DNA. Meselson-Stahl experiment, autoradiographic demonstration, applicability to single stranded DNA and RNA. Theta replication. Eukaryotic chromosomal DNA. Double Stranded DNA replication. Major enzymic activities involved in DNA replication. DNA polymerases (prokaryotic and eukaryotic), DNA gyrase, ligase, primes, helices and binding proteins. Initiation, elongation and termination of replication, Brief description of replication of eukaryotic chromosome.	Lecture Discussion Assignment	Quiz/MCQ Short answer Easy type answer Report
- Classify different replication process and their application. - Compare different process related to the replication - Summarize different stages of transcription techniques. - Explain molecular techniques related to the transcription.	Replication process in <i>E. coli</i> : Initiation point, unwinding of parental DNA, polymerization, synthesis of primer, Okazaki fragments, Joining of precursor strand. Events at replication fork. Replication for DNA in eucaryotes. Multiple replication forks, histone separation Transcription: Definition, classes of RNA molecules. Features of prokaryotic and eukaryotic mRNA. tRNA and rRNA Prokaryotic transcription:	Lecture Discussion Assignment	Quiz/MCQ Short answer Easy type answer report

Select replication techniques for application	Stages of transcription, Binding of RNA polymerase to the DNA template, initiation of polymerization, chain elongation and termination of synthesis, Initiation and termination signals Eukaryotic transcription: eukaryotic RNA polymerases. Difference between prokaryotic and eukaryotic transcripts; promoters. caps and tails; Introns and exons, post transcriptional processing, Reverse transcription.		
- Compare different types translation process - Discuss essential components of protein through translation - Explain details about Prokaryotic and Eukaryotic translation technique	Translation Essential components of protein biosynthesis. The Genetic code: characteristics; deciphering the genetic code, codon assignments. Activation of amino acids: Codon-Anticodon recognition. Structure of ribosomes and tRNAs, Prokaryotic ribosome, eukaryotic ribosome, Stage of protein synthesis: initiation, elongation and termination. Energy requirement for protein synthesis; fidelity of translation. Difference between prokaryotic and eukaryotic translation. Protein localization in eukaryotes. Synthesis on membrane- bound ribosomes. Endoplasmic reticulum. Signal hypothesis: Glycoprotein. Inhibitors of protein synthesis	Lecture Discussion Assignment	Quiz/MCQ Short answer Easy type answer report
- Discuss different gene regulation techniques - Summarize gene regulation and expression system - Explain how translation control in cell	Regulation of Gene expression: The operon model: Lac operon (inducible system), catabolic repression. Trip operon (repressible system), Transposable genetic elements, mechanism of transposition. Translation control: Post translational processing. Feedback inhibition, protein degradation.	Lecture Discussion Assignment	Quiz/MCQ Short answer Easy type answer report

Books Recommended

1. Lehninger Principles of Biochemistry. Nelson and Cocks, 3rd edition, Worth Publishers Inc.
2. Lehninger Principles of Biochemistry. Nelson and Cocks, 4th edition, Worth Publishers Inc.
3. Lehninger Principles of Biochemistry. Nelson and Cocks, 5th edition, Worth Publishers Inc.
4. Biochemistry, J.M. Berg, J. L.Tymoczko and L Stryer, 7thedition, W.H.Freeman and Company, 2007.
5. Donald Voet and Judith G Voet. Biochemistry. John Wiley and Sons.1990.
6. Eric E. Conn, Paul K. Stumpf. George, Brunening. Roy, H. Dor. Outlines of Biochemistry Joh Wiley and Sons, 1987.
7. R. W. Old and S. B. Primose. Principles of Gene manipulation. An introduction to genetic engineering. Blackwell publications 1989.
8. Bruce Alberts, Dennis Bray. julian Lewis, martin Raff, keith Roberts & James D. Watson Molecular Biology of the cells. 2nd edition, Garland Publishing Inc. n. Y. 1989.

Course Code: BIOC 509 Course Title: Biochemistry of Plant Hormones and Biocides (Compulsory)	Credit hour: 03	Degree: MS in Biochemistry	Semester: July - December
Rationale: The course is designed to provide knowledge and update information about Phytohormones and Biocides; Biochemistry, physiological functions and their application in culture of plant world.			
Course Outcomes ▪ Conceptualize Phytohormones. ▪ Acquire knowledge about Phytohormones and biocides and their application on plant world.			
Intended Learning Outcomes (ILOs) The student will be able to –	Course Content	Teaching Learning Strategies	Assessment Strategies
▪ Point out functions, mode of action of auxins, ▪ Express confidence on bioassay of naturally occurring auxins	Biochemistry, physiological functions. mode of action and bioassay of naturally occurring auxins	Lecture Discussion Visual presentation Assignment	MCQ Short answer Essay type answers Report
▪ Illustrate physiological functions. mode of action and bioassay of naturally occurring gibberellins	Biochemistry, physiological functions. mode of action and bioassay of naturally occurring gibberellins	Lecture Discussion Visual presentation	MCQ Short answer Essay type answers
▪ Acquaint with and justify the functions, mode of action and bioassay of naturally occurring cytokinins	Biochemistry, physiological functions. mode of action and bioassay of naturally occurring cytokinins	Lecture Discussion Visual presentation Assignment	MCQ Short answer Essay type answers Report
▪ Exercise the bioassay of naturally occurring ethylene and abscisic acid.	Biochemistry, physiological functions. mode of action and bioassay of naturally occurring ethylene and abscisic acid.	Lecture Discussion Visual presentation	MCQ Short answer Essay type answers
▪ Becoming more exact about functions. mode of action and bioassay of naturally occurring and synthetic growth retardants	Biochemistry, physiological functions. mode of action and bioassay of naturally occurring Natural and synthetic growth retardants	Lecture Discussion Visual presentation Assignment	MCQ Short answer Essay type answers Report
▪ Exercise the application of herbicides in field crop	Biochemistry and mode of action and application of herbicides in field crop	Lecture Discussion Visual presentation	MCQ Short answer Essay type answers
▪ Evaluate the toxicity of organophosphorous pesticides	Biochemistry and mode of action and toxicity of organophosphorous	Lecture Discussion Visual presentation	MCQ Short answer Essay type answers

Describe the application and the mode of action of insecticides	Biochemistry and mode of action insecticides	Lecture Discussion Visual presentation	MCQ Short answer Essay type answers
Interpret the mode of action some important fungicides	Biochemistry and mode of action some important fungicides	Lecture Discussion Visual presentation	MCQ Short answer Essay type answers
Investigate on the application of some important bactericides, nematocides and acaricides	Biochemistry and mode of action some important bactericides, nematocides and acaricides	Lecture Discussion Visual presentation Assignment	MCQ Short answer Essay type answers Report

Book References

1. A. L. Lehninger. 1982. Biochemistry, 2nd Edition, Kalyani Publishers, Lubiana, New Delhi,
2. J.L.Jain.2001. Fundamentals of Biochemistry, 5th Edition, published by Chand & Company Ltd. Ram
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6. Amarjit Basra, 2000. Plant Growth Regulators in Agriculture and Horticulture: Their Role and
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11. Öpik H, Rolfe SA, Willis AJ, Street HE. 2005. [The physiology of flowering plants](#) (4th ed.). Cambridge University Press. p. 191. [ISBN 978-0-521-66251-2](#).
12. Osborne DJ, McManus MT.2005. [Hormones, signals and target cells in plant development](#). Cambridge University Press. p. 158. [ISBN 978-0-521-33076-3](#).
13. Thomas Elliot W, Thomas L R (1979). *Botany: a brief introduction to plant biology*. New York:
14. Wiley. pp. 155–170. [ISBN 0-471-02114-8](#).

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1. Tarakhovskaya ER, Maslov Y, Shishova MF (2007). "Phytohormones in algae". *Russian Journal of Plant Physiology*. **54** (2): 163–170.
2. "Gibberellin formation in microorganisms". *Plant Growth Regulation*. **15**: 303–314.
3. Swarup R, Perry P, Hagenbeek D, Van Der Straeten D, Beemster GT, Sandberg G, Bhalerao R, Ljung K, Bennett MJ (July 2007). ["Ethylene upregulates auxin biosynthesis in Arabidopsis seedlings to enhance inhibition of root cell elongation"](#). *The Plant Cell*. **19** (7): 2186–96.
3. Feurtado JA, Ambrose SJ, Cutler AJ, Ross AR, Abrams SR, Kermode AR (February 2004). "Dormancy termination of western white pine (*Pinus monticola*Dougl. Ex D. Don) seeds is associated with changes in abscisic acid metabolism". *Planta*. **218** (4): 630–9.
4. Ren H, Gao Z, Chen L, Wei K, Liu J, Fan Y, Davies WJ, Jia W, Zhang J (2007). ["Dynamic](#)

[analysis of ABA accumulation in relation to the rate of ABA catabolism in maize tissues under water deficit](#)". *Journal of Experimental Botany*. **58** (2): 211–9.

5. Else MA, Coupland D, Dutton L, Jackson MB (January 2001). "Decreased root hydraulic conductivity reduces leaf water potential, initiates stomatal closure, and slows leaf expansion in flooded plants of castor oil (*Ricinus communis*) despite diminished delivery of ABA from the roots to shoots in xylem sap". *Physiologia Plantarum*. **111** (1): 46–54.
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7. Kermode AR (December 2005). "Role of Abscissic Acid in Seed Dormancy". *J Plant Growth Regul.* **24** (4): 319–344
8. Walz A, Park S, Slovin JP, Ludwig-Müller J, Momonoki YS, Cohen JD (February 2002). "[A gene encoding a protein modified by the phytohormone indoleacetic acid](#)". *Proceedings of the National Academy of Sciences of the United States of America*. **99** (3): 1718–23.

Course Code: BIOC 510 Course Title: Soil Biochemistry	Credit hour: 03	Degree: MS in Biochemistry	Semester: July - December
Rationale: The course is planned to provide knowledge on Soil Biochemistry.			
Course Outcomes: ▪ Conceptualize the microbe ecosystem of plant and animal in soils. ▪ Acquire knowledge on conversion of atmospheric nitrogen to soil nitrogen. ▪ Implement the knowledge how atmospheric nitrogen use as nutrients for different plants. ▪ Interpret the activity of soil enzyme on storage and structural polysaccharides. ▪ Transformation and utility of sulfur and phosphorus in soil.			
Intended Learning Outcomes (ILOs) The student will be able to –	Course Content	Teaching Learning Strategies	Assessment Strategies
▪ Explain the role of Soil-microbe-plant in ecosystem. ▪ Discuss about the formation and degradation of humus	Biochemistry of Ecosystem: Soil-microbe-plant animal ecosystem. Biochemistry of formation and degradation of humus	Lecture Discussion Visual presentation Assignment	MCQ Short answer Essay type answers Report
▪ Describe the soil enzyme and their activity in diverse soil types. ▪ Illustrate the synthesis and breakdown of soil polysaccharides.	Soil Enzyme & Polysaccharides: Soil enzyme and their activity in diverse soil types. Synthesis and breakdown of soil polysaccharides.	Lecture Discussion Visual presentation	MCQ Short answer Essay type answers
• Define atmospheric nitrogen fixation. • Describe the causes of nitrogen fixation. • Discuss the types of nitrogen fixation. ▪ Explain the importance nitrogen fixation.	Nitrogen fixation: Biochemistry of fixation of atmospheric nitrogen and transformation of soil nitrogen.	Lecture Discussion Visual presentation Assignment	MCQ Short answer Essay type answers
▪ Describe transformation of sulfur and phosphorus in soil.	Biochemical Transformation: Biochemical transformation of sulfur and phosphorus in soil.	Lecture Discussion Visual presentation	MCQ Short answer Essay type answers
▪ Discuss metabolism of lignin and humic acid.	Metabolism: Metabolism of lignin and humic acid	Lecture Discussion Visual presentation	MCQ Short answer Essay type answers
▪ Explain the soil microbe Relationship	Soil microbe Relationship	Lecture Discussion Visual presentation	MCQ Short answer Essay type answers

Books Recommended:

1. A. Douglas Melaren and George H. Peerson. Soil Biochemistry. Edward Arnold (Publishers) Ltd. London. 1988.
2. C.N. Lewis and M. Randell. Thermodynamics, McGraw – Hill, New York, 1983.
3. J. A. Quastel, Soil Metabolism. The Royal Institute of Chemistry of Great Britain and Ireland, London, 1974.
4. S. A. Walksman, Humus 2nd ed. Williams and Wilkins. Baltimore, 1989.

Course Code: BIOC 512 Current Topics in Nutrition (Compulsory)		Credit Hours: 03	Degree: MS in Biochemistry	Semester: July- December
Rationale: The course is designed to provide knowledge and update information on food value and their nutritional status, calorific value of different classes of food, balanced diet and basic four foods, co-enzyme activity of vitamins and micronutrients, protein-calorie malnutrition, nutritional management.				
Course Outcome - Acquire knowledge on food value - Compare foods on the basis of nutrition , vitamins and micronutrients - Implement of acquired knowledge to face malnutrition and nutritional deficiency - Demonstrate statistical representation about current scenario of nutritional status - Conceptualize of nutrition education and public health				
Intended Learning Outcome (ILOs)	Course content	Teaching Strategies		Assessment Strategies
At the end of the course student will be able to- - Describe different nutrients and their role - Compare different foods based on their nutritional aspect - Explain caloric value and balance diet for healthy life	Introduction to food and nutrition for individual and community goal; Nutrients in health and disease. Central role of energy in living system; Energy requirement according to age, sex and physiological state. Nutritive and calorific value of different classes of foods. Balanced diet and Basic four foods guide	Lecture Discussion Assignment		Quiz/MCQ Short answer Easy type answer report
- Contrast different vitamins, minerals and their biochemical function in human body - Implement of nutritional management in different kinds of diseases	Vitamin as coenzyme in biological system; Micronutrients (Vitamins and minerals) in energy transduction system; Effect of energy deficiency on the utilization of other nutrients Protein energy malnutrition: Marasmus and Kwashiorkor. Role of cholesterol.	Lecture Discussion Assignment		Quiz/MCQ Short answer Easy type answer report

▪ Discuss about different methods of nutritional management and its implementation to lead a good health life ▪ Explain details about Nutritional requirement in different stages of life	Nutritional management of diabetes mellitus and cardiovascular disease. Obesity and its implication for health. Infant nutrition, nutrition in pregnancy and lactation. Geriatric Nutrition. Nutrition education to combat malnutrition.	Lecture/Discussion/Assignment	Quiz/Class test/Report /Semester final
▪ Summarize nutritional rules and laws. ▪ Represent statistical information on the current scenario of nutritional aspects	Assessment of nutritional status in a community. Nutritional surveillance and National Nutrition Policy. Nutritional consideration in Agricultural Policy	Lecture/Discussion/Assignment	Quiz/Class test/Report /Semester final

Books Recommended

1. Robinson, Corinne H. Nutrition and Diet, Therapy. McMillan Publishing Co. 1985.
2. Robinson, Corinne H. Normal and Therapeutic Nutrition. Macmillan Publishing Co. 1987.
3. Swasminathan (Vol-1 & Vol-2), M., Hand Book of Food and Nutrition. Ganesh and Company. Madras, India. 1977.
4. Mitchell, Helen S. Nutrition in Health and Disease. J.B. Lippincott Company. Philadelphia 1976.
5. Maclaren, Donald S. Nutrition in the community. John Wiley and Sons 1976.
6. Walker, Ann F. Applied Human Nutrition. Ellis Horwood Limited, West Sussex, England 1990.
7. Human Nutrition and Dietetics, S. Davidson, A.P. Meiklejohn and R. Passmore, Edinburgh and London: E. & S. Livingstone Ltd. 1959

Course Code: BIOC 513 Course Title: Principles of Recombinant DNA Technology (Compulsory)		Credit Hours: 03	Degree: MS in Biochemistry	Semester: January-June
Rationale: The course is designed to provide knowledge on recombinant DNA technology, host, vector, restriction enzyme etc. related to design recombinant DNA.				
Course outcome: - Acquire knowledge on determination of desired base sequences and identification of specific clones by hybridization - Conceptualize recombinant DNA technology - Implement the knowledge on recombinant DNA technology - Interpret different molecular tools				
Intended Learning Outcome (ILOs)	Course content	Teaching Strategies	Assessment Strategies	
At the end of the course student will be able to- - Describe genes and its elements - Conceptualize of recombination - Define and explain transformation, translation and conjugation - Discuss the types of recombination mechanisms.	Rearrangement of Genes: Mutation; Sexual reproduction: Fusion, Meiosis, Diploidy, Haploidy, Acquisition of genetic information by prokaryotes : transformation, transduction and conjugation; Mobile genetic element: lysogenic phage plasmids, Transposable elements or transposons; Types of recombination mechanisms site, specific recombination, homologous recombination, transposition (Holliday mechanism), illegitimate recombination.	Lecture Discussion Assignment	Quiz/MCQ Short answer Easy type answer Report	
- Illustrate different techniques of recombination - Construct different vectors, hosts with desire DNA - Categorize different chromosomal clones. - Select the appropriate methods of gene cloning - Familiar with different molecular tools related to the recombinant DNA	Creation of Recombinant DNA molecules. Recombinant DNA methodology: donors, vectors, restriction endonucleases, Synthesis of complementary DNA; Cloning of DNA: safe hosts, safe vectors; drug resistance plasmids; integration of cDNA with vector DNA, preparation of genetically pure, clonal population of recipient cells; Construction of chromosomal clones: genomic libraries, fragmentation of DNA, Cloning of DNA fragment-using plasmids,	Lecture Discussion Assignment	Quiz/MCQ Short answer Easy type answer Report	

technology.	phage lambda, cosmids		
- Identify specific cloning hybridity - Define and explain mRNA and cDNA cloned with synthetic oligonucleotides	Chromosome Walking Identification of specific clones by hybridization: with mRNA, with the cloned cDNA, with synthetic oligonucleotides	Lecture Discussion Assignment	Quiz/MCQ Short answer Easy type answer Report
Discuss different analysis method of DNA probing	Analysis of DNA and RNA: Analysis of chromosomal DNA (Southern blot) Analysis of RNA (northern blot) Determination of base sequence.	Lecture Discussion Assignment	Quiz/MCQ Short answer Easy type answer Report
Implement techniques of gene cloning in biological sciences	Practical benefits from Gene Cloning. In agriculture, medicine and industry	Lecture Discussion Assignment	Quiz/MCQ Short answer Easy type answer Report
Explain the latest research findings and information of advanced crop production and improvement technology	Latest research findings and information regarding advanced crop production and improvement technology	Lecture Discussion Assignment	Quiz/MCQ Short answer Easy type answer Report

Recommended Books

1. Robert H. Tamarin 1996. Principles of Genetics 5th edition. W. M.C. Brood Publishers.
2. Watson, J. D. M. Gilman, J. Witowski and M Zoller 1992 Recombinant DNA 2nded New York. Freeman.
3. Wu. R.L. Grossman and K. Moldave eds. 1989. Recombinant DNA Methodology. San Diego Academic Press.
4. Karl Drlica understanding DNA and Gene Cloning. A Guide for the Curious John Wiley and Son. 1984.
5. Hardy, K. G. Plasmid- A Paractical Approach 1987. IRL Press Ltd.
6. Kerby, L.T. 1990. DNA Fingerprinting. An introduction New York Stockton Press.
7. Biochemistry, J.M. Berg, J. L.Tymoczko and L Stryer, 7th edition, W.H. Freeman and Company, 2007.
8. Lehninger Principles of Biochemistry. Nelson and Cocks, 5th edition, Worth Publishers Inc. 2007.

Course Code: BIOC 514 Course Title: Animal hormones (Compulsory)	Credit hour: 03	Degree: MS in Biochemistry	Semester: January - June
Rationale: The course is designed to provide knowledge and update information about animal hormones and its implication to develop animal health through metabolic activities of hormones.			
Course Outcomes ▪ Conceptualize animal endocrinology ▪ Acquire knowledge about endocrine glands, sources of hormones and its functions ▪ Develop animal health through the manipulation of different hormones			
Intended Learning Outcomes (ILOs) The student will be able to –	Course Content	Teaching Learning Strategies	Assessment Strategies
▪ Acquaint with the mammalian endocrine system ▪ Determine relationship between primary and secondary messengers ▪ Gather basic concept on animal hormones	Organization of mammalian endocrine system. Basic concept of hormones, Relationship between primary and second messengers.	Lecture Discussion Visual presentation Assignment	MCQ Short answer Essay type answer Report
▪ Classify hormones based on general features ▪ Acquaint with structural similarities and mechanism of action of hormones	General features of hormone classes based on structural similarities, action mechanism. Mechanism of hormone action.	Lecture Discussion Visual presentation	MCQ Short answer Essay type answer
▪ Familiar with chemical nature of hormones ▪ Evaluate physiological and biochemical action of the different hormones:	Chemical nature, regulation of secretion. Physiological and biochemical action of the different hormones:	Lecture Discussion Visual presentation Assignment	MCQ Short answer Essay type answer Report
▪ Identify and explain Pituitary hormone ▪ Defends chemistry and biological importance of hormones	Pituitary hormone. prolactin and gonadotrophins. oxytocin and vasopressin: thyroxine and triiodothyroxine	Lecture Discussion Visual presentation	MCQ Short answer Essay type answer
▪ Justify the significance of medullary and cortical hormones ▪ Locates the sexsteroid other than male and female endocrine gland	Hormones of Adrenal gland: Epinephrine and norepinephrine, Glucocorticoid, Mineralocorticoid and sexsteroid	Lecture Discussion Visual presentation Assignment	MCQ Short answer Essay type answer Report

Identify and explain the male hormonal integrity	Male hormones: Androgen, testosterone, androstenedione	Lecture Discussion Visual presentation	MCQ Short answer Essay type answer
Illustrate Parathyroid hormonal activity	Parathyroid hormone and calcium metabolism.	Lecture Discussion Visual presentation	MCQ Short answer Essay type answer
Categorize gastro intestinal secretion and their integration	Hormones GIT: Gastrin, cholecystokinin, endorphins. secretin etc.	Lecture Discussion Visual presentation	MCQ Short answer Essay type answer
Acquaint with and justify the Female hormonal system and their implication	Female hormones: Estrogen, progesterone, Estradiol	Lecture Discussion Visual presentation	MCQ Short answer Essay type answer
Illustrate the chemistry and physiological action of pancreatic hormones	Hormones of pancreas: Insulin and glucagon.	Lecture Discussion Visual presentation Assignment	MCQ Short answer Essay type answer Report

Book References:

1. Guiton J. 1990. Human Physiology, 2nd Edition, Pergamon Press. Oxford. London, New York. Paris.
2. A. L. Lehninger. 1982. Biochemistry, 2nd Edition, Kalyani Publishers, Lubiana, New Delhi,
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1. Beato M, Chavez S, Truss M. 1996. "Transcriptional regulation by steroid hormones". *Steroids*. **61** (4): 240–251
2. Hammes SR (2003). ["The further redefining of steroid-mediated signaling"](#). *Proc Natl Acad Sci USA*. **100** (5): 21680–2170.
3. Enard J (1992). "Mammalian hormones in microbial cells". *Trends Biochem. Sci.* **17** (4): 147–50.
4. Janssens PM. "Did vertebrate signal transduction mechanisms originate in eukaryotic microbes?". *Trends in Biochemical Sciences*. **12**: 456–459.
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Course Code: BIOC 515 Course Title: Biochemistry of Fishes	Credit hour: 03	Degree: MS in Biochemistry	Semester: July - December
Rationale: The course is planned to provide knowledge on basic carbohydrate, fat and protein in fish, and their energy requirement. Finally the content will provide detailed idea about digestion and absorption of carbohydrate, fat and protein in fish.			
Course Outcomes - Acquire knowledge on metabolism of nutrients in Fishes. - Learn about antioxidant and toxicity of fishes.			
Intended Learning Outcomes (ILOs) The student will be able to –	Course Content	Teaching Learning Strategies	Assessment Strategies
Discuss metabolism. Basal metabolism. Weight-metabolism relationship.	Metabolism: Concept of Maintenance metabolism. Basal metabolism. Weight-metabolism relationship.	Lecture Discussion Visual presentation Assignment	MCQ Short answer Essay type answers Report
- Describe the regulation of carbohydrate metabolism in fishes. - Explain the role of carbohydrate in energy supply. - Describe the importance of gluconeogenesis	Metabolism of carbohydrates: Regulation of carbohydrate metabolism. Role of carbohydrate in energy supply. Role of gluconeogenesis.	Lecture Discussion Visual presentation	MCQ Short answer Essay type answers
- Describe the metabolic energy of protein. - Discuss the qualitative and quantitative requirement of amino acids and protein. - Determine the nutritional value of protein.	Metabolism of protein: Metabolic energy of protein. Qualitative and quantitative requirement of amino acids and protein. Evaluation of nutritional value of protein.	Lecture Discussion Visual presentation Assignment	MCQ Short answer Essay type answers Report
- Discuss the fat and fatty acid. - Explain the biological oxidation of fatty acids - Explain how oxidation occurred by oxygen and lipoxygenase. - Categorize the biosynthesis of essential fatty acids, polyenes, triglycerides and prostaglandin's.	Metabolism of lipids: Requirements of fat and fatty acids. Biological oxidation of fatty acids: epoxidation, hydroxylation, oxidative fusion. Oxidation by oxygen and lipoxygenase. Biosynthesis of essential fatty acids, polyenes, triglycerides and	Lecture Discussion Visual presentation	MCQ Short answer Essay type answers

	prostaglandin's. Toxic constituents of oxidized lipid and its effect on fish.		
- Define antioxidant - Classify different types of antioxidant - Explain the biochemical mechanism of antioxidant action. - Describe free radicals and their reaction mechanism. - Discuss vitamins and minerals in fish nutrition.	Antioxidant: Types of Antioxidant. Biochemical mechanism of antioxidant action. Synergists. Concept of free radicals and their reaction mechanism. Vitamins and minerals in fish nutrition.	Lecture Discussion Visual presentation	MCQ Short answer Essay type answers
- Define toxins - Classify toxins - Determine the biochemical effects of toxins on fish. - Explain how hormone control fish metabolism can.	Toxins: Types of toxins Biochemical effects of toxins on fish. Hormonal control of fish metabolism.	Lecture Discussion Visual presentation	MCQ Short answer Essay type answers
Recommended Books: - Donald Voet, Judith G. Voet. Biochemistry John Wiley and Sons, 1990. - Lehninger, A. L. Principles of Biochemistry. Worth Publishers Inc, 1984. - Mahler, H. R. and E. H. Cordes. Biological Chemistry, Harper and Harper, 1971. - Williams, R. T. (ed.). The Biochemistry of Fishes, London. Cambridge University Press, 1951. - Halver, J. E. Fish nutrition. 2nd Ed. Academic Press, 1988. - Harper, B. nutrition of Pond Fishes. Cambridge University Press, 1990. - Gunstone, F. D. and norris, F. A. Lipids in Foods, Chemistry, Biochemistry and Technology. Pergamon Press, 1983. - Hudson, B. J. F. Food Antioxidant. Elsevier Science Publishers Ltd, 1990.			