

KASHI NARESH UNIVERSITY, BHADOHI
(National Education Policy-2020)

Syllabus
of
Biochemistry

(Effective from Academic Session 2026-2027)
For
B.Sc.

Approved by
Board of Studies
Department of Biochemistry
Faculty of Science
Kashi Naresh University, Bhadohi



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Department of Biochemistry

Faculty of Science

THREE-YEAR FULL-TIME PROGRAMME

(Six-Semester Course)

Kashi Naresh University Bhadohi, U.P.

221304

B.Sc. Biochemistry Syllabus

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Semester-wise Titles of the Papers in B.Sc. (Biochemistry)

Year	Sem.	Course Code	Paper title	Theory/ practical	credits
1	I	B110101T	Fundamentals of Biochemistry and Metalloenzymes	Theory	4
		B110102P	Biosafety Measures, Preparation of Solutions and Qualitative Analysis of Biomolecules	Practical/ Field Work	2
	II	B110201T	Human Physiology and Clinical Biochemistry	Theory	4
		B110202P	Clinical Biochemistry Lab	Practical/ Field Work	2
2	III	B110301T	Tools and Techniques in Biochemistry	Theory	4
		B110302P	Biochemical Tools and Techniques Lab.	Practical	2
	IV	B110401T	Enzymes and Immunology	Theory	4
		B110402P	Enzymes and Immunological Techniques Lab	Practical	2
		B110403R	Research Project		3
3	V	B110501T	Bioenergetics and Metabolism	Theory	4
		B110502T	Fundamentals of Microbiology	Theory	4
		B110503P	Microbial Techniques and Metabolism Lab	Practical	2
	VI	B110601T	Cell, Molecular Biology and Genetic Engineering	Theory	4
		B110602T	Biochemistry of Health and Disease, Plant and Animal Hormones	Theory	4
		B110603P	Genetic Engineering and Bioinformatics Lab	Practical	2

Programme/Class: Certificate	Year: First	Semester: First
Course Code: B110101 T	Course Title: Fundamental of Biochemistry and Metalloenzymes	

Course outcomes: The student at the completion of the course will learn to understand:

- Basic details of structure, function of carbohydrate molecules and its classification
- Details of structure, function and classification of amino acid & structural levels of protein molecules
- Structure and function of fatty acids, storage and structural lipids
- Details of structure and Function of Nucleotide, DNA and RNA
- Basic details of Vitamin molecules and its classification
- Metalloenzymes

Credits: 4	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks: As per rules
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0	

Unit	Topics	No. of Lectures (60)
I	Basics of Biochemistry • History of biochemistry with special reference to contribution of Indian biochemists. • General idea about normality, molarity, molality, percentage solutions, mole fraction. W/v and v/v solutions. • Concept of pH determinations using indicators, buffer solutions and their biological importance. • Water as universal solvent	5
II	Amino acids and proteins • Structural features and classification, Physical properties, optical properties (Stereoisomerism) • Chemical properties of amino acids • Uncommon amino acids and their function. • Classification of protein, structural organization as primary, secondary, tertiary and quaternary structure of protein and characteristics of the peptide bond	10
III	Carbohydrate • Monosaccharides - structure of aldoses and ketoses, Ring structure of sugars, conformations of sugars, mutarotation, anomers, epimers and enantiomers • Structure of biologically important sugar derivatives, oxidation and reduction of sugars • Formation of disaccharides, reducing and non-reducing disaccharide • Polysaccharides – homo- and heteropolysaccharides, structural and storage polysaccharides	10
IV	Lipids • Building blocks of lipids - fatty acids, glycerol, ceramide • Storage lipids - triacyl glycerol and waxes • Structural lipids in membranes – glycerophospholipids, galactolipids and sulpholipids, sphingolipids and sterols • Plant steroids	10

V	Nucleic acids • Nucleotides - structure and properties • Nucleic acid structure – Watson-Crick model of DNA • Structure of major species of RNA - mRNA, tRNA and rRNA • Nucleic acid chemistry - UV absorption, effect of acid and alkali on DNA • Other functions of nucleotides - source of energy, component of coenzymes, second messengers	10
VI	Vitamins • Structure and active forms of water soluble and fatsoluble vitamins, • Deficiency diseases and symptoms, hypervitaminosis • Sources, dietary requirements	5
VII	Metalloenzymes: Oxygen Transport and Storage System: Hemoglobin, myoglobin, hemerythrin, hemocyanin	5
VIII	Electron Transport system: Cytochrome c oxidase, Cytochrome c peroxidase, Nitrogenase, Iron sulphur protein	5
Suggested readings: 1. Lehninger, Albert, Cox, Michael M. Nelson, David L. (2017) <i>Lehninger principles of biochemistry</i> New York: W. H. Freeman. 2. Voet, D., & Voet, J. G. (2011). <i>Biochemistry</i>. New York: J. Wiley & Sons 3. <i>Biochemistry – Lubertstryer Freeman International Edition.</i> 4. <i>Biochemistry – Keshav Trehan Wiley Eastern Publications</i> 5. <i>Fundamentals of Biochemistry - J. L. Jain S. Chand and Company</i> 6. Voet & Voet: <i>Biochemistry Vols 1 & 2: Wiley (2004)</i> 7. Murray et al: <i>Harper's Illustrated Biochemistry: McGraw Hill (2003) Elliott and Elliott:</i> 8. <i>Biochemistry and Molecular Biology: Oxford University Press</i> 9. Taiz, L., Zeiger, E., <i>Plant Physiology. Sinauer Associates Inc., U.S.A. 5th Edition.</i> 10. Hopkins, W.G., Huner, N.P., <i>Introduction to Plant Physiology. John Wiley & Sons,</i> 11. <i>Vander's Human Physiology (2008) 11th ed., Widmaier, E.P., Raff, H. and Strang, K.T. McGraw Hill International Publications, ISBN: 978-0-07-128366-3.</i> 12. <i>Endocrinology (2007) 6th ed., Hadley, M.C. and Levine, J.E. Pearson Education (New Delhi), Inc. ISBN: 978-81-317-2610-5.</i>		

Programme/Class: Certificate	Year: First	Semester: First
Course Code: B110102 P	Course Title: Biosafety Measures, Preparation of Solutions and Qualitative Analysis of Biomolecules	
Course outcomes: After the successful course completion, learners will develop following attributes • Preparation of various solutions • Preparation of Buffers • Perform Qualitative test of Biomolecules • Estimation of vitamin C • Perform spot test for amino acids in a given sample		
Credits: 4	Core Compulsory	
Max. Marks: 25+75	Min. Passing Marks: As per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4		
	Topics	Total No. of Lectures
I	• Safety measures in laboratories • Preparation of normal and molar solutions • Preparation of buffers • Determination of pKa of acetic acid and glycine • Qualitative tests for carbohydrates, lipids, amino acids, proteins and nucleic acids • Estimation of vitamin C • Perform spot test for amino acids in a given sample	60
Suggested readings: 1. Principles of Biochemistry- Albert L. Lehninger CBS Publishers & Distributors 2. Textbook of Biochemistry with Clinical Correlations (2011) 7th ed., Devlin, T.M., John Wiley & Sons, Inc. (New York), ISBN:978-0-470-28173-4. 3. An Introduction to Practical Biochemistry, David T. Plummer (2006)Tata McGraw Hill Education, 3rd edition		






Programme/Class: Certificate	Year: First	Semester: Second
Course Code: B110201 T	Course Title: Human Physiology and Clinical Biochemistry	
Course outcomes- • After the successful course completion, learners will develop following attributes • Develop an understanding of the inter relationships within and between anatomical and physiological systems of the human body. • Develop the understanding of basic concepts of clinical biochemistry. • To understand disorder related with bio molecules metabolism. • Anticoagulant preservatives for blood and urine. • Metabolism of bilirubin, jaundice - types, differential diagnosis and Liver function.		
Credits: 4	Core Compulsory	
Max. Marks: 25+75	Min. Passing Marks:	
Total No. of Lectures (in hours per week):		

Unit	Topics	No. of Lectures (60)
I	Digestion and Respiration • Structural organization and functions of gastrointestinal tract and associated glands • Mechanical and chemical and enzymatic digestion of food, Absorptions of • carbohydrates, lipids, proteins, water, minerals and vitamins, • Mechanism of respiration, Pulmonary ventilation, Respiratory • volumes and capacities, Transport of oxygen and carbon dioxide in blood Respiratory pigments, Dissociation curves and the factors influencing it, Control of respiration	8
II	Circulation and Excretion • Components of blood and their functions • Haemostasis: Blood clotting system, Blood groups: Rh factor, ABO and MN • Cardiac cycle, Cardiac output and its regulation, Electrocardiogram, Blood pressure and its regulation • Structure of kidney and its functional unit, Mechanism of urine formation	8
III	Nervous System and Muscular System • Structure of neuron, and physiology of nerve impulse transmission • Histology of different types of muscle, Ultra structure of skeletal muscle • Molecular and chemical basis of muscle contraction • Control of muscle contraction by nerve impulses	8
IV	Basic concepts of Clinical Biochemistry • A Brief review of units and abbreviations used in expressing concentrations and standard solutions • Specimen collection and processing (Blood, urine, feces) • Anticoagulant and preservatives for blood and urine samples • Transport of specimens	8

V	Hematology: Blood - Composition and functions of various components, - Anemia:- classifications, erythrocyte indices - Blood coagulation system, Clotting time, Bleeding time Prothrombin time, RBC count, WBC count, Platelet count Differential count - determination of Hb, PCV and ESR. Hemoglobinopathies, Thalassemia	8
VI	Disorders of Carbohydrate metabolism - Regulation of blood sugar - Glycosuria-types of Glycosuria - Oral glucose tolerance test in normal and diabetic condition - Diabetes mellitus and Diabetic insipidus - hypoglycemia, hyperglycemia. Ketonuria, ketosis	6
VII	Disorders of Lipid metabolism - Cholesterol: Factors affecting blood cholesterol level - Dyslipoproteinemia, atherosclerosis risk factor and fatty liver. - Involvement of enzymes in diagnostics of heart disease including aspartate transaminase, isoenzymes of creatine kinase and lactate dehydrogenase and troponin	6
VIII	Liver function test - Types, differential diagnosis - Liver function test - Icteric index, Vandenberg test, plasma protein changes. Renal function test: Clearance test-Urea, Creatinine - Para- aminohippuric acid (PAH) test, Concentration and dilution test. Enzymology: Clinical significance of SGOT, SGPT, ALP, ACP, CPK and LDH	8

Suggested readings:

1. Textbook of Medical Physiology by Guyton. A.C., H. Sanders Philadelphia. 1988.
2. Physiological basis of Medical practice, West J.B., Best and Taylor.
3. Introduction to Physiology by Davidson H and Segal M.B. Academic Press.
4. Sherwood L – Human Physiology: From Cells to Systems, (Wadsworth Publishing, 2000, ISBN: 0534568262)
5. Tortora G J Principles of Anatomy & Physiology, (John Wiley & Sons, 1999, ISBN: 0471366927)
6. Medical Biochemistry by MN Chatterjee, Rana Shinde, 8 edition, 2013, Jaypee publications.
7. Textbook of Medical Laboratory Technology by Praful B. Godkar and Darshan P. Godkarth
8. Medical Laboratory Technology by Ramniksood, 5 Edition, 1999, Jaypee publishers
9. Text book of Biochemistry with clinical correlation, Thomas M. Devlin, 3rd edition, A JohnWiley-Liss Inc. Publication.

10. Practical Clinical Biochemistry, Harold Varley, 4th edition, CBS Publication and Distributors, New Delhi.		
Programme/Class: certificate	Year: First	Semester: Second
Course Code: B110202 P	Course Title: Clinical Biochemistry Lab	
Course outcomes- • To learn qualitative and quantitative analysis of constituents of biological fluids such as urine, blood and their estimation using standard methods. • Students will able to Perform basic hematological laboratory testing		
Credits: 4	Core Compulsory	
Max. Marks: 25+75 Min.	Passing Marks:As per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4		
UNIT	Topic	Total No.of Lectures
	• Qualitative and quantitative analysis of urine : proteins, Bence-Jones proteins, Cl^-, Ca^{+2} • Qualitative analysis of abnormal constituents in urine - glucose, albumin, bile pigments,bile salts and ketone bodies. • Experiments on blood (a) Estimation of haemoglobin by cyanmethemoglobin method (b) Determination of A/G ratio in serum • Isolation and estimation of serum cholesterol • Serum enzyme assays: alkaline phosphatase, SGOT, SGPT • Estimation of haemoglobin using Sahli's haemoglobinometer • Recording of blood pressure using a sphygmomanometer • Recording of blood glucose level by using glucometer • Ninhydrin test for N-amino acids. • Test for sugar and acetone in urine.	60
Suggested Readings: 1. Medical Biochemistry by MN Chatterjee, Rana Shinde, 8 edition, 2013, Jaypee publications. 2. Textbook of Medical Laboratory Technology by Praful B. Godkar and Darshan P. Godkarth 3. Medical Laboratory Technology by Ramniksood, 5 Edition, 1999, Jaypee publishers. 4. Text book of Biochemistry with clinical correlation, Thomas M. Devlin, 3rd edition, A. JohnWiley-Liss Inc. Publication. 5. Practical Clinical Biochemistry, Harold Varley, 4th edition, CBS Publication and Distributors, New Delhi.		

Programme/Class: DIPLOMA	Year: SECOND	Semester: THIRD
Course Code: B110301 T	Course Title: Tools and Technique in Biochemistry	
Course outcomes: • The objective of the course is to introduce various techniques to the students, which are used in biological research. • Students will acquire knowledge about the principles and applications of spectrophotometric and chromatography techniques used in a biochemistry lab. • Students will learn about the principle and application of electrophoresis, centrifugation techniques, microscopic and molecular biological techniques.		
Credits: 4	Core Compulsory	
Max. Marks: 25+75	Min. Passing Marks:	
Total No. of Lectures (in hours per week): L-T-P: 4-0-0		

Unit	Topics	No. of Lectures (60)
I	Basics of Biophysics • Chemical bonding – Ionic bond, covalent bond, hydrogen bond and Vander-Waals force.	8
II	Chromatography • Introduction & Principle of Chromatography • Paper, thin-layer, column, • HPLC, GLC and molecular sieving., • Ion exchange chromatography • Affinity Chromatography	8
III	Centrifugation • Principle of centrifugation • Basic rules of sedimentation, sedimentation coefficient. • Various types of centrifuges, low speed centrifuge, high speed centrifuge and ultracentrifuge, • types of rotors. • Application of centrifugation, • differential centrifugation, density gradient centrifugation- zonal and isopycnic.	10
IV	Electrophoresis: • Basic Principle of electrophoresis, • Gel electrophoresis, PAGE, SDS-PAGE, Native gels, denaturing gels • Agarose gel electrophoresis,	8
V	Microscopy • Principle of light microscopy, • Phase contrast microscopy • Fluorescence microscopy • Electron microscopy • Permanent and temporary slide preparation, histology and staining.	8

VI	Radioactivity • Types, their importance in biological studies • Measure of radioactivity • GM counters and Scintillation counting.	8
VII	Fundamental principles and basics of instrument design of: • UV-Visible spectrophotometry and Beer-Lambert law • Fluorescence techniques • Infra-Red and Raman spectrometry • Circular Dichroism and Optical Rotatory dispersion • Nuclear Magnetic Resonance spectrometry • Atomic absorption and emission spectrometry • X Ray diffraction • Mass spectrometry	10

Suggested readings:

1. Boyer, R.F., Biochemistry Laboratory: Modern Theory and Techniques, 6th ed., Boston, Mass: Prentice Hall, 2012,
2. Plummer D. T., An Introduction to Practical Biochemistry 3rd ed., Tata McGraw Hill Education Pvt. Ltd. 2006.
3. Wilson K. and Walker J., Principles and Techniques of Biochemistry and Molecular Biology, 7th ed., Cambridge University Press, 2010
4. Rastogi & Pathak, Genetic Engineering, Oxford University Press, 2009

Programme/Class: DIPLOMA		Year: SECOND	Semester: THIRD
Course Code: B110201 P		Course Title: Biochemical Tools and Techniques Lab	
Course outcomes- It will also give them an opportunity to get hands on experience to develop their experimental skills expected from any biochemist working in a pathology/diagnostic/research lab.			
Credits: 4		Core Compulsory	
Max. Marks: 25+75 Min.		Passing Marks:As per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4			
UNIT	Topic	Total No.of Lectures	
	• Verification of Beer's Law • Estimation of proteins by Biuret/Lowry method • Separation of amino acid acids by TLC/paper chromatography • To perform agarose gel electrophoresis • To isolate mitochondria by differential centrifugation • Visualization of cells by methylene blue • SDS PAGE	60	
Suggested Readings: 1. Narayanan, P (2000) Essentials of Biophysics, New Age Int. Pub. New Delhi. 2. Roy R.N. (1999) A Text Book of Biophysics New Central Book Agency. 3. Plummer D. T., An Introduction to Practical Biochemistry 3rd ed., Tata McGraw Hill Education Pvt. Ltd. 1998. 4. Wilson K. and Walker J., Principles and Techniques of Biochemistry and Molecular Biology, 7th ed., Cambridge University Press, 2010			

Programme/Class: DIPLOMA	Year: SECOND	Semester: FOURTH
Course Code: B110301 T	Course Title: Enzymes and Immunology	
Course outcomes: • The objective of the course is to provide detailed knowledge about enzymes, the biological catalysts with remarkable properties that sustain life. • Students will learn the nature and importance of enzymes in living systems • Students will gain insight into the thermodynamic and molecular basis of catalysis by enzymes and the underlying basis of their specificity • Students will learn about the mechanisms of enzyme action, kinetics of enzyme catalyzed reactions and clinical importance of enzyme inhibitors • Students will also learn to appreciate how enzymes are regulated and the physiological importance of enzyme regulation in the cell • Students will develop the understanding of basics of Immunology, types of Immune Responses, antigens and antibodies, histocompatibility, vaccines and immunization		
Credits: 4	Core Compulsory	
Max. Marks: 25+75	Min. Passing Marks:	
Total No. of Lectures (in hours per week): L-T-P: 4-0-0		

Unit	Topics	No. of Lectures (60)
I	Introduction to enzymes • General characteristics of enzymes • Co-factor and prosthetic group, apoenzyme, holoenzyme. Classification and nomenclature of enzymes. • Enzyme assays- • Enzyme activity, specific activity, units to express enzyme activity. Features of enzyme catalysis • Catalytic power and specificity of enzymes (concept of active site), Fischer's lock and key hypothesis • Koshland's induced fit hypothesis.	10
II	Enzyme kinetics • Relationship between initial velocity and substrate concentration Michaelis-Menten equation • Lineweaver-Burk plot, • Eadie-Hofstee and Hanes plot • Determination of K_m and V_{max}, K_{cat}, specificity constant • Effect of pH and temperature on the activity of enzymes.	8
III	Enzyme inhibition and Regulation • Reversible inhibition (competitive, uncompetitive, non-competitive and mixed) • Irreversible inhibition • Substrate inhibition • Allosteric regulation and feedback inhibition (ATPase) • Isoenzymes • Enzyme immobilization and its applications	10

IV	Introduction of Immunology - Types of Immunity: Passive, Active, Innate and Acquired immunity, Humoral and Cell Mediated Immunity - Antigens: haptens, epitopes and Factors influencing immunogenicity - Antibodies: Structure, types, production and functions of immunoglobulins Clonal selection theory. - Antigen Antibody reaction: Precipitation, Immunoelectrophoresis, Haem-agglutination, RIA and ELISA. - Cell and organs of immune responses and their functions - B & T cells - factors responsible for immunogenicity - Monoclonal antibodies production and applications	8
V	Histocompatibility - Structure of MHC class I, II & III antigens and their mode of antigen presentation - MHC restriction, - Complement system: Components, Classical and alternate pathways of complement activation - Hypersensitivity - Autoimmunity.	8
VI	Vaccines and Immunization - Passive and Active immunization - Types of Vaccines: Inactivated, Attenuated, Recombinant and Vaccines - Peptide and DNA Vaccines - RNA Vaccines	8
VII	Transplantation immunology - Immunological basis of graft rejection - Clinical manifestations - Immunosuppressive therapy and privileged sites	8

Suggested readings:

1. Lehninger, AL "Principles of Biochemistry".
2. Lubert Stryer "Biochemistry".
3. Voet & Voet "Biochemistry".
4. Alan Fersht "Enzyme Structure and Mechanism".
5. David S. Sigman, Paul S. Sigman "The Enzymes: Mechanisms of Catalysis".
6. Trevor Palmer and Philip Bonner 2008 Enzymes Biochemistry, Biotechnology, Clinical Chemistry, 2nd edn EWP
7. Gerhartz W 2003 Enzymes in Industry Production and Applications, Wiley VCH
8. Wilson, K and Walker, J (eds 2000 Principles and Techniques of
9. Practical Biochemistry, 5th edn Cambridge University Press Palmer "Enzymes"
10. Dixon & Webb "Enzymes"

11. Kuby Immunology (2007) 6th ed., Kindt, T.L., Goldsby, R.A. and Osborne, B.A., W.H Freeman and Company (New York)
12. William, E. Paul (1989) Fundamental Immunology, 2nd Edition Raven Press, New York.
13. William, R. Clark (1991) the Experimental Foundations of Modern Immunology (4th Edition) John Wiley and Sons, New York.
14. Basic Immunology, A.K. Abbas and A.H. Lichtman, Saunders W.B. Company
15. Fundamentals of Immunology, W. Paul, Lippincott Williams and Wilkins
16. Immunology, W.L. Anderson, Fence Creek Publishing (Blackwell).



Programme/Class: DIPLOMA		Year: SECOND	Semester: FOURTH
Course Code: B110402 P		Course Title: Enzymes and Immunological Techniques Lab	
Course outcomes- After the successful course completion, learners will develop following attributes:			
• Know how to isolate enzyme and determine enzyme activity. • Know how to study the effect of pH and temperature on the enzyme activity. • Know how to study the effect of varying substrate and inhibitor concentration on the enzyme activity • Know how to detect Amino acids by Paper chromatography and TLC • This course aims to develop the understanding of basics of immunology, types of Blood grouping, cell counts, ELISA, Ouchterlony Double diffusion (ODD) and Separation of serum from blood & precipitation of Immunoglobulins • It will also give them an opportunity to get hands on experience to develop their experimental skills expected from any biochemist working in a pathology/diagnostic research lab.			
Credits: 4		Core Compulsory	
Max. Marks: 25+75		Passing Marks: As per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4			
UNIT	Topic	Total No.of Lectures	
	• Isolation of enzyme and determination of enzyme activity • Study of the effect of pH on the enzyme activity. • Study of the effect of varying substrate concentration on the enzyme activity and determination of Km and Vmax. • Study of the effect of temperature on the enzyme activity. • Study of the effect of inhibitors on the enzyme activity. • Blood grouping • Differential Count of WBC • Detergent lysis of RBC • Dot ELISA • ELISA – Demonstration • Ouchterlony Double diffusion (ODD) • Separation of serum from blood & precipitation of Immunoglobulins	60	
Suggested Readings: 1. Clark & Switzer Experimental Biochemistry. Freeman (2000) 2. Trevor Palmer and Philip Bonner 2008 Enzymes Biochemistry, Biotechnology, Clinical Chemistry, 2 ndedn FWP			



3. Wilson, K and Walker, J ..(eds 2000 Principles and Techniques of Practical Biochemistry, 5th edn Cambridge University Press
4. Kuby Immunology (2007) 6th ed., Kindt, T.L., Goldsby, R.A. and Osborne, B.A., W.H Freeman and Company (New York)
5. William, E. Paul (1989) Fundamental Immunology, 2nd Edition Raven Press, New York.
6. William, R. Clark (1991) the Experimental Foundations of Modern Immunology (4th Edition) John Wiley and Sons, New York.
7. Basic Immunology, A.K. Abbas and A.H. Lichtman, Saunders W.B. Company



Programme/Class: DEGREE	Year: THIRD	Semester: FIFTH
Course Code: BI10501 T	Course Title Bioenergetics and Metabolism	
Course outcomes: The learners will be able to: • Understand the concepts of metabolism, characteristics of metabolic pathways and strategies used to study these pathways. • Gain a detailed knowledge of various catabolic and anabolic pathways • Understand the regulation of various pathways • Gain knowledge about the diseases caused by defects in metabolism with emphasis on the metabolic control		
Credits: 4	Core Compulsory	
Max. Marks: 25+75	Min. Passing Marks:	
Total No. of Lectures (in hours per week):		

Unit	Topics	No. of Lectures
I	Principle of Bioenergetics: • Bioenergetics and thermodynamics. • Laws of Thermodynamics • Gibbs free energy, enthalpy • Entropy and their relationships • Free energy change • ATP as universal currency in biological system • Coenzymes and proteins as universal electron carriers	6
II	Oxidative phosphorylation • The electron transport chain - its organization and function • Peter Mitchell's chemiosmotic hypothesis and Proton motive force • FoF₁ATP synthase, structure and mechanism of ATP synthesis • Metabolite transporters in mitochondria • Regulation of oxidative phosphorylation • ROS production and antioxidant mechanisms • Oxidative phosphorylation and ATP synthesis uncouplers	6
III	Carbohydrate Metabolism: • Glycolysis • TCA cycle • Electron Transport Chain • Pentose phosphate pathway • Gluconeogenesis and Glycogen metabolism • Diseases associated with metabolic irregularities.	8
IV	Photosynthesis • Light harvesting and photosynthetic electron transport • Water splitting, formation of H⁺ gradient and photophosphorylation • Calvin cycle, and its regulation	8

	• Photo respiration • C4 and CAM pathways in plants	
V	Lipid Metabolism: • Degradation of fatty acids • β oxidation • regulation of fatty acid oxidation • ω oxidation and α oxidation • Ketone-body metabolism • Cholesterol synthesis • Fatty acid synthase complex enzyme • Synthesis of saturated, unsaturated, odd and even chain fatty acids • Regulation of fatty acid metabolism • Diseases associated with abnormal lipid metabolism	8
VI	Protein Metabolism • Urea Cycle • Transport of ammonia • Deamination and transamination reactions • Inborn errors of protein metabolism • Glucogenic and ketogenic amino acids • Overview of amino acid synthesis	8
VII	Nucleic Acid Metabolism • De novo synthesis of purine and pyrimidine nucleotides • regulation and salvage pathways • degradation of purine and pyrimidine nucleotides • Inhibitors of nucleotide metabolism • Disorders of purine and pyrimidine metabolism	8
VIII	Nitrogen metabolism • Biological nitrogen fixation by free living and in symbiotic association Structure and function of the enzyme nitrogenase • Nitrate assimilation: Nitrate and Nitrite reductase • Primary and secondary ammonia assimilation in plants • ammonia assimilation by glutamine synthetase-glutamine oxoglutarate amino transferase (GS-GOGAT) pathway	8

Suggested readings :

1. Lehninger, Albert, Cox, Michael M, Nelson, David L. (2017) *Lehninger principles of biochemistry*. New York: W. H. Freeman.
2. Voet, D., & Voet, J. G. (2011) *Biochemistry*. New York: J. Wiley & Sons
3. *Biochemistry – Lubertstryer* Freeman International Edition.
4. *Biochemistry – Keshav Trehan* Wiley Eastern Publications
5. *Fundamentals of Biochemistry* - J. L. Jain S. Chand and Company
6. Voet & Voet: *Biochemistry* Vols 1 & 2: Wiley (2004)
7. Murray et al: *Harper's Illustrated Biochemistry*: McGraw Hill (2003) Elliott and Elliott:
8. *Biochemistry and Molecular Biology*: Oxford University Press
9. Taiz, L., Zeiger, E., *Plant Physiology*. Sinauer Associates Inc., U.S.A. 5th Edition

10. Hopkins, W.G., Huner, N.P., Introduction to Plant Physiology. John Wiley & Sons,

Programme/Class: DEGREE	Year: THIRD	Semester: FIFTH
Course Code: BI10502 T	Course Title Fundamentals of Microbiology	
Course outcomes: After the successful course completion, learners will develop following attributes		
• Know the basics of microbiology • Have knowledge of the general classification of microbes • understand basics of Control of Microorganisms • Study microbes in extreme environments and microbial interactions • Know the basics of recombination in Prokaryotes • Food & Industrial Microbiology • Basics of virology		
Credits: 4	Core Compulsory	
Max. Marks: 25+75	Min. Passing Marks:	
Total No. of Lectures (in hours per week):		

Unit	Topics	No. of Lectures (60)
I	History of Microbiology • Spontaneous generation versus biogenesis • Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Alexander Fleming • Various forms of microorganisms (bacteria, fungi, viruses, protozoa, PPLOs)	6
II	Classification of microbiology • Nutritional classification of microorganisms • Nature of the microbial cell surface • Gram positive and Gram negative bacteria • Growth curve	8
III	Control of Microorganisms • Physical agents (Autoclave, Hot air oven, Laminar airflow and membrane filter.) • Chemical agents (Alcohol, Halogens and Gaseous agents antibiotics), Radiation Methods (UV rays)	8
IV	Pathogenicity of Microorganisms and Antimicrobial Chemotherapy • Introduction to pathogenic microbes, Bacteria, Viruses, Algae, protozoa and fungi • General Characteristics of antimicrobial drugs • determining the level of microbial activity • dilution susceptibility test and disc diffusion test • Range of activity and mechanism of action of penicillin, vancomycin and tetracycline	8
V	Microbes in extreme environments and microbial interactions	8

	• The thermophiles alkalophiles, acidophiles • symbiosis and antibiosis among microbial population • N₂ fixing microbes in agriculture and forestry.	
VI	Recombination in Prokaryotes • Transformation • Conjugation • Transduction	6
VII	Food and Industrial Microbiology • Importance of microbiology in food and industries • Basic design of fermenter • Continuous and discontinuous culture • Preparation of fermented food products such as yoghurt, curd and cheese. Preparation of alcoholic beverages like wine and beer • Single cell proteins • Treatment of wastewater and sewage bBioremediation and biodegradation	8
VIII	Brief outline of virology • Discovery of virus • Early development of virology • nomenclature • classification and taxonomy of viruses - based on host, nucleic acids and structure • Evolution of viruses	8
Suggested readings : • Brock Biology of Microorganisms 11th edition and Brock Biology of Microorganisms ILLUSTRATIONS ISBN 0-13-196893-9 © Prentice Hall • MICROBIOLOGY - AN INTRODUCTION, 8th edition Gerard J. Tortora, Bergen Community College by Berdell R. Funke, North Dakota State University Christine L. Case, Skyline College©2004 Pearson • J. Willey, L. Sherwood & C. Woolverton, Prescott's Microbiology, 10th Ed., McGraw Hill international, (2017). ISBN 13: 9781259657573 2. MJ Chan, ECS Krieg & NR Pelczar, Microbiology, 5th Ed. McGraw Hill International, (2004)		

Programme/Class: DIGREE		Year: THIRD	Semester: FIFTH
Course Code: B110503 P		Course Title: Microbial Techniques and Metabolism Lab	
Course outcomes			
- On successful completion of this paper, students should be able to: - Perform enzyme assay - Identify different microbes - Perform routine microbiological practices including sterilization, media preparation, maintenance of microbial culture, staining etc. - To carry out research using microbes. - To test microbial culture for antibiotic resistance.			
Credits: 4		Core Compulsory	
Max. Marks: 25+75 Min.		Passing Marks: As per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4			
UNIT	Topic	Total No. of Lectures	
	- Enzyme assay (one example) - Biochemical tests–starch hydrolysis, gelatin liquefaction. - Assay of salivary amylase. - Cholesterol estimation. - Cleaning and sterilization of glassware. - Study of instruments: Compound microscope, Autoclave, Hot air oven, pH meter, Laminar airflow and centrifuge - Media preparation: Nutrients agar, Nutrient broth and LB. - Staining Techniques: Simple, Negative staining, Gram staining, Endospore staining, fungal staining. - Isolation of bacteria and fungi from soil/ air/ water – dilution and pour plate methods - Study of Rhizobium from root nodules of legumes - Growth curve of bacteria	60	
Suggested Readings:			
- Wilson, K and Walker, J ..(eds 2000 Principles and Techniques of Practical Biochemistry, 5 thedn Cambridge University Press - M.T. Madigan, J.M. Martinko& D.A. Stahl, Brock Biology of Microorganisms, 13th Ed., Pearson Education International. (2010) - J.G. Cappuccino, and N. Sherman, Microbiology: A Laboratory manual, 10th Ed. Benajamin/ Cummings (2013)			

Programme/Class: DEGREE	Year: THIRD	Semester: SIXTH
Course Code: BI10601 T	Course Title: Cell, Molecular Biology and Genetic Engineering	
Course outcomes: After the successful course completion, learners will develop following attributes: • Distinguish between the cellular organization of prokaryotic and eukaryotic cells • Would have deeper understanding of cell at structural and functional level. • Will able to understand details of central dogma of life • Get proper knowledge about the DNA manipulative enzymes: Restriction enzymes and DNA ligases, and Gene cloning vectors. • Gain knowledge about In vitro construction of recombinant DNA molecules vector DNA • learn about screening and selection of recombinant host cells, Gene Libraries, cloning techniques, Expression of cloned DNA • Have knowledge of Application of r-DNA technique in human health and quality crop production		
Credits: 4	Core Compulsory	
Max. Marks: 25+75	Min. Passing Marks:	
Total No. of Lectures (in hours per week):		

Unit	Topics	Total no. of Lectures (60)
I	Cell Biology: • Intracellular organization: • Cell Membrane, Fluid Mosaic Model, and membrane transport. • Structure and functions of organelles, • Prokaryotic and eukaryotic cell wall, • Cell cycle, cell death and cell renewal: • Eukaryotic cell cycle, restriction point, and checkpoints. • Cell division: Mitosis and Meiosis. • Apoptosis and necrosis	4
II	• Fundamental principles of cell signalling. Concept of signalling as a two-box system • G-Protein and Receptor Tyrosine Kinase mediated signalling • Elements of eukaryotic cytoskeleton. Organisation and dynamics of actin microfilaments and microtubules • Endomembrane system, secretory pathways and vesicular trafficking	8
III	Basics of Molecular Biology: • Central dogma of Life • Organization of Genetic Material, • DNA Replication • Prokaryotic- Enzymes and proteins involved in replication • Spontaneous and induced mutations, • Physical and chemical mutagens,	10

	• Mutation at the molecular level, • DNA damage & Repair • Mutations in plants, animals, and microbes for economic benefit of man.	
IV	Transcription: • Transcription in prokaryotes, • Mechanism, Promoters • RNA polymerase • Transcription factors	8
V	Translation: • Genetic code, • Properties and Wobble hypothesis. • Translation: Mechanism of translation in Prokaryotes • Regulation of Gene expression: • Regulation of Gene expression in Prokaryotes: • Operon concept (Lac)	8
VI	Recombinant DNA Technology: • DNA manipulative enzymes • Restriction enzymes and DNA ligases, • Gene cloning vectors: Plasmids, Bacteriophage and Chimeric plasmids, • Creation of r-DNA, • Transformation of r-DNA by different methods, • Screening and selection of recombinant host cells, • Gene Libraries: Genomic DNA and cDNA cloning techniques	8
VII	Applications of r-DNA technique in human health • Production of Insulin, • Production of recombinant vaccines: Hepatitis B, • Production of human growth hormone	6
VIII	Transgenic plants • Methods of plant transformation • Agrobacterium mediated plant transformation • Application of plant genetic engineering: • Insect resistance, • Disease resistance, • Herbicide resistance • Abiotic stress tolerance • Delayed fruit ripening	8

Suggested readings :

1. Lehninger, Albert L., Cox, Michael M Nelson, David L. (2017) *Lehninger principles of biochemistry* New York : W.H Freeman
2. Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., & Losick, R. M. (2013). **Molecular biology of the gene**
3. Voet, D., & Voet, J. G. (2011). *Biochemistry*. New York: J. Wiley & Sons

4. Ulrich Hubscher, Giovanni Maga, and Silvio Spadari (2007), Eukaryotic dna polymerases Annu. Rev. Biochem. 2002. 71:133–63 DOI:10.1146/annurev.biochem.71.090501.150041.
5. Smita Rastogi and Neelam Pathak (2009), Genetic Engineering, Oxford University Press.
6. Gene Cloning and DNA Analysis (2010) 6th ed., Brown, T.A., Wiley-Blackwell publishing (Oxford, Principles of Gene Manipulation and Genomics (2006) 7th ed., Primrose, S.B., and Twyman, R. M., Blackwell publishing (Oxford, UK)
7. Molecular Biotechnology: Principles and Applications of Recombinant DNA (2010) 4th ed., Glick B.R., Pasternak, J.J. and Patten, C.L., ASM Press (Washington DC).
8. Molecular Cloning: A laboratory manual (2014), 4th ed., Michael R Green and J. Sambrook Cold spring Harbor laboratory press (3vol.), ISBN: 978-1-936113-42-2



Programme/Class: DEGREE	Year: THIRD	Semester: SIXTH
Course Code: B110602 T	Course Title: Biochemistry of health and disease, Plant and Animal Hormones	
Credits: 4	Core Compulsory	
Max. Marks: 25+75	Min. Passing Marks:	
Total No. of Lectures (in hours per week):		

Unit	Topics	No. of Lectures (60)
I	Importance of Clinical Biochemistry.* Sources of variation in clinical biochemistry: Analytical, Physiological. Reference Ranges. Clinical Utility: Sensitivity and. Specificity. False positives, false negatives. Specimens used in clinical biochemistry: Collection, storage and use of blood, plasma, serum. Urine. Saliva, other tissues. Significance and limitations.	10
II	Commonly measured analytes in blood: Complete Blood Count: Hemoglobin, hematocrit, total and differential leukocyte count, microscopy of erythrocytes. Plasma proteins.	8
III	Blood glucose: Maintenance. Significance. Glucose tolerance test. The glycemic index. Renal function tests: Kidney functions. Kidney diseases. Blood urea. Serum creatinine. GFR. Applications for disease diagnosis.	8
IV	Lipoproteins: Classification. Properties. Functions. Diagnosis of dyslipidemia.	6
V	The meaning of disease: Categorization of diseases: Climatic and Environmental factors in disease: Disorders related to heat and cold.	8
VI	A brief overview of the following categories of diseases: Nutritional diseases: Marasmus, Kwashiorkor, Beri beri, Scurvy, Rickets Metabolic diseases: Diabetes, Obesity, Alkaptonuria, Phenylketonuria, Goitre Parasitic diseases: Dengue, malaria Bacterial diseases: Plague, Diphtheria, Typhoid, Bacillary dysentery, Cholera Viral diseases: Measles, Mumps, Chicken pox, AIDS, Hepatitis	10
VII	Plant Hormones • Classification, structural features & functions in Plants • Auxins, gibberellins, Cytokinins, ethylene, and abscisic acid	5
VIII	Animal Hormones • Classification, structural features & Functions of hormones secreted by endocrine glands: Hypothalamus, pituitary gland- anterior	5

	pituitary and posterior pituitary, thyroid gland, adrenal gland, Pancreas, gonads	
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Programme/Class: DIGREE	Year: THIRD	Semester: Sixth
Course Code: B110603 P	Course Title: Genetic Engineering and Bioinformatics Lab	
Course outcomes On completion of this course, students will be able to: • Isolate genomic DNA from bacteria, plant and animal tissues • Isolate plasmid DNA (E. coli) • Perform restriction digestion of DNA • Perform Agarose Gel Electrophoresis • Develop understanding of Bioinformatics as tools for Sequence Alignment, FASTA & BLASTsearch, Multiple Sequence Alignment, Protein Structure Visualization, as well as for Gene Finding		
Credits: 4	Core Compulsory	
Max. Marks: 25+75 Min.	Passing Marks: As per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4		
UNIT	Topic	Total No. of Lectures
	• Isolate genomic DNA from bacteria, plant and animal tissues • Isolate plasmid DNA (E. coli) • Perform restriction digestion of DNA • Perform Agarose Gel Electrophoresis • Learning to analyze data using SPSS or R software • Introduction to types of sequence databases (Nucleotides & Protein) • Pair wise Sequence Alignment (NW and SW approach) • FASTA & BLAST search • Multiple Sequence Alignment (ClustalX&Treeview)	60
Suggested Readings: 1. Molecular Cloning: A laboratory manual (2014),4nd ed., Michael R Green and J. SambrookCold spring Harbor laboratory press (3vol.), 2. Bioinformatics – Principles and Applications (2008), 1st ed. Ghosh, Z. and Mallick, B., Oxford University Press (India)		

 