

DEPARTMENT OF BIOCHEMISTRY
B.Sc. (in Faculty of Life Science)
(Based on Choice Based Credit System)
SUBJECT: BIOCHEMISTRY
SYLLABUS
Under NEP-2020

SEMESTER WISE PAPER TITLES WITH DETAILS

| Sem. | Course Code | Papertitle | CIE | End Semester Examination | Total | Credits | Teachinghours |
|-------------------------------------------------------------------------------------------------|-------------|---------------------------------------------------------------------------------------|-----|--------------------------|-------|---------|---------------|
| B. SC. 1ST YEAR OR CERTIFICATE COURSE IN CLINICAL BIOCHEMISTRY | | | | | | | |
| I | BCB101T | Fundamentals of Biochemistry | 25 | 75 | 100 | 4 | 60 |
| | BCB102P | Biosafety Measures, Preparation of Solutions and Qualitative Analysis of Biomolecules | 25 | 75 | 100 | 2 | 60 |
| II | BCB201T | Human Physiology and Clinical Biochemistry | 25 | 75 | 100 | 4 | 60 |
| | BCB202P | Clinical Biochemistry Lab | 25 | 75 | 100 | 2 | 60 |
| B. SC. 2ND YEAR OR DIPLOMA IN TOOLS AND TECHNIQUES IN BIOCHEMISTRY | | | | | | | |
| III | BCB301T | Tools and Techniques in Biochemistry | 25 | 75 | 100 | 4 | 60 |
| | BCB302P | Biochemical Tools and Techniques Lab. | 25 | 75 | 100 | 2 | 60 |
| IV | BCB401T | Enzymology and Immunology | 25 | 75 | 100 | 4 | 60 |
| | BCB402P | Enzymes and Immunological Techniques Lab | 25 | 75 | 100 | 2 | 60 |
| B. SC. 3RD YEAR OR Degree in Bachelor of Science (in Faculty of Life Science) | | | | | | | |
| V | BCB501T | Bioenergetics and Metabolism | 25 | 75 | 100 | 4 | 60 |
| | BCB502T | Fundamentals of Microbiology | 25 | 75 | 100 | 4 | 60 |
| | BCB503P | Microbial Techniques and Metabolism Lab | 25 | 75 | 100 | 2 | 60 |
| VI | BCB601T | Cell, Molecular Biology and Genetic Engineering | 25 | 75 | 100 | 4 | 60 |
| | BCB602T | Biostatistics, Bioinformatics and computer application in Biochemistry | 25 | 75 | 100 | 4 | 60 |
| | BCB603P | Genetic Engineering and Bioinformatics Lab | 25 | 75 | 100 | 2 | 60 |

SUBJECT PREREQUISITE

To study Biochemistry at undergraduate, a student must have Chemistry, Biology and /or Biotechnology in Class 12.

PROGRAMME OUTCOMES(POS)

After completion of the B. Sc. Biochemistry programme, the candidate should be able to:

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| PO1 | 1. The programme has been designed in such a way so that the students get exposed to strong theoretical and practical background on various domains of biochemistry. |
| PO2 | 2. The programme includes details of biomolecules, clinical biochemistry, tools and techniques, enzymes, immunology, cell biology, molecular biology genetic engineering followed by biostatistics and bioinformatics to make the study of living system more interesting and relevant to human studies which is the need of hour. |
| PO3 | 3. The practical courses have been designed to equip the students with the laboratory skills in biochemistry. Students will be able to design and conduct experiments, as well as to analyze and interpret scientific data |
| PO4 | 4. The programme will provide students with the knowledge and skill base that would enable them to undertake further studies in biochemistry and related areas or in multidisciplinary areas that involve biochemistry and help develop a range of generic skills that are relevant in enhancing entrepreneurship skills among students |
| PO5 | 5. The students will be exposed to a wide range of careers that combine biology, plants and medicine. |

PROGRAMME SPECIFIC OUTCOMES(PSOS)**CERTIFICATE COURSE IN CLINICAL BIOCHEMISTRY**

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| First Year | <ul style="list-style-type: none"> • This course introduces fundamentals of structure and function of biomolecules. Students will be able to develop an understanding of: the inter relationships within and between anatomical and physiological systems of the human body. • The students will develop the understanding of basic concepts of clinical biochemistry, they would also understand disorder related with bio molecules metabolism • The students will learn the basic principles of biochemistry and how to prepare various types of solutions, buffers. The course develops the understanding of basic knowledge of Biomolecular testing. • The students will have hands-on training on qualitative estimation of important which will help them in getting employment in pathology labs and contribute to health care system. • This Certificate courses will enable students to apply for technical positions in government and private labs, academic and research institutes. |
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DIPLOMA IN TOOLS AND TECHNIQUES IN BIOCHEMISTRY

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| Second Year | <p>After completion of diploma course, students will be able to-</p> <ul style="list-style-type: none">• The students will be able to develop an understanding of: Principle, working and applications of Biochemical tools & techniques which prepares them for independent execution of laboratory experiments using the standard methods and techniques.• The objective of this course is to develop the understanding of the concepts of enzyme and enzyme kinetics.• The students will develop the understanding of basics of Immunology, types of Immune Responses, antigens and antibodies, histocompatibility, vaccines and Immunization.• The course aims to develop the understanding of the concepts of enzyme dynamics. The students will also have 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• The Diploma courses will ensure employability in Hospitals/Diagnostics and Pathology labs with good hands-on training. It will also enable students to take up higher studies and Research as their career and work in renowned national and international labs. Students can have their own start-ups as well. |
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DEGREE IN BACHELOR OF SCIENCE

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| Third Year | <p>After completing the three years degree course in Biotechnology, the students will be able to –</p> <ul style="list-style-type: none">• The student at the completion of the course will be able to have a detailed and conceptual understanding of molecular processes.• The students will be able to understand and apply the principles and techniques of molecular biology which prepares students for further career in molecular biology. Independently execute a laboratory experiment using the standard methods and techniques.• The principles of genetic engineering, gene cloning and related technologies will enable students to play an important role in applications of biotechnology in various fields like agriculture, forensic sciences, industry and human health and make a career out of it. Students can have their own start-ups as well.• The basic tools of bioinformatics will enable students to analyze large amount of genomic data and its application to evolutionary biology. Apply knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics existing software effectively to extract information from large databases and to use this information in computer modeling.• The Degree courses will enable students to go for higher studies like Masters and Ph.D in Biochemistry and Allied subjects. |
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| Programme/Class:Certificate | Year:First(1) | Semester:First(I) |
| Subject:Biochemistry | | |
| CourseCode:BCB101T | CourseTitle:Fundamental of Biochemistry | |
| Course Outcomes(COs) | | |
| <p>This course introduces the principles of cell biology and genetics. After completion of this course, students will be able to-</p> <p>Course outcomes: The student at the completion of the course will learn to understand:</p> <ul style="list-style-type: none"> • 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 • Classification, structural features and Function of Plant & Animal Hormone | | |
| Credits:4 | | Core Compulsory |
| Max.Marks CIE:25 Max.Marks End Semester Examination : 75 Total Max. Marks: 100 | | Min.Passing Marks CIE:09 Min.Passing Marks End Semester Examination : 26 Total Min. Passing Marks : 35 |
| Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P:4-0-0 | | |
| Unit | Topics | No. of Lectures Hours 60 |

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| I | Basics of Biochemistry <ul style="list-style-type: none"> • History of biochemistry with special reference to contribution of Indian biochemists. • General idea about normality, molarity, molality percentage solutions, mole fraction • Concept of pH determinations using indicators, buffer solutions and its biological importance water as universal solvent | 5 |
| II | Amino acids and proteins <ul style="list-style-type: none"> • Structural features and classification, Physical properties, optical properties (Stereoisomerism) • Chemical properties of amino acids • Classification of protein, structural organization as primary, secondary, tertiary and quaternary structure of protein and peptide bond | 10 |
| III | Carbohydrate <ul style="list-style-type: none"> • 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 |

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| IV | Lipids <ul style="list-style-type: none"> • 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 • | 10 |
| V | Nucleic acids <ul style="list-style-type: none"> • 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 | 10 |
| VI | Vitamin <ul style="list-style-type: none"> • Structure and active forms of water soluble and fatsoluble vitamins, • Deficiency diseases and symptoms, hypervitaminosis • Sources, dietary requirements | 5 |
| VII | Plant Hormones <ul style="list-style-type: none"> • Classification, structural features & functions in Plants: • Auxins, gibberellins, cytokinins, ethylene, and abscisic acid | 5 |
| VIII | Animal Hormones <ul style="list-style-type: none"> • Classification, structural features & Functions of hormones secreted by endocrine glands: Hypothalamus, pituitary gland- anterior pituitary and posterior pituitary, thyroid gland, adrenal gland, Pancreas, gonads | 5 |

Suggested Reading

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,*
11. *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.*
12. *Endocrinology (2007) 6th ed., Hadley, M.C. and Levine, J.E. Pearson Education (New Delhi), Inc. ISBN: 978-81-317-2610-5.*

Suggested Continuous Internal Evaluation (CIE) methods Total marks: 25

One Test/Assignments (hand written or typed 500 -1500 words)/Quizzes/ Presentation etc. (as decided by the teacher) carrying Maximum Marks 20 and a Viva-Voce/Class interaction of 5 marks.

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| Programme/Class:Certificate | Year:First(1) | Semester:First(I) |
| Subject:Biochemistry | | |
| CourseCode:BCB102P | CourseTitle:Biosafety Measures, Preparation of Solutions and Qualitative Analysis of Biomolecules | |
| CourseOutcomes(COs) | | |
| After completion of this course, students will be able to- <ul style="list-style-type: none"> • 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:2 | Core Compulsory | |
| Max.Marks CIE:25 | Min. Passing Marks CIE:09 | |
| Max.Marks End Semester Examination:75 | Min. Passing Marks End Semester Examination : 26 | |
| Total Max. Marks: 100 | Total Min. Passing Marks : 35 | |
| Total Number of Lectures-Tutorials-Practical (in hours per week) L-T-P:0-0-4 | | |
| | Suggested Lab/Virtual experiment | No. of Lectures/hours 60 |
| I | <ul style="list-style-type: none"> • 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 Reading | | |
| <ol style="list-style-type: none"> 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 | | |
| Suggested Continuous Internal Evaluation(CIE) | | |
| methods Total marks: 25 | | |
| One Practical Tests/Record/Chart/Model carrying Maximum Marks 20 and a Viva-Voce/Practical Class Interaction as decided by the concerned teacher/HOD) of 5 marks. | | |

| Programme/Class:Certificate | | Year:First(1) | Semester:Second(II) |
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| Subject:Biochemistry | | | |
| CouseCode:BCB201T | | CourseTitle:Human Physiology and Clinical Biochemistry | |
| CourseOutcomes(COs) | | | |
| Student will be able to- <ul style="list-style-type: none"> • 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 CIE:25 | | Min. Passing Marks CIE:09 | |
| Max.Marks End Semester Examination:75 | | Min. Passing Marks End Semester Examination : 26 | |
| Total Max. Marks: 100 | | Total Min. Passing Marks : 35 | |
| Total Number of Lectures-Tutorials-Practical (in hours per week) L-T-P:4-0-0 | | | |
| Unit | Topic | No. of Lectures/hours 60 | |
| I | Digestion and Respiration <ul style="list-style-type: none"> • Structural organization and functions of gastrointestinal tract and associated glands • Mechanical and chemical digestion of food, Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins, | 8 | |
| II | Circulation and Excretion <ul style="list-style-type: none"> • Components of blood and their functions Haemostasis: Blood clotting system, Blood groups: Rh factor, ABO and MN <ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • Structure of neuron, resting membrane potential • Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers • Types of synapse • Histology of different types of muscle, Ultra structure of skeletal muscle • Molecular and chemical basis of muscle contraction, | 8 | |
| IV | Basic concepts of Clinical Biochemistry <ul style="list-style-type: none"> • A Brief review of units and abbreviations used in expressing concentrations and standard solutions • Specimen collection and processing (Blood, urine, feces) • Anticoagulant preservatives for blood and urine • Transport of specimens | 8 | |

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| V | <p>Hematology: Blood</p> <ul style="list-style-type: none"> • Composition and their functions, • Anemia:- classifications, erythrocyte indices • Blood coagulation system, Clotting time, Bleeding time Prothrombin time, RBC count, WBC count, Platelet count Differential count | 8 |
| VI | <p>Disorders of Carbohydrate metabolism</p> <ul style="list-style-type: none"> • 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 | <p>Disorders of Lipid metabolism</p> <ul style="list-style-type: none"> • 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 | <p>Liver function test</p> <ul style="list-style-type: none"> • Types, differential diagnosis • Liver function test - Icteric index, Vandenberg test, plasma protein changes. Renal function test: Clearance test–Urea, Creatinine • Enzymology: Clinical significance of SGOT, SGPT, ALP, ACP, CPK and LDH | 8 |

Suggested Reading

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 Pysiology: 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, RanaShinde, 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

Suggested Continuous Internal Evaluation (CIE)

methodsTotalmarks: 25

One Test/Assignments(hand written or typed 500 -1500 words)/Quizzes/ Presentationetc.(as decided by the teacher)carrying Maximum Marks 20 and a Viva-Voce/Class interaction of 5 marks.

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| Programme/Class:Certificate | Year: First(1) | Semester: Second(II) |
| Subject:Biochemistry | | |
| CouseCode:BCB202P | CourseTitle:Clinical Biochemistry Lab | |
| CourseOutcomes(COs) | | |
| After completion of the course, the student shall be able to- <ul style="list-style-type: none"> To learn qualitative and quantitative analysis of constituents of biological fluids such as urine, blood and their estimation using standard methods. Students will be able to Perform basic hematological laboratory testing | | |
| Credits:2 | Core Compulsory | |
| Max.Marks CIE:25 Max.Marks End Semester Examination:75 Total Max. Marks: 100 | Min. Passing Marks CIE:09 Min. Passing Marks End Semester Examination : 26 Total Min. Passing Marks : 35 | |
| Total Number of Lectures-Tutorials-Practical (in hours per week) L-T-P:0-0-4 | | |
| | Suggested Lab/Virtual experiment | No. of Lectures |
| | <ul style="list-style-type: none"> 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 Reading | | |
| <ol style="list-style-type: none"> Medical Biochemistry by MN Chatterjee, Rana Shinde, 8 edition, 2013, Jaypee publications. Textbook of Medical Laboratory Technology by Praful B. Godkar and Darshan P. Godkar Medical Laboratory Technology by Ramniksood, 5 Edition, 1999, Jaypee publishers. Text book of Biochemistry with clinical correlation, Thomas M. Devlin, 3rd edition, A. John Wiley-Liss Inc. Publication. Practical Clinical Biochemistry, Harold Varley, 4th edition, CBS Publication and Distributors, New Delhi. | | |
| Suggested Continuous Internal Evaluation (CIE) methods | | |
| Total marks: 25 | | |
| One Practical Tests carrying Maximum Marks 20 and a Viva-Voce/Practical Class Interaction as decided by the concerned teacher/HOD) of 5 marks. | | |

| Programme/Class:Diploma | | Year:Second(2) | Semester:Third(III) |
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| Subject:Biochemistry | | | |
| CouseCode:BCB301T | | CourseTitle:Tools and Technique in Biochemistry | |
| CourseOutcomes | | | |
| <p>After successful completion of the course, student will be able to:</p> <ul style="list-style-type: none"> • 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 | | CoreCompulsory | |
| Max.Marks CIE:25 Max.Marks End Semester Examination:75 Total Max. Marks: 100 | | Min.PassingMarks CIE:09 Min.Passing Marks End Semester Examination : 26 Total Min. Passing Marks : 35 | |
| Total Number of Lectures-Tutorials-Practical (in hours per week) L-T-P:4-0-0 | | | |
| Unit | Topic | No. of Lectures 60 | |
| I | Basics of Biophysics <ul style="list-style-type: none"> • Chemical bonding – Ionic bond, covalent bond, hydrogen bond and Vander-Waals force. | 4 | |
| II | Chromatography <ul style="list-style-type: none"> • Introduction & Principle of Chromatography • Paper, thin-layer, column, • HPLC, GLC and molecular sieving., • Ion exchange chromatography • Affinity Chromatography | 10p | |
| III | Centrifugation <ul style="list-style-type: none"> • 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, | 10 | |
| IV | Electrophoresis: <ul style="list-style-type: none"> • Basic Principle of electrophoresis, • Gel electrophoresis, PAGE, SDS-PAGE, Native gels, denaturing gels • Agarose gel electrophoresis, | 8 | |
| V | Microscopy <ul style="list-style-type: none"> • Principle of light microscopy, • Phase contrast microscopy | 5 | |
| VI | <ul style="list-style-type: none"> • Fluorescence microscopy • Electron microscopy | 5 | |

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| VII | Radioactivity <ul style="list-style-type: none"> • Types, their importance in biological studies • Measure of radioactivity • GM counters and Scintillation counting. | 8 |
| VIII | Molecular Techniques <ul style="list-style-type: none"> • DNA sequencing, Polymerase Chain Reaction (PCR), • DNA fingerprinting, site directed mutagenesis. • Southern, Northern and Western Blotting | 10 |

Suggested Reading

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
1. Course Books published in Hindi must be prescribed by the Universities and Colleges.

Suggested Continuous Internal Evaluation (CIE) methods

Total Marks: 25

One Test/Assignments(hand written or typed 500 -1500 words)/Quizzes/ Presentation etc.(as decided by the teacher)carrying Maximum Marks 20 and a Viva-Voce/Class interaction of 5 marks.

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| Programme/Class:Diploma | Year:Second(2) | Semester:Third(III) |
| Subject:Biochemistry | | |
| CouseCode:BCB302P | CourseTitle: Biochemical Tools and Techniques Lab | |
| CourseOutcomes | | |
| <ul style="list-style-type: none"> 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:2 | | CoreCompulsory |
| Max.Marks CIE:25 Max.Marks End Semester Examination:75 Total Max. Marks: 100 | | Min.PassingMarks CIE:09 Min.Passing Marks End Semester Examination: 26 Total Min. Passing Marks : 35 |
| TotalNumberofLectures-Tutorials-Practical (inhoursperweek)L-T-P:0-0-4 | | |
| | Suggested Lab/Virtual experiment | No.of Lectures |
| | <ul style="list-style-type: none"> 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 PAG. | 60 |

Suggested Reading

- Narayanan, P (2000) Essentials of Biophysics, New Age Int. Pub. New Delhi.
- Roy R.N. (1999) A Text Book of Biophysics New Central Book Agency.
- Plummer D. T., An Introduction to Practical Biochemistry 3rd ed., Tata McGraw Hill Education Pvt. Ltd. 1998,
- Wilson K. and Walker J., Principles and Techniques of Biochemistry and Molecular Biology, 7th ed., Cambridge University Press, 2010

Suggested Continuous Internal Evaluation

(CIE)methodsTotalmarks: 25

One Practical Tests/Record/Chart/Model carrying Maximum Marks 20 and a Viva-Voce/Practical Class Interaction as decided by the concerned teacher/HOD) of 5 marks.

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| Programme/Class:Diploma | Year:Second(2) | Semester:Fourth(IV) |
| Subject:Biochemistry | | |
| CouseCode:BCB401T | CourseTitle:Enzymology and Immunology | |
| CourseOutcomes | | |
| <p>On the successful completion of the course, student will be able to:</p> <ul style="list-style-type: none"> • 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 | | CoreCompulsory |
| Max.Marks CIE:25 Max.Marks End Semester Examination:75 Total Max. Marks: 100 | | Min.PassingMarks CIE:09 Min.Passing Marks End Semester Examination : 26 Total Min. Passing Marks : 35 |
| Total Number of Lectures-Tutorials-Practical (in hours per week) L-T-P:4-0-0 | | |
| Unit | Topic | No.of Lectures 60 |
| I | Introduction to enzymes <ul style="list-style-type: none"> • 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. | 8 |
| II | <ul style="list-style-type: none"> • Enzyme kinetics • Relationship between initial velocity and substrate concentration Michaelis-Menten equation • Determination of K_M and V_{max}, K_{cat}, specificity constant • Effect of pH and temperature on the activity of enzymes. | 8 |
| III | <ul style="list-style-type: none"> • Enzyme inhibition and Regulation • Reversible inhibition (competitive, uncompetitive, non-competitive and mixed) • Irreversible inhibition • Substrate inhibition • Isoenzymes • Enzyme immobilization and its applications | 8 |

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| IV | <p>Introduction of Immunology</p> <ul style="list-style-type: none"> • 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 | 10 |
| V | <p>Histocompatibility</p> <ul style="list-style-type: none"> • Structure of MHC class I, II & III antigens and their mode of antigen presentation | 5 |
| VI | <ul style="list-style-type: none"> • Complement system: Components, Classical and alternate pathways of complement activation • Hypersensitivity | 5 |
| VII | <p>Vaccines and Immunization</p> <ul style="list-style-type: none"> • Passive and Active immunization • Types of Vaccines: Inactivated, Attenuated, Recombinant and Vaccines • Peptide and DNA Vaccines • RNA Vaccines | 8 |
| VIII | <p>Transplantation immunology</p> <ul style="list-style-type: none"> • Immunological basis of graft rejection • Clinical manifestations • Immunosuppressive therapy and privileged sites • Passive & active immunization. • Types of vaccines-DNA vaccines, recombinant vaccines, inactivated vaccine | 8 |

Suggested Reading

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).
1. Course Books published in Hindi must be prescribed by the Universities and Colleges.

Suggested Continuous Internal Evaluation (CIE) methods

One Test/Assignments (hand written or typed 500 -1500 words)/Quizzes/ Presentation etc. (as decided by the teacher) carrying Maximum Marks 20 and a Viva-Voce/Class interaction of 5 marks.

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| Programme/Class:Diploma | Year:Second(2) | Semester:Fourth(IV) |
| Subject:Biochemistry | | |
| CouseCode:BCB402P | CourseTitle: Enzymes and Immunological Techniques Lab | |
| CourseOutcomes | | |
| Course outcomes- After the successful course completion, learners will develop following attributes: | | |
| <ul style="list-style-type: none"> • 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:2 | | CoreCompulsory |
| Max.Marks CIE:25 Max.Marks End Semester Examination:75 Total Max. Marks: 100 | | Min.PassingMarks CIE:09 Min.Passing Marks End Semester Examination : 26 Total Min. Passing Marks : 35 |
| TotalNumberofLectures-Tutorials-Practical (inhoursperweek)L-T-P:0-0-4 | | |
| | Suggested Lab/Virtual experiment | No.ofLectures |
| | <ul style="list-style-type: none"> • 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 |
| SuggestedReading | | |
| <ol style="list-style-type: none"> 1. Clark & Switzer. Experimental Biochemistry. Freeman (2000) 2. Trevor Palmer and Philip Bonner 2008 Enzymes Biochemistry, Biotechnology, Clinical Chemistry, 2nd edn EWP 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 | | |
| Course Books published in Hindi must be prescribed by the Universities and Colleges | | |
| Suggested ContinuousInternal Evaluation (CIE) | | |
| Totalmarks: 25 | | |
| One Practical Tests/Record/Chart/Model carrying Maximum Marks 20 and a Viva-Voce/Practical Class Interaction as decided by the concerned teacher/HOD) of 5 marks. | | |

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| Programme/Class:Degree | Year:Third (3) | Semester:Fifth(V) |
| Subject:Biochemistry | | |
| CouseCode:BCB501T | CourseTitle: Bioenergetics and Metabolism | |
| CourseOutcomes | | |
| After completion of the course, students will be able to- <ul style="list-style-type: none"> • 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 | | CoreCompulsory |
| Max.Marks CIE:25 Max.Marks End Semester Examination:75 Total Max. Marks: 100 | | Min.PassingMarks CIE:09 Min.Passing Marks End Semester Examination : 26 Total Min. Passing Marks : 35 |
| Total Number of Lectures-Tutorials-Practical (in hours per week) L-T-P:4-0-0 | | |
| Unit | Topic | No. of Lectures 60 |
| I | Principle of Bioenergetics: <ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • The electron transport chain - its organization and function • Peter Mitchell's chemiosmotic hypothesis and Proton motive force • FoF1 ATP 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: <ul style="list-style-type: none"> • Glycolysis • TCA cycle • Electron Transport Chain • Pentose phosphate pathway • Gluconeogenesis and Glycogen metabolism | 8 |

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| IV | <p>Photosynthesis</p> <ul style="list-style-type: none"> • Photosynthesis dark reaction • Calvin cycle, regulation • C4 and CAM pathways in plants | 8 |
| V | <p>Lipid Metabolism:</p> <ul style="list-style-type: none"> • Degradation of fatty acids • β oxidation of saturated fatty acid • regulation of fatty acid oxidation • Ketone-body metabolism • Fatty acid synthase complex enzyme • Synthesis of saturated, unsaturated, odd and even chain fatty acids • Regulation of fatty acid metabolism | 8 |
| VI | <p>Protein Metabolism</p> <ul style="list-style-type: none"> • 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 | <p>Nucleic Acid Metabolism</p> <ul style="list-style-type: none"> • De novo synthesis of purine and pyrimidine nucleotides • regulation and salvage pathways • degradation of purine and pyrimidine nucleotides • Inhibitors of nucleotide metabolism | 8 |
| VIII | <p>Nitrogen metabolism</p> <ul style="list-style-type: none"> • Biological nitrogen fixation by free living and in symbiotic association Structure and function of the enzyme nitrogenase • Nitrate assimilation: Nitrate and Nitrite reductase • ammonia assimilation by glutamine synthetase-glutamine oxoglutarate amino transferase (GS-GOGAT) pathway | 8 |

Suggested Reading

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,

Suggested Continuous Internal Evaluation (CIE) methods

Total marks: 25

One Test/Assignments (hand written or typed 500 -1500 words)/Quizzes/ Presentation etc. (as decided by the teacher) carrying Maximum Marks 20 and a Viva-Voce/Class interaction of 5 marks.

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| Programme/Class:Degree | Year:Third (3) | Semester:Fifth(V) |
| Subject:Biochemistry | | |
| CourseCode:BCB502T | CourseTitle: Fundamentals of Microbiology | |
| CourseOutcomes(COs) | | |
| Course outcomes:After the successful course completion, learners will develop following attributes <ul style="list-style-type: none"> • 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 | | CoreCompulsory |
| Max.Marks CIE:25 Max.Marks End Semester Examination:75 Total Max. Marks: 100 | | Min.PassingMarks CIE:09 Min.Passing Marks End Semester Examination : 26 Total Min. Passing Marks : 35 |
| TotalNumberofLectures-Tutorials-Practical (inhoursperweek)L-T-P:4-0-0 | | |
| Unit | Topic | No.ofLectures 60 |
| I | History of Microbiology <ul style="list-style-type: none"> • Spontaneous generation versus biogenesis • Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Alexander Fleming • Various forms of microorganisms (bacteria, fungi, viruses, protozoa, PPLOs) | 8 |
| II | Classification of microbiology <ul style="list-style-type: none"> • Nutritional classification of microorganisms • Nature of the microbial cell surface • Gram positive and Gram negative bacteria • Growth curve | 8 |
| III | Control of Microorganisms <ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • The thermophiles alkalophiles, acidophiles • symbiosis. • N₂ fixing microbes in agriculture and forestry. | 8 |

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| VI | Recombination in Prokaryotes <ul style="list-style-type: none"> • Transformation • Conjugation • Transduction | 4 |
| VII | Food and Industrial Microbiology <ul style="list-style-type: none"> • 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 waste water and sewage Bioremediation and biodegradation | 8 |
| VIII | Brief outline of virology <ul style="list-style-type: none"> • 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 Reading

- 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)

Suggested Continuous Internal Evaluation (CIE) methods

Total marks: 25

One Test/Assignments(hand written or typed 500 -1500 words)/Quizzes/ Presentation etc.(as decided by the teacher)carrying Maximum Marks 20 and a Viva-Voce/Class interaction of 5 marks.

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| Programme/Class:Degree | Year:Third (3) | Semester:Fifth(V) |
| Subject:Biochemistry | | |
| CouseCode:BCB503P | CourseTitle: Microbial Techniques and Metabolism Lab | |
| CourseOutcomes(COs) | | |
| <p>Course outcomes</p> <ul style="list-style-type: none"> ● 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:2 | | CoreCompulsory |
| Max.Marks CIE:25 Max.Marks End Semester Examination:75 Total Max. Marks: 100 | | Min.PassingMarks CIE:09 Min.Passing Marks End Semester Examination : 26 Total Min. Passing Marks : 35 |
| TotalNumberofLectures-Tutorials-Practical (inhoursperweek)L-T-P:0-0-4 | | |
| | Suggested Lab/Virtual experiment | No.of Lectures |
| | <ul style="list-style-type: none"> ● 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 Reading | | |
| <ol style="list-style-type: none"> 1. Wilson, K and Walker, J ..(eds 2000 Principles and Techniques of Practical Biochemistry, 5 thedn Cambridge University Press 2. M.T. Madigan, J.M. Martinko& D.A. Stahl, Brock Biology of Microorganisms, 13th Ed., Pearson Education International. (2010) 3. J.G. Cappuccino, and N. Sherman, Microbiology: A Laboratory manual, 10th Ed. Benajamin/ Cummings (2013) | | |
| SuggestedContinuousInternalEvaluation(CIE)methods | | |
| <p>Total marks: 25 One Practical Tests/Record/Chart/Model carrying Maximum Marks 20 and a Viva-Voce/Practical Class Interaction as decided by the concerned teacher/HOD) of 5 marks.</p> | | |

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| Programme/Class:Degree | Year:Third (3) | Semester:Sixth(VI) |
| Subject:Biochemistry | | |
| CouseCode:BCB601T | CourseTitle: Cell, Molecular Biology and Genetic Engineering | |
| CourseOutcomes | | |
| Course outcomes:After the successful course completion, learners will develop following attributes: | | |
| <ul style="list-style-type: none"> • 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 CIE:25 Max.Marks End Semester Examination:75 Total Max. Marks: 100 | Min.PassingMarks CIE:09 Min.Passing Marks End Semester Examination : 26 Total Min. Passing Marks : 35 | |
| TotalNumberofLectures-Tutorials-Practical(inhoursperweek)L-T-P:4-0-0 | | |
| Unit | Topic | No.ofLectures 60 |

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| I | Cell Biology: <ul style="list-style-type: none"> • 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 | 8 |
| II | Central Dogma of Molecular Biology: <ul style="list-style-type: none"> • Organization of Genetic Material, • DNA Replication: • Prokaryotic- Enzymes and proteins involved in replication | 8 |
| III | Transcription: <ul style="list-style-type: none"> • Transcription in prokaryotes, • Mechanism, Promoters • RNA polymerase • Transcription factors | 8 |
| IV | Translation: <ul style="list-style-type: none"> • Genetic code, • Properties and Wobble hypothesis. • Translation: Mechanism of translation in Prokaryotes • Regulation of Gene expression: • Regulation of Gene expression in Prokaryotes • Operon model | 8 |

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| V | <p>Mutations:</p> <ul style="list-style-type: none"> • Spontaneous and induced mutations, • Physical and chemical mutagens, • Mutation at the molecular level, • DNA damage & Repair • Mutations in plants, animals, and microbes for economic benefit of man. | 4 |
| VI | <p>Recombinant DNA Technology:</p> <ul style="list-style-type: none"> • 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 | <p>Applications of r-DNA technique in human health</p> <ul style="list-style-type: none"> • Production of Insulin, • Production of recombinant vaccines: Hepatitis B, • Production of human growth hormone | 8 |
| VIII | <p>Transgenic plants</p> <ul style="list-style-type: none"> • 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 Reading

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

Suggested Continuous Internal Evaluation (CIE) methods

Total marks: 25

One Test/Assignments (hand written or typed 500 -1500 words)/Quizzes/ Presentation etc. (as decided by the teacher) carrying Maximum Marks 20 and a Viva-Voce/Class interaction of 5 marks.

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| Programme/Class:Degree | Year:Third (3) | Semester:Sixth(VI) |
| Subject:Biochemistry | | |
| CouseCode:BCB602T | CourseTitle: Biostatistics, Bioinformatics and computer application in Biochemistry | |
| CourseOutcomes | | |
| <p>Course outcomes:After the successful course completion, learners will develop following attributes:</p> <ul style="list-style-type: none"> • Understand the principles of biological data collection, statistical analysis and presentation. • Learn and appreciate various factors that influence type of sample collected and sample size. • Collect, analyze and interpret biological data using appropriate statistical tools • Improvise their computational, mathematical and computer skills, which would increase their eligibility to pursue research based higher education. • Formulate and justify appropriate choices in technology, strategy, and analysis for a range of projects involving DNA, RNA, or protein sequence data. • Explain common methods and applications for analysis of gene or protein expression. • Use data visualization software to effectively communicate results. | | |
| Credits:4 | | CoreCompulsory |
| Max. Marks CIE : 25 Max. Marks End Semester Examination:75 Total Max. Marks: 100 | | Min. Passing Marks CIE : 09 Min. Passing Marks End Semester Examination : 26 Total Min. Passing Marks : 35 |
| Total Number of Lectures-Tutorials-Practical (inhoursperweek)L-T-P:4-0-0 | | |
| Unit | Topic | No.ofLectures 60 |

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| I | <p>Handling of data</p> <ul style="list-style-type: none"> • Tabulation and diagrammatic representation of data • Bar diagram and pie diagram. • Measures of central tendency: mean, median and mode. • Measures of dispersion: range, quartile deviation, mean deviation and standard deviation. • Coefficient of variation. | 8 |
| II | <p>Tests of significance:</p> <ul style="list-style-type: none"> • Null hypothesis and alternative hypothesis, • Z-test, • Student's distribution, • Paired t – test, • F-test for equality of population variances. • Contingency table, • Chi-square test for goodness of fit and independence of attributes, Correlation analysis | 8 |
| III | <p>Computer basics</p> <ul style="list-style-type: none"> • Operating systems • Hardware, Software, • DOS, Data Access Using Data Control • Internet, LAN, WAN, Web servers. • Ms word office, excel ,powerpoint | 4 |
| IV | <p>Definition and need of Bioinformatics,</p> <ul style="list-style-type: none"> • Brief history of biological databases • International nucleotide databases (e.g., Gen Bank, European Molecular Biology Laboratory (EMBL) • Bio information and DNA Data Bank of Japan (DDBJ) | 8 |

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| | <p>Center)</p> <ul style="list-style-type: none"> • International Nucleotide Sequence Database Collaboration (INSDC). | |
| V | <p>Protein Databases</p> <ul style="list-style-type: none"> • Classification of protein databases (e.g., primary, secondary, and composite databases) • Brief overview of ExPASy (Expert Protein Analysis System) bioinformatics resource portal • Protein 3D structural databases (e.g., RCSB-PDB (Research Collaboratory for Structural Bioinformatics Protein Data Bank), and MMDB (Molecular Modeling Database) of NCBI) | 8 |
| VI | <p>Database Similarity Searches:</p> <ul style="list-style-type: none"> • BLAST, • FASTA, • PSI-BLAST, algorithms, • Multiple sequence alignments - CLUSTAL, PRAS. • Primer Designing, • Homology Modeling, • Phylogenetic analysis • Drug Designing, • Determination of Secondary & Tertiary of proteins. | 10 |
| VII | <p>Biological File Formats and Literatures Databases</p> <ul style="list-style-type: none"> • Brief overview of biological sequence and 3D structure file formats (e.g., GenBank/GenPept, EMBL, FASTA, PIR, and PDB), • NCBI's literature databases (e.g., PubMed, PubMed Central, PubChem Project and OMIM database) | 10 |
| VIII | <p>Database Similarity Searching and Phylogenetics</p> <ul style="list-style-type: none"> • Requirements of database searching, • BLAST (Basic Local Alignment Search Tool) algorithm, • Statistical significance and variants of BLAST • FASTA algorithm and its statistical significance • Comparison of BLAST and FASTA • Brief Overview of phylogenetic analysis | 4 |

Suggested Reading

1. Analysis of biological data, M. Whitlock and D. Schluter (2009), Roberts and company publishers
2. Principles of biostatistics, M. Pagano and K. Gauvreau (2000), Duxbury Thomas learnings
3. Protein Bioinformatics: From Sequence to Function, Academic Press, 2011, ISBN 0123884241, 9780123884244.
4. Essential Bioinformatics, Cambridge University Press, 2006, ISBN 113945062X, 9781139450621

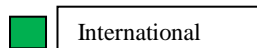
Kerns EH, Di L. Drug-Like Properties: Concepts, Structure Design and Methods: from ADME to Toxicity Optimization, Academic Press, Oxford, 2008

Suggested Continuous Internal Evaluation (CIE) methods Total

al marks: 25

One Test/Assignments(hand written or typed 500 -1500 words)/Quizzes/ Presentation etc.(as decided by the teacher)carrying Maximum Marks 20 and a Viva-Voce/Class interaction of 5 marks.

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| Programme/Class:Degree | Year:Third (3) | Semester:Sixth(VI) |
| Subject:Biochemistry | | |
| CouseCode:BCB603P | CourseTitle: Genetic Engineering and Bioinformatics Lab | |
| CourseOutcomes | | |
| <p>Course outcomes On completion of this course, students will be able to:</p> <ul style="list-style-type: none"> • 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 & BLAST search, Multiple Sequence Alignment, Protein Structure Visualization, as well as for Gene Finding | | |
| Credits:2 | CoreCompulsory | |
| Max. Marks CIE : 25 Max. Marks End Semester xamination:75 Total Max. Marks: 100 | Min. Passing Marks CIE : 09 Min. Passing Marks End Semester Examination : 26 Total Min. Passing Marks : 35 | |
| TotalNumberofLectures-Tutorials-Practical (inhoursperweek)L-T-P:0-0-4 | | |
| | Suggested Lab/Virtual experiment | No.ofLectures |
| | <ul style="list-style-type: none"> • 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 |
| SuggestedReading | | |
| <ol style="list-style-type: none"> 1. 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) | | |
| Suggested ContinuousInternal Evaluation (CIE): methods | | |
| Totalmarks 25 One Practical Tests/Record/Chart/Model carrying Maximum Marks 20 and a Viva-Voce/Practical Class Interaction as decided by the concerned teacher/HOD) of 5 marks. | | |



The Syllabus of B. Sc Biochemistry is designed to expose the students to recent exciting developments in the area of biochemistry internationally.