UNIT OPERATIONS [As per Choice Based Credit System (CBCS) scheme] SEMESTER-III			
Subject Code	15BT32	IA Marks	20
Number of Lecture Hrs./Week	04	Exam Marks	80
Total number of lecture hours	50	Exam Hours	03

CREDITS-04

Course objectives : This course will enable students

- To know the fundamental concepts of fluid mechanics, heat and mass transfer.
- To solve the engineering problems related to fluid flow, heat and mass transfer.
- To understand the design concepts of fluid and particulate technology.
- To design and operate the heat exchange equipment

MODULES	TEACHING HOURS	REVISED BLOOM'S TAXONOMY (RBT) LEVEL
MODULE – 1		
FLUID MECHANICS CONCEPTS Fluid definition and classification, Rheological behavior of fluids & Newton's Law of viscosity. Fluid statics-Pascal's law, Hydrostatic equilibrium, Barometric equation and pressure measurement(problems),Basic equations of fluid flow - Continuity equation, Euler's equation and Bernoulli equation; Types of flow - laminar and turbulent; Reynolds experiment; Flow through circular and non circular conduits - Hagen Poiseuille equation (no derivation).Flow past immersed bodies – drag and drag co-efficients, application of Kozney-Karmen & Burke Plummer equation; Flow through stagnant fluids – theory of Settling and Sedimentation – Equipments (cyclones, thickners) Conceptual numericals.	**10 Hours**	**L1, L2, L3,L4**
MODULE –2		
FLOW MEASUREMENTS & MECHANICAL OPERATIONS: Different types of flow measuring devices, flow measurements – Orifice meter, Venturimeter, Rotameter. Pumps – types of pumps (Centrifugal & Reciprocating pumps), application of Bernoulli's equation for Energy calculations in pumps.Properties and handling of particulate solids – characterization of solid particles, average particle size, screen analysis- Conceptual numericals of differential and cumulative analysis. Size reduction –	**10 Hours**	**L1, L2, L3,L4**

characteristics of comminuted products, crushing laws, working principle of ball mill., Mixing – types of mixers (ribbon and muller mixer), power number and power number calculation; Filtration & types, filtration equipments (plate and frame, rotary drum). Conceptual numerical		
MODULE – 3		
CONDUCTIVE & CONVECTIVE HEAT TRANSFER: Modes of heat transfer; Conduction – steady state heat conduction through unilayer and multilayer walls, cylinders; Insulation, critical thickness of insulation. Convection- Forced and Natural convection, principles of heat transfer co-efficents, log mean temperature difference, individual and overall heat transfer co-efficients, fouling factor; Condensation – film wise and drop wise (no derivation). Conceptual numericals.	**10 Hours**	**L1, L2, L3**
MODULE – 4		
HEAT TRANSFER EQUIPMENTS & BASICS OF MASS TRANSFER: Heat transfer equipments – double pipe heat exchanger, shell and tube heat exchanger. Diffusion - Fick's law of diffusion. Types of diffusion. Steady state molecular diffusion in fluids at rest and laminar flow (stagnant / unidirection and bi direction). Mass, heat and momentum transfer analogies. Measurement of diffusivity, Mass transfer coefficients and their correlations. Interphase mass transfer- equilibrium, diffusion between phases. Conceptual numericals.	**10 Hours**	**L1, L2, L3,L4**
MODULE – 5		
MASS TRANSFER OPERATIONS: Distillation – Methods of distillation, distillation of binary mixtures using McCabe Thiele method. Liquid liquid extraction – equilibrium, stage type extractors (belt extraction and basket extraction). Drying- drying operations, batch and continuous drying. Conceptual numerical	**10 Hours**	**L2, L3, L5**
Course outcomes: After studying this course, students will be able to • State and describe the nature and properties of the fluids. • Study the different flow measuring instruments. • Study and understand the principles of various size reduction, conveying equipments, sedimentation and mixing tanks. • Comprehend the laws governing the heat and mass transfer operations to solve the problems.		

- Design the heat transfer equipment suitable for specific requirement.

Graduate Attributes (as per NBA)

- Engineering Knowledge
- Problem Analysis
- Design/development of solutions

Question Paper Pattern:

- The question paper will have ten questions
- Each full question consists of 16 marks.
- There will be 2 full questions (with a maximum of four sub questions) form each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module

TEXT BOOKS

1. Unit operations in Chemical Engineering by Warren L. McCabe , Julian C. Smith & Peter Harriot, McGraw-Hill Education (India) Edition 2014.
2. Transport Process Principles and Unit Operations by Christie Geankoplis, Prentice Hall of India.
3. Fluid Mechanics by K L Kumar, S Chand & Company Ltd.
4. Introduction to Chemical Engineering by Badger W.I. and Banchero, J.T., Tata McGraw Hill New York, 1997.
5. Mass Transfer Operations by Robert E. Treybal. McGraw-Hill Education

REFERENCE BOOKS

1. Principles of Unit Operations by Alan S Foust, L.A. Wenzel, C.W. Clump, L. Maus, and L.B. Anderson , John Wiley & Sons.
2. Engineering Fluid Mechanics by Kumar K.L. Eurasia Publishing House (P) Ltd., New Delhi, 1984.
3. Mechanics of fluids by B.S. Massey, Chapman & Hall Publishers.
4. Unit Operations of Chemical Engineering by Chattopadhyaya, Vol I & II , Khanna Publishers, Delhi-6, 1996.
5. Chemical Engineering by Coulson and Richardson., J.F., Vols I & II. Elsevier Science.
6. Process Heat Transfer by Kern D. Q., McGraw Hill, New York.
7. Heat Transfer by J P Holman, McGraw Hill International Ed.
8. Chemical Engineers Hand Book by Perry, McGraw Hill Publications

BIOCHEMISTRY [As per choice Based Credit System (CBCS) Scheme] SEMESTER III			
Subject Code	15BT33	I.A Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS 04

Course objectives: This course will enable students

- To learn basic principles of biochemistry occurring at cellular and molecular level in living organisms.
- To understand cross-functional nature of biochemistry in life sciences, food, agriculture, pharma, medicine.
- To apply the concepts in the clinical biochemistry aspects

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
MODULE-1		
BASIC CONCEPTS & BIOMOLECULES: Types of chemical reactions, pH, buffers and their properties, concentration of solutions. Stereo chemistry of carbon compounds. Carbohydrates, fats and lipids, structure and properties of phospholipids, glycolipids, steroids, amino acids and proteins. Classes of Enzymes with examples. Biologically important peptides, purines, pyrimidines, nucleic Acids- DNA and RNA.	**10 Hours**	**L1, L2**
MODULE-2		
BIOENERGETICS: Energy, energy flow cycle, energy conversion. Structure and properties of ATP. High energy compounds, Thermodynamic considerations, coupling reactions of ATP and NDP (Nucleotide di phosphate); photosynthesis, light reaction, dark reaction, ancillary Pigments, Photosystems PS I & II	**10 Hours**	**L1, L2,L4**
MODULE-3		
TRANSPORT MECHANISM: Biological membranes: structure, permeability, properties, passive transport and active transport, facilitated transport, energy requirement, mechanism of Na+ / K+, glucose and amino acid transport. Organization of transport activity in cell. Action Potentials. Role of transport in signal transduction processes.	**10 Hours**	**L1, L2,L3**

MODULE-4		
METABOLISM OF CARBOHYDRATES AND LIPIDS: Glycolysis –metabolism. Aerobic and anaerobic pathway and regulation, TCA cycle, NADPH Cycle, Glyoxylate cycle, Pentose Phosphate Pathway. Electron transport chain and oxidative phosphorylation, energetics, energy balance sheet, oxidative stress. Gluconeogenesis – regulation of gluconeogenesis. Biosynthesis of polysaccharides. Biosynthesis of fatty acids, cholesterol, phospholipids, glycolipids. Biodegradation of triglycerides and fatty acids.	**10 Hours**	**L1, L2,L3,L4**
MODULE-5		
METABOLISM OF AMINO ACIDS & NUCLEIC ACIDS: Biosynthesis and catabolism of essential amino acids: Lysine, Phenylalanine and Glutamine. Deamination, transamination and urea cycle. Metabolism and regulation of Purines, pyrimidine and precursors of nucleic acids (nucleosides & nucleotides).	**10 Hours**	**L1, L2, L3**

Course outcomes: After studying this course, students will be able to:

- Know about bio molecules
- Understanding basic metabolic pathways
- Understand metabolic regulations

Graduate Attributes (as per NBA):

- Lifelong learning.
- Problem Analysis
- Societal concern

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 16 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Principles of Biochemistry by Albert Lehninger, CBS publishers.
2. Biochemistry by Nelson and Cox, Palgrave Macmilan, Freeman Edn.
3. Principles of Biochemistry by Lubert Stryer, Freeman Int. Edition
4. Biochemistry by Mathews, Vanholde & Arhen, Pearson Education.
5. Biochemistry by Garett & Grisham Thompson Learning.
6. Bioenergetics by L Eruster, Greena Publishing Associates.
7. Fundamentals of Biochemistry by Dr.J.L.Jain, Sunjay Jain and Nitin Jain, S.Chand Publishers.

Reference Books:

1. Biochemistry by Voet &Voet, Wiley New York.
2. Biochemistry by Trehan. K, New Age International.
3. Biochemistry & Molecular Biology by Elliot, William H., Oxford University Press.
4. Biochemistry of cell signaling by Helmreich, Oxford University Press. 5. Bioorganic Chemistry by Hermann Dugas, Spinger.
5. Biochemistry by U Sathyanarayana, Books & Allied Publishers.
6. Biochemistry & Molecular Biology y Elliott & Elliott, Oxford Press Publishers, 4th Edition.
7. A textbook of Biochemistry for medical students by Rafi.M.D, 2nd edition, University Press.
8. A textbook of Biochemistry for medical students by Rafi.M.D, 2^{nd} edition, University Press.

MICROBIOLOGY [As per Choice Based Credit System (CBCS) scheme] SEMESTER III			
Subject Code	15BT34	I.A. Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS- 04

Course objectives: This course will enable students

- To learn the details of classification, structural features and functional aspects of prokaryotic and eukaryotic microorganisms.
- To gain insights into microbial metabolism and metabolic pathways.
- To understand the details of microbial techniques for growth, cultivation and characterization of microorganisms.
- To appreciate the recent developments in the area of medical microbiology, environmental microbiology, industrial microbiology, etc.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Levels
Module-1		
INTRODUCTION TO MICROBIOLOGY AND STUDY OF MICROORGANISMS: Scope of microbiology, History of microbiology, Origin of life, Prokaryotes and Eukaryotes. Microbial Diversity and Taxonomy. Structure, Classification and Reproduction of bacteria, Fungi, Viruses, Protozoa and Algae. General features of Prions, Spirochetes, Actinomycetes and Rickettsiae.	**10 Hours**	**L1,L2,L3**
MODULE-2		
METHODS AND TECHNIQUES IN MICROBIOLOGY: Microscopy: Concepts, Light, Electron, Phase Contrast, Acoustic Microscopy, camera Lucida and Micrometry. Media preparation, types of media, Culture methods, pure culture techniques, Staining Techniques. Sterilization & disinfection.	**10 Hours**	**L1,L2,L3**
MODULE-3		
MICROBIAL GROWTH AND METABOLISM: Growth curve patterns, Physical conditions required for growth. Metabolism; Primary and Secondary metabolites with examples, metabolic pathways important in Microorganisms-Respiration and Fermentation	**10 Hours**	**L1,L2,L3**
MODULE-4		
MEDICAL MICROBIOLOGY: Introduction to Medical Microbiology, Common diseases caused by microbes: Bacterial diseases: Typhoid, Diphtheria, Cholera, Tuberculosis, Leprosy, Plague, Syphilis,	**10 Hours**	**L1,L2,L3,L4**

Gonorrhea; Viral diseases: Herpes, Polio, Hepatitis, AIDS, Rabies, SARS and H1N1; Protozoan diseases: Malaria: common types of fungal infections.		
MODULE-5		
SOIL, ENVIRONMENTAL & INDUSTRIAL MICROBIOLOGY: Soil Microbiology: Soil micro flora and biogeochemical cycles. Bio fertilizers: VAM and Rhizobium. Atmospheric Microbiology: Aerobiology and allergy. Air sampling principles and types of samplers, Selective media for air sampling, significance of aerobiological studies. Aquatic Microbiology: Marine micro flora, fresh water microflora, Microbiology of potable water, Purification, Sewage disposal, Microbes in Bioremediation. Industrial Microbiology: Production of antibiotics (penicillin), Organic acids (citric acid), Enzymes from Microbes (proteases). Production of Vitamin B12.	**10 Hours**	**L2,L3,L5**

Course outcomes: After studying this course, students will be able to:

- Describe the structure and function of typical prokaryotic and eukaryotic cell structure like bacteria, algae, yeast & molds, protozoa, viruses, etc.
- Understand the techniques used for the isolation, growth, identification, disinfection and sterilization of microorganisms.
- Define the role of microorganisms towards environmental protection, industrial applications and infectious diseases.
- Out-line industrial fermentation processes leading to the production of antibiotics, organic acids, enzymes, vitamins and therapeutic products.

Graduate Attributes (as per NBA):

- Problem Analysis.
- Societal and environmental concern.
- Innovation and entrepreneurship

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 16 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. General Microbiology by Roger Y Stanier, John L Ingraham, and Mark L Wheels, Macmillan Press Ltd.
2. Microbiology by Michael J Pelczar Jr Chan ECS, Noel R Krieg, Tata McGraw Hill Publishing co ltd.
3. Microbiology by Prescott, Harley, Klein, McGraw Hill.
4. Industrial Microbiology by Samuel C Prescott, Cecil G Dunn, Agro bios (India)
5. Palynology and its applications By Shripad N.Agashe, Oxfor and IBH publishing Pvt.

Ltd.
6. Biotechnological Applications of Microbes by Edite-Ajit Verma, IK Intl. Pub House.
7. Alcamos Fundamentals of Microbiology by Jeffery C Pommerville, Jones and Bartlett Publishers.
8. Microbiology, an Introduction, Gerard J. Tortora, Berdell R. Funke, Christine L. Case, 2012. Pearson
9. Principles of Microbiology: Ronald M Atlas, 1995.McGraw-Hill Inc., US (addition)
10. Microbiology: Principles and Explorations, Jacquelyn G. Black, 8thEdition, John Wiley & Sons,2012.
11. Roger Y Stanier, John L Ingraham, and Mark L Wheelis- General Microbiology, 5th EditionMacmillan Press Ltd.
12. Jacquelyn G. Black - Microbiology: Principles and Explorations, 8th Edition, John Wiley & Sons. Samuel C Prescott, Cecil G Dunn- Industrial Microbiology, 1st Edition- Agro bios (India

Reference Books:

1. The Air Spora: A manual for catching and identifying airborne biological particles. Maureen E. Lacey and Jonathan S. West. Springer.
2. Soil Microbiology by NS Subba Rao, Oxford and IBH.
3. Palynology and its applications By Shripad N.Agashe, Oxfor and IBH publishing Pvt. Ltd.
4. Text Book of Microbiology by Anantahnarayan and Jayaram Panicker, Universities Press.

CELL BIOLOGY AND GENETICS
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – III

Subject Code	15BT35	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS-04

Course objectives: This course will enable students:

- To gain basic concepts of cell biology and genetics.
- To understand cellular processes, pathways occurring at cellular level in living organisms.
- To learn and apply the Fundamental aspects of genetics in biotechnology.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Levels
MODULE-1		
CYTOSKELETON: Eukaryotic and prokaryotic cells, Plant and animal cells, brief mention of membrane organization. Cytosketal elements, Microtubules: structure & functions, shaping of the cells and mechanical support. Microfilaments: structure & functions. Structure of intermediate filaments. Cytoplasmic micro trabecular system (lattice). Covalent modifications of cytosketal proteins. Cytoskeletal architecture.	**10 Hours**	**L1, L2**
MODULE-2		
CELL STRUCTURE AND FUNCTION: Mitosis and Meiosis. Structure of cytoplasm, Nucleus, Mitochondria, Ribosome, Golgi bodies, Lysosomes. Endoplasmic Reticulum, Peroxisomes, Chloroplast and Vacuoles. Cell to cell integration, Cell locomotion (Amoeboid, Flagella, Cillar).Types of cell functions, cell division. Apoptosis and Ageing.	**10 Hours**	**L1, L2**
MODULE-3		
GENETICS: Nature of genetic material, Mendelian Laws of inheritance, monohybrid and dihybrid inheritance, law of segregation & independent assortment, Gene interactions, supplementary genes - Comb patterns in fowls, Complementary genes - Flower color in sweet peas, Epistasis- Inhibitory and colored genes in fowls, simple problems. Identification of genetic material, classical experiments- Hershey & Chase, Avery, McLeod etc., Multiple alleles and groups antigens. Numericals based on concepts.	**10 Hours**	**L1, L2**
MODULE-4		

CHROMOSOMES STRUCTURE AND ORGANIZATION & POPULATION GENETICS: Chromosome, Centrosome, telomere, Chemical composition of chromatin, structural organization of nucleosomes, heterochromatin. Polytene and lamp-brush chromosomes, human chromosomes. Introduction, Gene frequency, and equilibrium estimation, changes in gene frequency, inbreeding and heterosis, genetic structure of population, speciation and evolution, prospects for the control of human evolution. Spontaneous and induced mutations, Eugenics. Pedigree analysis.	**10 Hours**	**L1, L2, L3,L4**
MODULE-5		
SEX CHROMOSOMES AND INHERITED DISEASES: The organ of heredity, chromosomes, morphology, classification. Sex determination in plants, animals XX-XY, XX-XO, ZW-ZZ, ZO-ZZ types in animals. Chromosomal disorders. Sex linked inheritance molecular diseases, hemoglobinpathies. Disorders of coagulation, Color blindness, hemophilia, Non-disjunction as a proof of chromosomal theory of inheritance, Linkage maps, crossing over. Chromosomal maps, interference coincidence.	**10 Hours**	**L1, L2, L3, L4**

Course outcomes: After studying this course, students will be able:

- To gather contemporary knowledge of cell biology & genetics
- To be able to understand the basis of inherited disorders.

Graduate Attributes (as per NBA):

- Problem Analysis.
- Societal and environmental concern.
- Life-long learning.

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 16 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
  The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Cell Biology by Kimbal, Willey Pub.
2. Cell Biology by S C Rastogi, New Age International Pub.
3. Genetics by Monroe W Strickberger, Macmillan Pub. Newyork.
4. Principles of Genetics by Gardener, Simmons and Slustad. Wiley Pub.
5. Principles of Gene manipulation and Genomics by Primrose, Oxford University Press.
6. Genetics W Strick by Monroe, Macmillan Publication
7. Cell Biology by T.Devasana, Oxford Press publishers.

Reference Books:

1. Molecular Cell Biology by Darnell, and Baltimore, Freeman Pub.
2. Molecular Aspects of Cell Biology by Garret and Grisham. Cengage Learning.
3. Cellular & Biochemical Science by G. Tripathi, I K Intl.
4. Genes and Genomes by M Singer, and P Berg, Blackwell Scientific Pub.
5. Developmental Genetics by Gurbachan s & Miglani, I K Intl. Pub.
6. Problems on Genetics, Molecular Genetics and Evolutionary Genetics by Pranab Kr. Banerjee, New Central Book Agency.

BASICS OF COMPUTER APPLICATIONS
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – III

Subject Code	15BT36	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS-04

Course objectives: This course will enable students

- To gain knowledge about the different languages
- To gain the functioning and understanding the usage of internet, use of HTML in web-based designing
- To learn and implement different languages in biological applications
- To use of ontology for effective representation of data

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Levels
MODULE-1		
LINUX & XML : Introduction to Linux, basic commands, working with files, file attributes, installing programs using rpm, working with basic editors sed, awk and vi, using the shell, pipes, wildcards, checking processes, killing processes, basic decision making statements: if...then.... else...if - test - while...do...done - until...do...done - for...in..Do...done - case...in...esac - select...in...do., basic regular expressions, using grep command, string search applications using regular expressions. Structured and unstructured data, XML fundamentals, XML documents and XML files, elements and character tags, attributes, XML names, CDATA sections, XML declarations, DTD, element declarations, attribute declarations, namespaces, programming applications of XML; General features of NCBI's Molecular biology data model, BioXML, NeuroML, Chemical Markup Languages (CML), Microarray ML(MAML), RiboML and SBML.	**10 Hours**	**L1, L2**
MODULE-2		
INTERNET and DATABASE MANAGEMENT Internet Addresses, Internet Protocol, Transport layer, Upper layer protocols, Internet access and applications. Overview of HTML and HTTP; Web servers, Web access, Security, WWW (World Wide Web) proxies, HTML applications related to biotechnology. Novell's WWW service, Web based applications, Biology search	**10Hours**	**L1, L2,L3**

engines, legal and ethical issues. Introduction to flat files, DBMS and RDBMS, E-R relationship, Introduction to SQL, basic commands, using SQL in MS Access, creating and modifying tables, joining tables, simple queries using SQL, inner join, outer joins.		
MODULE -3		
ONTOLOGIES and MATLAB Overview of ontologies, gene ontologies, Open biological ontologies (OBO) and its applications, TAMBIS ontology, cell cycle ontology, GeneX ontology. Building ontology, ontology development tools (protégé 2000, GKB editor, OilEd), Ontology integration of bioontologies. Different types of data formats (CSV and tabbed formats for general file representation, data cleaning, flat file) Introduction to MATLAB, features of MATLAB toolbox, Usage of MATLAB towards bio statistical and biochemical applications. Modeling of biochemical and biotechnological systems using MATLAB scientific computing environment.	**10Hours**	**L1, L2, L3**
MODULE -4		
C++ CONCEPTS AND BIOPERL Overview of C programming concepts, Variables, Operators, Statements, Functions and Pointers. Introduction to Classes, Objects, C++ string classes, Introduction to OOPs concepts with respect to C++ (Encapsulation, polymorphism, Inheritance, Abstraction, Dynamic binding), data types, Arrays. Introduction to basic concepts of Bioperl.	**10Hours**	**L1, L2, L3, L4**
MODULE -5		
APPLICATIONS OF C AND C++ IN BIOTECHNOLOGY Writing a C program using numerical analysis technique towards solving the differential equations to biotechnology (such as finding the thermal death kinetics of microorganisms, holding time for sterilization, estimating the length of the lag phase, calculation of specific growth rate, doubling time, and substrate-to-cell yield coefficient, etc.). Write a C++ Program to find the optimum pH and temperature for maximum enzyme activity, to derive the column height needed to achieve the specified degree of conversion in a fluidized-bed biofilm reactor, to find the optimal dilution rate for maximum cell productivity, etc. Usage of NCBI's C++ tool kit to demonstrate certain features of sequence analysis.	**10Hours**	**L1-L6**

Course outcomes: After studying this course, students will be able to:

- Understand C- language with updated tool usage.
- Apply the basic concepts of MATLAB, Internet.
- Use the software with special reference to biotechnological applications.

Graduate Attributes (as per NBA):

- Computational Knowledge.
- Problem Analysis.
- Conduct investigations of complex computing problems
- Design / development of solutions.

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 16 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Linux: the complete reference by Richard Peterson, McGraw Hill.
2. Internet: The complete reference by Margaret Levine Young, Tata McGraw Hill.
3. C Programming by E Balaguruswamy, Tata McGraw Hill.
4. HTML and XML for beginners by Michael Morrison, Microsoft Press.
5. A study in Ontology by Peter Simons, Oxford Press.
6. Essential MATLAB for Scientists and Engineers by Arnold, Wiley, NY.
7. Beginning Perl for Bioinformatics by James Tisdall "O'Reilly Media, Inc".

Reference Books:

1. SAMS teach SQL in 10mins by Ben Forta, Williams Publishing.
2. Beginning XML by David Hunter, Wrox Press.
3. Introducing UNIX and LINUX by Mike Joy, Palgrave Macmillan.
4. SQL Simplified: Learn to read and write SQL by Cecelia. L. Allison, Jones and Bartlett.
5. SQL queries for mere mortals: A hands-on guide to data manipulation in SQL by Michael J. Hernandez and John. L. Viescas, Addison Wesley.

UNIT OPERATION LABORATORY [As per Choice Based Credit System (CBCS) scheme] SEMESTER – III			
Laboratory Code	15BTL37	IA Marks	20
Number of Lecture Hours/Week	01Hr Tutorial (Instructions) + 02 Hours Laboratory	Exam Marks	80
		Exam Hours	03
CREDITS – 02			

Course objectives: This laboratory course enables students to get practical experience in

1. Basic unit processes in industrial set up pertaining to fluid mechanics, mechanical operations.
2. Trouble shooting of problems related to fluid mechanics & Mechanical operations.

Laboratory Experiments: **A) Experiments based on principles of Fluid Mechanics & Mechanical Operations**	**Revised Bloom's Taxonomy (RBT) Level**
1. Friction losses in circular pipes	L4, L5
2. Flow measurements using Venturi /Orifice/ Rotameter.	L2, L3, L4
3. Centrifugal /Reciprocating pumps	L2, L3, L4
4. Packed bed flow	L5, L6
5. Batch sedimentation.	L5, L6
6. Ball Mill	L2, L3, L4
7. Cyclone separator	L5, L6
8. Leaf / Pressure filter	L2, L3, L4
9. Screen analysis/effectiveness.	L2, L3, L4
B) Experiments based on principles of Heat and Mass Transfer Operations.	
1. Natural convection in bare and finned tubes.	L2, L3, L4
2. Heat transfer in packed bed.	L5, L6
3. Heat transfer through DPHE	L5, L6
4. Critical thickness of insulation.	L5, L6
5. Diffusion of organic solvent in air.	L2, L3, L4
6. Simple Distillation.	L2, L3, L4
7. Steam Distillation.	L2, L3, L4

8. Single Stage Extraction.	L2, L3, L4
9. Drying-Tray dryer.	L2, L3, L4

Note: Minimum 12 experiments are to be conducted choosing at least 6 from sections A and B.

Course outcomes: On the completion of this laboratory course, the students will be able to:

1. Should be able to record observations systematically and arrive at required results based on experiments conducted.
2. Study and design different flow measuring instruments.
3. Understand and Estimate the shape and size of irregular particles

Graduate Attributes (as per NBA)

- Engineering Knowledge.
- Problem Analysis.
- Design/Development of solutions

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Students are allowed to pick one experiment from the lot.
3. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

Reference Book:

1. Principles of Unit Operations by Alan S Foust, L.A. Wenzel, C.W. Clump, L. Maus, and L.B.
2. Anderson, John Wiley & Sons.
3. Chemical Engineering by Coulson and Richardson. Vols I & II. Elsevier Science.
4. Chemical Engineers Hand Book by Perry, McGraw Hill Publications.
5. Process Heat Transfer by Kern, McGraw Hill.

MICROBIOLOGY LAB
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – III

Laboratory Code	15BTL38	IA Marks	20
Number of Lecture Hours/Week	01Hr Tutorial (Instructions) + 02 Hours Laboratory	Exam Marks	80
		Exam Hours	03

CREDITS – 02

Course objectives: This laboratory course enables students to get practical experience in:

- Working principle and use of Microbiological Lab equipment's like autoclave, incubators, LAF, microscope, etc.
- The basic laboratory techniques for isolation, characterization, enumeration and control of microorganisms.

Laboratory Experiments:	**Revised Bloom's Taxonomy (RBT) Level**
1. Study of Laboratory Instruments	L5,L4
2. Media preparation, Preparation of plates and tubes.	L2,L3,L4
3. Pure culture techniques (Streak, pour and spread - plates)	L1,L2,L3,L4,L5
4. Enumeration of microbes by Plate count and haemo-cytometer.	L2,L4,L5,L6
5. Determination of size of cell or fungal spores by Micrometry.	L2,L3,L5
6. Gram staining, Capsule staining, and endospore and flagella staining.	L2,L3,L4
7. Staining of fungi.	L2,L3,L4
8. Characterization of bacteria by Biochemical Tests: IMViC, Starch hydrolysis, carbohydrate fermentation, Catalase, Urease, hydrogen sulphide, Nitrate reduction.	L1,L2,L3,L4,L5,L6
9. Isolation of actinomycetes and rhizobium and their identification	L1,L2,L3,L4,L5
10. Determination of bacterial motility by hanging drop technique.	L1,L2,L3,L4
11. Growth curve studies.	L1,L2,L3,L4,L5
12. Antibiotic sensitivity tests.	L1,L2,L3,L4,L5

Course outcomes: On the completion of this laboratory course, the students will be able to:

- Use different laboratory equipment and instruments such as Microscope, Laminar Air Flow Station, Autoclave, oven, incubators.
- Prepare the media and use for the cultivation of the microorganisms.
- Perform laboratory experiments for the isolation, identification and characterization of microorganisms.
- Carry-out experiments for the enumeration, staining and control

Graduate Attributes (as per NBA)

- Problem Analysis.
- Design/Development of solutions.
- Professional ethics
- Societal and environmental concern.
- Modern tool usage.

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Students are allowed to pick one experiment from the lot.
3. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

Reference Book:

1. Microbiology: A Lab Manual by Cappuccino Pearson education, 2007
2. Lab Math by Dany Spencer Adams, IK Intl. Pub house.
3. Lab Ref by Jaine Roskams& Linda Rodgers IK Intl.Pub house.
4. Case-Microbiology: An Introduction by Gerard J. Tortora, Berdell R. Funke, Christine L. 11thEdition- Pearson publications.
5. Laboratory Manual Of Microbiology And Biotechnology by Aneja K.R. Medtec, 2014