Choice Based Credit System (CBCS)

Name of the Programme (UG): B.Tech

Syllabus for III - Semester and IV - Semester

With effect from 2017 - 2018

Specialization /Branch:Bio-Technology

Chaitanya Bharathi Institute of Technology (A)
Chaitanya Bharathi (P.O), Gandipet
Hyderabad-500075, Telangana State.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY(A)
Choice Based Credit System
B.Tech (Bio-Technology)

SEMESTER – III

S.No	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
THEORY								
1	16MT C06	Mathematics –III	3	-	3	30	70	3
2	16BT C05	Process Principles and Reaction Engineering	4	-	3	30	70	4
3	16BT C06	Biochemistry	4	-	3	30	70	4
4	16BT C07	Cell Biology	3	-	3	30	70	3
5	16BT C08	Microbiology	3	-	3	30	70	3
6	16BT C09	Genetics	3	-	3	30	70	3
PRACTICALS								
7	16BT C10	Biochemistry Lab	-	3	3	25	50	2
8	16BT C11	Microbiology Lab	-	3	3	25	50	2
9	16EG C03	Soft Skills and Employability Enhancement Lab	-	2	2	15	35	1
TOTAL			**20**	**8**	**-**	**245**	**555**	**25**

L: Lecture T: Tutorial D: Drawing P: Practical
CIE - Continuous Internal Evaluation SEE - Semester End Examination

Assessment Procedures for Awarding Marks

The distribution of marks is based on internal assessment (Sessional) by concerned teacher and the Semester end examination shall be as follows:

Course (in terms of credits)	CIE	Semester end Examination (Marks)	Remarks	Duration of Semester End Examination
Three(3) Credits/ Four(4) Credits	30*	70**	Theory Course/ Engg . Graphics	3 Hours
Two(2) Credits	20*	50***	Theory	2 Hours
Two(2) Credits	25	50	Lab Course/Workshop	3 Hours
One(1) Credit	15	35	Lab Course	2 Hours
Two(2) Credits	50	—	Project Seminar/Seminar	----
Six(6) Credits	50	100	Project	Viva
One(1) Credit	—	50***	Environmental Studies, Professional Ethics and Human values	2 Hours
One(1) Credit	50		Mini Project	-----

CIE: Continuous Internal Evaluation

* Out of 30/20 sessional marks(CIE), 10/5 marks are allotted for slip-tests(Three slips test will be conducted, each of 10/5 marks, best two average is considered) and the remaining 20/15 marks are based on the average of two tests, weightage for each test is 20/15 marks.

** The question paper will be in two parts, Part-A and Part-B. Part A is for Ten(10) questions and is compulsory, covers the entire syllabus, and carries 20 marks. Part-B carries 50 marks and covers all the units of the syllabus (student has to answer five out of seven questions)

***The question paper will be in two parts, Part-A and Part-B. Part A is for Ten(10) questions and is compulsory, covers the entire syllabus, and carries 15 marks. Part-B carries 35 marks and covers all the units of the syllabus (student has to answer five out of seven questions)

Note:A course that has CIE(sessional marks) but no semester end examination as per scheme, is treated as Pass/Fail for which pass marks are 50% of CIE.

A candidate has earned the credits of a particular course, if he/she secures not less than the minimum marks/ grade as prescribed. Minimum pass marks for theory course is 40% of total marks i.e., CIE plus semester end examinations where as for the lab course/project is 50%.

16MT C06

MATHEMATICS-III

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: To learn

1. Identifying limit of functions which are in Indeterminate Forms.
2. Understand the basic concept of continuity, differentiability and geometric interpretation of mean value theorems.
3. Concept of partial differentiation, maximum and minimum.
4. Identifying vector, scalar addition, multiplication, geometrical interpretation in 2D, 3D space.
5. Understand the concept of scalar and vector point functions of divergence and curl of vector functions and its physical interpretations.

Outcomes: On the successful completion of the course, the student shall be able to

1. Solve the limit problems by using L-Hospital rule.
2. Solve the problems based on Mean value theorems.
3. Solve maxima and minima problems.
4. Solve vector and scalar triple product related problems.
5. Solve divergence and curl related problems.

UNIT-I

Indeterminate Forms: Types of Indeterminate forms L-Hospital's rule to evaluation of limits in indeterminate forms $\frac{0}{0};\frac{\infty}{\infty};\infty-\infty;1^{\infty};\infty^{0};0^{0};0\times\infty$, Maclaurin's series and Taylor's series (without proof) for single variable.

UNIT-II

Mean value theorems: Fundamental theorem, Continuity and differentiability- Rolle's Theorem, Lagrange's theorem, Cauchy's theorem, Geometrical interpretations-related problems (statements only).

UNIT-III

partial differentiation-Homogeneous functions-Euler's theorem on homogeneous functions, Taylor's series of two variable, maxima and minima of functions one variable.

UNIT-IV

Vector Algebra : Addition of vectors, scalar multiplication, angle between two non zero vectors, linear combination of vectors, component of vectors in three dimensions, scalar product-geometrical interpretations- orthogonal projections, properties of dot product, angle between two vectors, vector product of two vectors and properties, scalar triple product, vectors triple products-results.

UNIT-V

Vector differentiation: Definitions- scalar and vector point functions, vector differential operator, Gradient, Divergence and Curl, Solenoidal and Irrational vectors, properties of gradient, divergence and curl (vector identities).

Text Books:

1. B.S.Grewal, "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, 2015.
2. N P Bali and Manish Goyal, "A Text Book of Engineering Mathematics", 9th Edition, Laxmi publishers, 2016.
3. Narayan Shanti and Mittal P.K. ," Differential Calculus" , 30th edition, S Chand publishers, 2005.

Suggested Reading:

1. A.R.Vasistha, "Matrices" , 43rd edition, Krishna Prakashan Media (P) Ltd. 2014.
2. A.R.K Jain and S.R.K Iyenger, "Advance engineering mathematics",3rd edition, Narosa publications, 2007.
3. Joseph Edwards, "Differential Calculus For Beginners", arihant publishers, 2016.
4. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th edition, Wiley publishers, 2015.

16BT C05

PROCESS PRINCIPLES AND REACTION ENGINEERING

Instruction	4 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	4

Course Objectives:

1. The aim of the course is to impart knowledge of the basic chemical engineering principles and techniques used in analyzing a chemical process.
2. This course also aims to enable the students to evaluate material and energy balances in different units.
3. Through this course the students are given an understanding of application of principles of unit operations and unit processes in biotech Industries.
4. This course aims at analyzing the kinetics of chemical reactions.
5. The aim of the course is also to give the students an understanding of the theory of biochemical reactors and enhanced skill in formulation and analysis of different types of reactors used in biochemical engineering.
6. The aim of the course is to impart knowledge of the animal and plant cell reactor technology.

Course Outcomes:

1. At the end of the course student should be able to solve the problems encountered in the preparation of material and energy balances of the process.
2. Be able to determine the flue gas composition from fuel composition and vice versa.
3. Be able to develop generalized flow sheets for different chemical processes.
4. Be able to write rate equations for any given chemical reaction.
5. Be able to perform basic design calculations of various reactors.
6. Be able to identify the reasons for non ideality.

UNIT 1:

DIMENSIONS AND SYSTEM OF UNITS

Fundamental quantities, derived quantities and conversions; SI and MKS system of Units; Basic Chemical Engineering calculations-Atomic, Molecular and Equivalent weights, molar concept, Concentration units for

pure components, Vapor pressures, Moles, Mixers and solutions, Molarity, Molality, Normality and Partial pressures; Laws of Chemical Combination; Definition of Stochiometry; Composition of mixers and solutions; Weight fraction; Mole fraction; Volumetric composition; Density and Specific gravity, Ideal gas law; Ideal mixtures and solution; Dalton's law of additive pressures; Amagots law of additive volumes.

UNIT II:
UNIT OPERATIONS IN BIOPROCESSES

Application of principles of unit operations and unit processes in biotech Industries, Application of principles of transport phenomenon (momentum, mass and heat transfer) in bioprocessing. Outline of an integrated bioprocess and the various (upstream and downstream) unit operations involved in bioprocesses, generalized process flow sheets. Laws of conservation of mass, meaning of material balance and its applications, Process flow sheet, Drawing material balance on non reacting steady system, Conversion, yield, Limiting reactants, Excess reactants, Recycling, By-passing, Material balances on steady state reacting systems with recycling and By-passing.

UNIT III:
MATERIAL BALANCES

Law of conservation of energy, Meaning of energy balance and its importance, Inputs of energy balance, Specific heat and sensible heat, Latent heat and heats of transition, Sublimation, Enthalpy of solutions, Standard heats of formation, Standard heats of combustion, Standard heats of reaction, Bess's law, Kirchoffs law, Determination of heat of reaction at temperature other than standard temperature using specific heat relationships, Combustion calculations, Combustion air requirements, determination of flue gas composition from fuel composition and vice versa.

UNIT IV:
INTRODUCTION TO REACTION KINETICS

Concepts of Reaction Kinetics, Types of reaction, order of reaction, The effect of temperature and pH on reaction rate. Rate equations and Reaction mechanisms; Interpretation of batch reactor data, constant volume batch reactor, integral method of analysis of data for reversible and irreversible reactions. Searching for mechanism - Arrhenius equation - Growth Kinetics: Batch growth quantifying cell concentration, chemostat growth,

UNIT V:

INTRODUCTION TO BIOREACTION ENGINEERING

Definitions, Differences and similarities between chemical and bioreactors; Classification of bioreactors; Reactor configurations; Description of a conventional bioreactor with all aspects; Design and construction criteria of a bioreactor; Residence time distributions, concentration, and temperature distributions; Models of non-ideal reactors.

Animal and plant cell reactor technology- Environmental requirements for animal cell cultivation, reactors for large-scale production using animal cells, plant cell cultivation.

Text Books:

1. Hougen and Watson K M and Ragatz R A, "Chemical Process Principles", 2nd Edition, Wiley, 1959.
2. Bhatt B I and S M Vora, "Stoichiometry", 4th Edition, Tata McGraw Hill 2006.
3. Chemical Reaction Engineering, Octave Leven Spiel.

Suggested Reading:

1. David M. Himmelblau, James B. Riggs, "Basic Principles and Calculations in Chemical Engineering", 8th Edition, Prentice Hall, 2012.
2. Dr.AVN.Swamy, "Fundamentals of Biochemical Engineering", BS Publications, 2007.
3. Warren Lee McCabe, Julian Smith, Peter Harriott, "Unit operations of chemical engineering", Mc-Graw Hill, 7th Edition 2005.
4. Pauline M. Doran, "Bio-process Engineering Principles", 2nd Edition, Academic press, 2013.

16BT C06

BIOCHEMISTRY

Instruction	4 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	4

Course objectives:

1. Students will learn structure, functions and metabolism of different biomolecules.

Course outcomes:

1. Recognize different biomolecules structures.
2. Describe the functions of various biomolecules.
3. Evaluate the energy yield from the catabolism of carbohydrates and lipids.
4. Reconstruct the anabolism of carbohydrates and lipids.
5. Outline steps involved in catabolism and anabolism of proteins.
6. Summarize steps involved in catabolism and anabolism of nucleic acids.

UNIT I:
BIOMOLECULES

Carbohydrates- classification, monosaccharide, disaccharides, polysaccharides, Glycoproteins; glycolipid; Classification and nomenclature of lipids; Amino acid - Classification and its structure, peptide bond- structure; protein structure - primary, secondary, tertiary and quaternary structure; Structure of nucleotides, nucleosides and nitrogenous bases; chemical structure of DNA and RNA;

UNIT II:
METABOLISM OF CARBOHYDRATES

Carbohydrate Metabolism- Glycolysis, HMP shunt, Citric Acid Cycle and Oxidative Phosphorylation, Metabolic Pathways- Biosynthesis of Glucose; Glycogen metabolism.

UNIT III:
METABOLISM OF LIPIDS

Lipid Metabolism - Catabolism of Fatty Acids, Triglycerol and Cholesterol Metabolism; Metabolic Pathways- Biosynthesis of Saturated and Unsaturated Fatty Acids, Triglycerol, Phospholipids and Sphingolipids.

UNIT IV:

METABOLISM OF PROTEINS

Amino acids metabolism- Biosynthesis of aromatic amino acids, Peptides; Metabolic fate of Amino group; Nitrogen Excretion and Urea Cycle; Catabolism of aromatic and branched chain amino acids; Transamination, Oxidative Deamination and Oxidative Decarboxylation.

UNIT V:

METABOLISM NUCLEIC ACIDS

Nucleic Acid Metabolism- Biosynthesis of Purine and Pyrimidine, Ribonucleotides, synthesis of Deoxyribonucleiotides; Degradation of Purine and Pyrimidine Nucleotides.

Texts Books:

1. Eric E.Conn, Paul K Stumpf, George Bruening, Roy H Doi, "Outlines of Biochemistry", 5//E, John Wiely and Sons, 2006.
2. David Lee Nelson and Michael M. Cox, Lehninger "Principles of Biochemistry", 6th edition, W. H. Freeman, 2013.

Suggested Reading:

1. Donald Voet and Judith G. Voet, "Biochemistry", 4th edition, John Wiley & Sons, New York, 2011.
2. Reginald Garrett and Charles Grisham, "Biochemistry", 5th edition, Cengage Learning, 2012.
3. Jeremy M. Berg, John L. Tymoczko and Lubert Stryer, "Biochemistry", 6th Edition. W. H. Freeman and Company, 2010.
4. Robert Murray, David Bender, Kathleen M. Botham, Peter J. Kennelly, Victor Rodwell, P. Anthony Well, "Harpers illustrated Biochemistry", 29th edition, McGraw Hill Professional, 2012.

16BT C07

CELL BIOLOGY

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives

1. Student is made to understand the basics of cell biology i.e. concept of cellular organelles and their functions.
2. Students are taught the structure of cytoskeleton, and how it maintains the cell structure integrity.
3. Student made to understand the structure of plasma membrane, and how it regulates the fluid balance.
4. Students are made aware of cell division and regulation of cell cycle.
5. Students are enlightened about cell signaling over being basis of cancer.
6. The concept of protein targeting is introduced to the students.

Course Outcomes:

1. Students able to understand the structure & functions of cell organelles.
2. Students enlightened about the transport of metabolites.
3. Explain the regulation of cell cycle and its control.
4. Analyze the importance of growth factors/ Receptors and their role in causing cancer.
5. Recognize the mechanisms in transport of proteins to destination.
6. Explain the advances in cell biology, protein degradation.

UNIT I:

CELL STRUCTURE, ORGANELLES AND THEIR FUNCTIONS

Cell structure and organization in bacteria, plants and animal cells; structure and functions of cell wall, lysosomes, ribosomes, golgi complex, peroxisomes, glyoxysomes, mitochondria, plastids, endoplasmic reticulum, vacuoles, centrioles; cytoskeleton - composition, structure and functions of microtubules, microfilaments and intermediate filaments; nucleus, its ultra structure, (nuclear envelope, nucleoplasm, chromatin fibers).

UNIT II:

MEMBRANE TRANSPORT

Biomembrane - lipid composition and structural organization, protein components and basic function, transport across membrane - passive diffusion, facilitated diffusion, osmosis, active transport (Na+/K+ Pump), cotransport; uniport, antiport, symport.

UNIT III:

CELL DIVISION AND CELL CYCLE

Cell Division: mitosis and meiosis- events and significance; meiosis and reproductive cycle.

Cell cycle: Different phases of cell cycle; check points of cell cycle; Regulation of cell cycle - cyclins and cyclin dependent kinases;

UNIT IV:

CELL COMMUNICATION

Basic concepts of cell communication; bacterial cell communication - Quorum sensing; multicellular organisms- intercellular communication through channels (gap junctions and plasmodesmata, cell-cell junctions), chemical signals (autocrine, paracrine, hormonal); cell signaling-signal transduction pathway; signal receptor proteins- G protein linked receptors(Jak/stat kinases), tyrosine kinase receptors, secondary messengers (cAMP) signaling path ways in cancer (hedgehog signaling, frizzled signaling).

UNIT V:

PROTEIN TARGETING/CELL DEATH

Targeting signals, targeting cytosolic proteins to mitochondria, chloroplast, nucleus; co-translational transport into RER, vesicle formation and transport, role of chaperones, applications of protein targeting, apoptosis, necrosis, senescence, proteasome degradation, mitochondrial degradation, Proteiostasis.

Text Books:

1. Geoffrey M. Cooper and Robert E. Hausman, "The cell: A molecular approach", 6th edition, Sinauer Associates, 2013.
2. Gerald Karp, "Cell and Molecular Biology": concepts and experiments, 6th edition, John Wiley & sons, 2009.
3. Benjamin Lewin, Jocelyn E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick, "Lewin's Genes XI", Jones and Bartlett publishers, 2014.

Suggested Reading:

1. Bruce Alberts, Dennis Bray, Karen Hopkin, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter, "Essential Cell Biology", 4th edition, Garland Science, 2013.
2. Rastogi S.C, "Cell Biology", 3rd edition, New Age International, 2005.
3. Powar, C.B, "Cell Biology", Himalya Publishing house, 2006.

16BTC08

MICROBIOLOGY

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: Students are made to understand the following concepts during there course of time:

1. History and scope of microbiology.
2. Classification of different group of microorganisms.
3. Concepts of sterilization and preparation of culture media for growth of microorganisms.
4. Various methods of preservation of microorganisms and their importance.
5. Preparation of culture media for growth of microorganisms.
6. Assimilation of nutrients by microorganisms and importance of bacterial growth phases.
7. Microbial pathogens like V. cholera, HIV, rabies virus causing diseases in humans and multidrug resistance of pathogens like M. tuberculosis and Hepatitis B virus.

Course Outcomes:

1. Explain contributions made by different scientists in microbiology.
2. Identify General characteristics of microorganisms and types of Taxonomy.
3. Select Physical and chemical methods of sterilization.
4. Demonstrate the preparation and functions of different types of media.
5. List classification of nutrients and types of assimilation methods in micro organisms.
6. Outline the Life cycle of pathogens causing diseases in humans.

UNIT I:
HISTORY AND INTRODUCTION TO MICROBIOLOGY

History and scope of microbiology, contributions of Antony van Leuwenhoek, Louis Pasteur, Robert Koch, Iwanowskii, Edward Jenner; prokaryotic cell structure - plasma membranes, cytoplasmic matrix - inclusion bodies, ribosome, bacterial chromosome and plasmids, cell wall, components external to cell wall - capsule, slime layer, pili, fimbriae, flagella, bacterial endospores and their formation. Importance of fixation and stains.

UNIT II:

CLASSIFICATION OF MICROORGANISMS

General and colony characters of major groups of microorganisms - algae, fungi, protozoa, bacteria and virus; identification of microorganisms by major taxonomical characteristics (morphological, physiological, ecological, cultural, metabolic/biochemical, immunological and genetic). classification of microorganisms - concept of classification; taxonomic groups; Haeckel's three kingdom concept, Whittaker's five kingdom concept, three domain concept of Carl Woes.

UNIT III:

MICROBIOLOGICAL TECHNIQUES

Methods of culturing of microorganisms in lab and industry - culture media, (liquid, semi-solid and solid media, synthetic media and complex media), isolation of pure cultures (streak, spread and pour plate methods). Serial dilution. concept of sterilization - methods and their application- physical methods (heat, filtration and radiation), chemical methods (phenolics, alcohols, halogens, heavy metals, dyes, quaternary ammonium compounds, aldehydes, gaseous agents), methods of preservation of microorganisms and their importance (Bacterial cultures).Biosafety cabinet.

UNIT IV:

MICROBIAL PHYSIOLOGY AND GROWTH

Nutrition in microorganisms and assimilation of major nutrients: active and passive transport. Facilitated diffusion and group translocation. Microbial growth - growth curve, mathematical expression of growth, measurement of microbial growth (cell numbers and cell mass), importance of growth phases of microorganisms; balanced and unbalanced growth, synchronous growth, factors affecting bacterial growth (solutes, water activity, pH, temperature, oxygen concentration, osmotic pressure, radiation).

UNIT V:

MEDICAL MICROBIOLOGY

Virulence factors ; air borne diseases (Tuberculosis), water borne diseases (Vibrio cholera, Hepatitis), zoonotic infections(rabies), extracellular pathogens , staphylococcus, streptococcus; facultative intracellular pathogen -obligate intracellular pathogen - rickettsia, chlamydias; sexually transmitted disease - syphilis; viral diseases - influenza, measles and HIV., Multidrug resistance (Mycobacterium tuberculosis, hepatitis B virus).

Text Books:

1. Pelczar Michael J., Krieg Noel R., Chan, E.C., "Microbiology", 5th edition, McGraw Hill higher education1993.
2. Michael T. Madigan, John M. Martinko, Kelly S. Bender, Daniel H. Buckley, David A-Stahl and Clark, "Brock Biology of Microorganisms", 13th edition, Prentice Hall International Inc, 2010.
3. R.Ananth Narayan, "Text Book of Microbiology", 7th edition, Universities Press, 2009.

Suggested Reading:

1. Powar C.B. and Daginawala H.F., "General Microbiology - Vol I & II", 2nd edition, Himalaya publishing house, 2005.
2. Arti Kapil, Ananthanarayan and Paniker's "Text book of Microbiology", 9th edition, Orient Blackswan, 2013.
3. Roger Y Stanier, "General Microbiology", 5th edition, Palgrave Macmillan Limited, 1999.

16BT C09

GENETICS

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives

1. Student is made to understand the basics of genetics, ie. Concept of how genes are responsible for inheritance of characteristics.
2. Students are taught the structure of chromosome, and how it stores genetic information.
3. Importance of chromosome taught by showing the effects of mutations on chromosomes.
4. Students are enlightened about crossing over being the basis of genetic diversity.
5. Students are made aware of chromosome related genetic disorders.
6. The concept of extra chromosomal inheritance is introduced to the students.

Course Outcomes:

1. Apply to real life situations, the principles of human heredity.
2. Incorporate the fundamentals of gene in order to understand how they impact humans.
3. Be able to describe the chromosomal basis of inheritance and how alterations in chromosome number or structure may arise during mitosis and meiosis.
4. Be able to describe the main modes of Mendelian and non-Mendelian inheritance.
5. Be aware of the role of both genetic and environmental factors in multifactorial Conditions such as, cancer, diabetes and psychiatric disorders.
6. Be able to take a family history and construct and interpret a pedigree.

UNIT I:
PHYSICAL BASIS OF HEREDITY

Mendel's laws of inheritance - segregation, independent assortment, modification of mendelian principles: co-dominance, incomplete dominance, multiple alleles, gene interactions, epistatic interactions, pleotropism. Interaction of genotype and environment: penetrance, expressivity, phenocopy.

UNIT II:

CHROMOSOME STRUCTURE AND ABBERATIONS

Eukaryotic chromosome structure, function, karyotyping; specialized chromosomes: gaint chromosomes - polytene and lamp brush chromosomes; chromosomal aberrations- structural aberrations (deletions, duplication, inversion and translocation), numerical aberrations (aneuploidy, euploidy, auto polyploidy and allopolyploidy). Mutations - spontaneous, induced; physical and chemical mutagens; lethal mutation (characteristics and types), AMES test, applications of mutations.

UNIT III:

LINKAGE AND CROSSING OVER

Concept of linkage and crossing over, cytological basis of crossing over (in Drosophila and Maize), factors affecting recombination frequency, linkage maps; mechanism of recombination - model involving single strand breaks and double strand break in DNA duplex, significance of Crossing over. Two point and three point test cross. Interference. Tetrad analysis.

UNIT IV:

SEX DETERMINATION, SEX LINKED AND GENETIC DISORDERS

Sex chromosomes, sex determination, mechanism of sex determination in animals (insects and humans) and plants, sex determination by genic balance and Y-linked genes. Dosage compensation, Maryleon's hypothesis; sex linkage, non disjunction of x chromosomes, sex linked disorders and autosomal disorders in human beings. Garrod's inborn errors of metabolism, one gene one enzyme hypothesis, one gene one polypeptide hypothesis.

UNIT V:

EXTRA CHROMOSOMAL INHERITANCE AND QUANTITATVE GENETICS

Extra chromosomal inheritance - inheritance of mitochondrial and chloroplast genes, maternal inheritance(CMS, nuclear petites in yeast, Mirabilus jalapa. Transgressive segregation, quantitative characters, Gene frequency, gene pool, Hardy- Weinberg Law, equilibrium, Fitness and selection Goodness of fit : Chi-square-test.

Text Books:

1. Singh, B.D. "Genetics - 3rd edition", Kalyani Publications , 2004.
2. Snustad, D.Peter, Simmons Michael, "Principle of Genetics 6th edition", Wiley publication, 2011.
3. Gardner, E. J., Simmons, M. J., Snustad, D. P. and Snustad, "Principles of Genetics", John Wiley and Sons, Inc. 1985.

Suggested Reading:

1. Verma, P. S. and V. K. Agrawal.. "Cell Biology, Genetics, Molecular Biology, Evolution and Ecology". S. Chand & Company Ltd., New Delhi, 2004.
2. Cummings Michael R, Charlotte A. Spencer, Michael A. Palladino Concepts of Genetics . Pearson Education. ISBN 0321754352, 9780321754356, 2012.
3. Krebs JE., Goldstein E.S and Kilpatrick S.T., "Lewin's Genes XI", Jones Bartlett publishers, 2014.
4. Gupta PK, "Genetics", 4th Rev Edition (2nd Reprint) Rastogi Publications, 2011.
5. Hartl L, Daniel and Ruvolo MGenetics, "analysis of genes and genomes", Eight edition, Jonnes and Bartlett Learning Books. USA, 2012.

16BT C10

BIOCHEMISTRY LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
CIE	25 Marks
Credits	2

Course objectives:

1. Students will learn the laboratory safety and standard operating procedures.
2. Students will learn how to estimate and analyze different biomolecules.

Course outcomes:

1. Learn and apply the laboratory safety and standard operating procedures.
2. Prepare the solutions and biological buffers.
3. Estimate and analyze carbohydrate by different methods.
4. Estimate and analyze amino acids and proteins by different methods.
5. Estimate and analyze lipids and compare the acid value, saponification value and iodine valve of various lipids.
6. Estimate and analyze nucleic acids.

List of Experiments:

1. Introduction to Biochemistry Lab: Units, Volume / Weight measurements, concentration units.
2. Preparation of Solutions - percentage solutions, molar solutions, normal solutions and dilution of stock solution.
3. Measurement of pH.
4. Preparation of buffers and reagents.
5. Titration curve of amino acid and calculation of pK and pI values.
6. Estimation of Carbohydrates by Anthrone method.
7. Estimation of Amino acids by Ninhydrin method.
8. Estimation of Proteins by Biuret method.
9. Estimation of Proteins by Lowry method.
10. Determination of Acid value, Saponification value and Iodine Number of Fat.
11. Estimation of Cholesterol by Liebermann Burchard method.
12. Estimation of DNA by Diphenyl amine method.
13. Estimation of RNA by Orcinol method.

Suggested Reading:

1. David, T. Plummer, "An introduction to Practical Biochemistry", 3rd edition, Tata McGraw Hill, 1988.
2. Beedu Sashidhar Rao and Vijay Deshpande, "Experimental Biochemistry - A student companion", Anshan Pub, 2006.
3. Sharma R.K., "Basic technique in Biochemistry and Molecular Biology", I.K. International Pvt. Ltd., New Delhi, 2008.

16BT C11

MICROBIOLOGY LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
CIE	25 Marks
Credits	2

Course Objectives: Students are made to understand the following experiments during their course of time:

1. Proper handling and focusing of Bright Field microscope.
2. Physical and chemical sterilization methods for control of microorganisms.
3. Preparation of culture media.
4. Techniques for the isolation of pure cultures.
5. Simple and Gram staining techniques.
6. Antibiotic sensitivity test by Disc Diffusion Method.

Course Outcomes

1. Outline of Magnification, Resolution, Refractive index of Microscope.
2. Operate the physical sterilization equipments.
3. Prepare the basic culture media for the growth of microorganisms.
4. Perform streak plate, spread plate and pour plate techniques.
5. Identify type of bacteria (Gram positive or Gram negative).
6. Evaluate sensitivity of microorganisms against different organisms.

List of Experiments:

1. Calibration of Microscope and Measurement of Microorganisms-Microtome.
2. Staining and Identification of microorganism: (a) Simple and Differential staining techniques.
3. Sterilization techniques (Autoclaving, Hot Air Oven, Radiation and Filtration).
4. Preparation of culture media (a) broth type of media (b) Agar.
5. Culturing of microorganism (a) broth (b) pure culture techniques-Streak plate, Pour plate.
6. Isolation and preservation of bacterial culture.
7. Antibiotic tests- Disc diffusion method, minimum inhibitory concentration.
8. Biochemical tests- IMIVC test, Catalase, Coagulase test,

Gelatinase test, Oxidase.

9. Factors affecting the bacterial growth and study of growth curve.
10. Measurement of Microbial Growth (Viable Count and Turbidometry) and enumeration of bacterial numbers by serial dilution.
11. Coliform test.

Suggested Reading:

1. Gopal Reddy M, M.N. Reddy, D.V.R. Sai Gopal and K.V. Mallaiah, "Laboratory Experiments in Microbiology", 3rd edition, Himalaya Publishing House Pvt. Ltd., 2008,
2. Gunasekaran P., "Laboratory manual in Microbiology", 3rd edition, New Age International Publ., New Delhi, 2007.
3. Kannan N., "Laboratory manual in General Microbiology", 1st edition, Panima Publishing Corp., New Delhi, 2002.
4. Alfred E. Brown, "Benson's Microbiological Applications: Laboratory manual in general microbiology", 12th edition, McGraw hill Education, 2011.

16EG CO3

SOFT SKILLS AND EMPLOYABILITY ENHANCEMENT LAB

Instruction	2 hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	35 Marks
Continuous Internal Evaluation	15 Marks
Credits	1

Course Objectives: To help the students

1. Participate in group discussions and case studies with confidence and to make effective presentations. Also to learn the art of communication.
2. With- resume packaging, preparing and facing interviews.
3. Build an impressive personality through effective time management & goal setting, self confidence and assertiveness.
4. Understand what constitutes proper grooming and etiquette in a professional environment. Also to understand academic ethics and value systems.
5. To understand the elements of research and hone their soft skills through a live, mini project.

Course Outcomes: The students will be able to

1. Be effective communicators and participate in group discussions and case studies with confidence. Also be able to make presentations in a professional context.
2. Write resumes, prepare and face interviews confidently.
3. Be assertive and set short term and long term goals. Also learn to mange time effectively and deal with stress.
4. Make the transition smoothly from Campus to Corporate. Also use media with etiquette and know what academic ethics are.
5. To do a live, mini project by collecting and analyzing data and making oral and written presentation of the same.

Exercise 1

Group Discussion and Case studies: Dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and coherence.

Elements of effective presentation, Structure of presentation, Presentation tools, Body language, Creating an effective PPT.

Exercise 2

Interview Skills: Resume writing, structure and presentation, planning, defining the career objective, projecting ones strengths and skill-sets.

Interview Skills: concept and process, pre-interview planning, opening strategies, answering strategies, mock interviews.

Exercise 3

Personality Development: Effective Time Management, setting realistic goals, self confidence and assertiveness, stress management, moral values.

Exercise 4

Corporate Culture: Grooming and etiquette, communication media etiquette,

Academic ethics and integrity

Exercise 5

Mini Project: General/Technical, Research, developing a questionnaire, data collection, analysis, written report and project seminar.

Suggested Reading:

1. Dr. Shalini Verma, "Body Language- Your Success Mantra", S Chand, 2006.
2. Ramesh, Gopalswamy, and Mahadevan Ramesh, "The ACE of Soft Skills", New Delhi: Pearson, 2010.
3. Covey and Stephen R, "The Habits of Highly Effective People", New York: Free Press, 1989.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY(A)
Choice Based Credit System
B.Tech (Bio-Technology)

SEMESTER – IV

S.No	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
THEORY								
1	16BT C12	Chemical and Biochemical Thermodynamics	4	-	3	30	70	4
2	16BT C13	Molecular Biology	3	-	3	30	70	3
3	16BT C14	Immunology	3	-	3	30	70	3
4	16BT C15	Instrumental Methods in Biotechnolgy	3	-	3	30	70	3
5	16BT C16	Industrial Biotechnology	3	-	3	30	70	3
6	16MB C01	Engineering Economics and Accountancy	3	-	3	30	70	3
PRACTICALS								
7	16BT C17	Immunology Lab	-	3	3	25	50	2
8	16BT C18	Instrumental Methods in Biotechnology Lab	-	3	3	25	50	2
TOTAL			**19**	**6**	-	**230**	**520**	**23**

L: Lecture T: Tutorial D: Drawing P: Practical
CIE - Continuous Internal Evaluation SEE - Semester End Examination

Assessment Procedures for Awarding Marks

The distribution of marks is based on internal assessment (Sessional) by concerned teacher and the Semester end examination shall be as follows:

Course (in terms of credits)	CIE	Semester end Examination (Marks)	Remarks	Duration of Semester End Examination
Three(3) Credits/ Four(4) Credits	30*	70**	Theory Course/ Engg . Graphics	3 Hours
Two(2) Credits	20*	50***	Theory	2 Hours
Two(2) Credits	25	50	Lab Course/Workshop	3 Hours
One(1) Credit	15	35	Lab Course	2 Hours
Two(2) Credits	50	—	Project Seminar/Seminar	----
Six(6) Credits	50	100	Project	Viva
One(1) Credit	—	50***	Environmental Studies, Professional Ethics and Human values	2 Hours
One(1) Credit	50		Mini Project	-----

CIE: Continuous Internal Evaluation

* Out of 30/20 sessional marks(CIE), 10/5 marks are allotted for slip-tests(Three slips test will be conducted, each of 10/5 marks, best two average is considered) and the remaining 20/15 marks are based on the average of two tests, weightage for each test is 20/15 marks.

** The question paper will be in two parts, Part-A and Part-B. Part A is for Ten(10) questions and is compulsory, covers the entire syllabus, and carries 20 marks. Part-B carries 50 marks and covers all the units of the syllabus (student has to answer five out of seven questions)

***The question paper will be in two parts, Part-A and Part-B. Part A is for Ten(10) questions and is compulsory, covers the entire syllabus, and carries 15 marks. Part-B carries 35 marks and covers all the units of the syllabus (student has to answer five out of seven questions)

Note:A course that has CIE(sessional marks) but no semester end examination as per scheme, is treated as Pass/Fail for which pass marks are 50% of CIE.

A candidate has earned the credits of a particular course, if he/she secures not less than the minimum marks/ grade as prescribed. Minimum pass marks for theory course is 40% of total marks i.e., CIE plus semester end examinations where as for the lab course/project is 50%.

16BT C12

CHEMICAL AND BIOCHEMICAL THERMODYNAMICS

Instruction	4 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	4

Course Objectives

1. Course aims at developing to reason so that students can apply thermodynamic principles in the solution of practical problems.
2. The aim of the course is also to give students an understanding of equilibrium conditions of chemical and biochemical extractions.
3. The course aims to give students the concepts of the transfer of chemical species between phases.
4. The course aims to facilitate students to apply I and II law of thermodynamics to open and closed systems to turbines and heat engines.
5. The course aims to give students the knowledge to calculate oxygen consumption and heat evolution in aerobic cultures.

Course Outcomes

1. Students will be able to measure heat and work increments for closed systems and cyclic processes.
2. Students will be able evaluate nozzle , turbine and compressors based on the principles of I-law of thermodynamics.
3. Students will be able to calculate coefficient of performance of heat engines and heat pump.
4. Students will be able predict the extent of various reactions by Gibbs and Duhem equation.
5. Students will be able to calculate separation processes like distillation based on vapour liquid equilibrium for binary systems.
6. Students will be able to calculate equilibrium conversions and yields of bio reactions.

UNIT I:

INTRODUCTION TO THERMODYNAMICS

System: Definition and Classification of system - closed and open system based on number of components, exchange of mass and heat. State and Path Functions, equilibrium, Phase rule. Thermodynamic Properties of fluids. Forms of energy, classification of properties. I-Law of Thermodynamics, application of I-law to closed, systems.

Volumetric Properties of Fluids: PVT behaviour of pure fluids. Real and Ideal Gas. Equations of state - Ideal gas law, Virial equations of state (restricted to first two terms). Cubic equations of state - Van der Waals and Redlich kwong. Processes involving ideal gases (isochoric, isobaric, isothermal, adiabatic, polytropic - simple applications).

UNIT II:

THE SECOND LAW OF THERMODYNAMICS

Second law of thermodynamics: Limitations to I-law, qualitative statement of Kelvin Plank and Clausius versions of II-law, entropy - definition, entropy and heat calculations for ideal gases. Maxwell relations - problems not included, Residual properties - definition (V^R, H^R, S^R, G^R - basic property relations for ideal gases, problems not included).

UNIT III:

SOLUTION THERMODYNAMICS

Partial molar properties - definition and simple applications involving calculation of partial molar properties for binary systems using analytical methods (no graphical method). Concepts of Chemical potential and fugacity (for pure species and species in solution). Lewis Randall rule, Raoult's law, Henry's law - Definition and simple applications. Excess properties - definition and fundamental relation for excess Gibbs free energy, (problems not included). Activity and activity coefficients, correlations to calculate activity coefficients - Margules, Van Laar and applications involving binary systems.

UNIT IV:

PHASE EQUILIBRIA AND CHEMICAL REACTION EQUILIBRIA

Phase Equilibria: Vapor-liquid equilibrium calculations for binary systems - P-x-y ,T-x-y diagrams, using simple Raonlt's law to binary mixture.

Chemical Reaction Equilibria: Equilibrium criteria for homogenous chemical reactions. Standard Gibbs energy change of reaction, Reaction co-ordinate -definition. Evaluation of equilibrium constant - numerical problems not included. Effect of pressure and temperature on equilibrium constant - qualitative treatment, simple problems involving temperature dependence of equilibrium constant. Calculation of equilibrium conversions and yields for single reactions.

UNIT V:

BIOENERGETICS

Energetics of Metabolic Pathways, Energy coupling (ATP & NADH). Stoichiometry and energetic analysis of Cell Growth and Product Formation. Thermodynamics of microbial growth. Oxygen consumption

and heat evolution in aerobic cultures. Energy balance equation for cell culture.

Text Books:

1. J.M.Smith, H.C.Van Ness and M.M.Abbott, "Introduction to Chemical Engineering Thermodynamics", 6th ed, TMH, 2003.
2. J.A.Roels, "Energetics and kinetics in biotechnology" , Elsevier, 1983.
3. Y.V.C.Rao, Revised edition, "An introduction to thermodynamics", Universities Press, 2004.

Suggested Reading:

1. Robert A.Alberty, "Biochemical Thermodynamics: Applications of Mathematica", John Wiley and Sons, 2006.
2. Stanley I. Sandler, "Chemical and Engineering Thermodynamics", 3rd Edition, Wiley, 1999.
3. K.V.Narayanan, "A Textbook of Chemical Engineering Thermodynamics", PHI Learning Pvt. Ltd, 2004.

16BT C13

MOLECULAR BIOLOGY

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives

1. Student is made to understand the basics of molecular biology, i.e. concept of structure of DNA and how that lengthy DNA strands packaged in Prokaryotes & Eukaryotes.
2. Students are taught the Replication of DNA and how it repairs after damage.
3. Students are enlightened about the mechanism of transcription by RNA polymerases.
4. Students are made aware of concept of Ribozyme. (Slicing and maturation of RNA).
5. Students are taught the structure of RNA's and Ribosome's, and how it translates the genetic information.
6. Students are made to understand the regulation of gene expression and Transposons.

Course Outcomes

1. Be able to describe the structure & functions of genetic material.
2. Be able to explain the how the DNA is packaged into chromosomes.
3. Be able to correlate the types of DNA damage & repair.
4. Be able to describe the mechanism of transcription and maturation of RNA to initiate translation.
5. Be able to describe the translation of genetic information into polypeptide.
6. Be able to describe the regulation of gene expression.

UNIT I:

STRUCTURE AND ORGANIZATION OF GENETIC MATERIAL

Structure of DNA - Watson and Crick's model; types of DNA - A-DNA, B-DNA, Z-DNA; difference between DNA and RNA; denaturation and renaturation of DNA, DNA packing - prokaryotes (nucleoid model), eukaryotes (nucleosome solenoid model), euchromatin, heterochromatin, role of histone and non histone proteins in structural organization of chromosomes; telomere and its importance; repetitive DNA, satellite DNA, pseudo genes, overlapping and split genes.

UNIT II:

DNA REPLICATION AND REPAIR

Replication of DNA - semi conservative replication and its experimental evidences, enzymology of replication, continuous and discontinuous DNA synthesis, complex replication apparatus, unidirectional replication, bi-directional replication, rolling circle replication; DNA damage and repair: Types of DNA damages- deamination, alkylation, pyrimidine dimmers; DNA Repair mechanisms- photo reactivation, Excision repair, mismatch repair, recombination repair, SOS repair.

UNIT III:

MECHANISM OF TRANSCRIPTION

Structure of promoters- RNA polymerases of prokaryotic and eukaryotic organism; transcription- initiation, elongation and termination; post transcriptional processes of eukaryotic RNA; structure and functions of RNA- (rRNA, mRNA, tRNA, Sn RNA), prokaryotic and eukaryotic transcription. Processing of t-RNA, r-RNA, m-RNA splicing; concept of ribozyme, inhibitors of transcription.

UNIT IV:

MECHANISM OF TRANSLATION

Ribosome- structural features of prokaryotic and eukaryotic ribosome; genetic code-triplet code, cracking of genetic code, features of genetic code, wobble hypothesis; protein synthesis: translation in prokaryotes and eukaryotes- initiation of translation, elongation of polypeptide chain, termination of translation. post translation modification, inhibitors of protein synthesis.

UNIT V:

REGULATION OF GENE EXPRESSION AND TRANSPOSABLE ELEMENTS

Operon concept of prokaryotic gene regulation, inducible operon - lac operon, repressible operon - trp operon, attenuation, negative and positive control of transcription. Britten Davidson model for eukaryotic gene regulation, eukaryotic gene regulation - transcriptional level, processing level, translational level; transposable elements - insertion sequences, composite transposons, transposable elements of eukaryotes (Ac-Ds in Maize, Ty elements in Yeast and P elements in Drosophila).

Text Books:

1. David Freifelder, "Molecular Biology", 2nd edition, Narosa Publication, 2007.
2. Harvey F. Lodish, "Molecular Cell Biology", 7th edition, W. H. Freeman., 2012.

Reference Books:

1. Burton E. Tropp, "Molecular Biology: Genes to proteins", 4th editions, Jones & Bartlett publishers, 2012.
2. Benjamin Lewin, Jocelyn E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick, "Lewin's Genes XI",
   Jones and Bartlett publishers, 2014.
3. Rastogi S.C., "Cell and Molecular Biology", 2nd edition, New Age International, 2006.

16BT C14

IMMUNOLOGY

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives

1. Students learn about the basic components and responses of Immune system.
2. Knowledge of Antigen and antibody and the application of Antigen and antibody reaction.
3. Importance of Antigen Processing and Presentation is emphasized.
4. Students understand significance of complement system and hypersensitivity.
5. The immunological basics for diseases is taught to the students.
6. Role of immunology in cancer therapy and vaccine is emphasized upon.

Course Outcomes

1. Identify Immune system components and how they work in a coordinated way.
2. Graduates apply the application of antigen-antibody interactions in development of medical diagnostic kits.
3. Analyze the Immune system related underlying causes in Allergies, Asthma and other hypersensitive reactions.
4. Graduate is acquainted with the diseases caused due to Immune system malfunctioning.
5. Explain to the Students, the Immune system related medical complications in transplantation and Cancers.
6. Graduates identify the role of immunology in vaccines development.

UNIT I:
IMMUNE SYSTEM

Introduction to immunity, types of immunity - innate and adaptive immunity, humoral and cell mediated immune response, hematopoiesis, cells of the immune system, organs of immune system - primary (bone marrow and thymus) and secondary (lymph node, spleen, MALT, GALT), molecules of immune system (cytokines, interleukins, interferons, chemokines).

UNIT II:

ANTIGEN, ANTIBODY AND ITS INTERACTION

Antigen - immunogenicity and antigenicity, factors influencing immunogenicity, haptens and adjutants, epitopes; Immunoglobulin - structure, classes and function, antigenic determinants of immunoglobulin - isotype, allotype, idiotype, generation of antibody diversity, production of monoclonal antibodies by hybridoma technology and its applications. Strength of antigen antibody interaction, affinity, avidity, cross reactivity, precipitation, agglutination, immunoelectrophoresis, RIA, ELISA, western blotting, immunoprecipitation, immunofluorescence, FACS.

UNIT III:

ANTIGEN PROCESSING AND PRESENTATION

Major histocompatibility complex (MHC) - organization, classes and function; Antigen processing and presentation - role of antigen presenting cells, endogenous antigens (cytosolic pathway), exogenous antigens (endocytic pathway), presentation of nonpeptide antigen.

UNIT IV:

THE COMPLEMENT SYSTEM AND HYPERSENSITIVITY

Complement system - components, function, activation (classical and alternative pathway); Hypersensitive reactions - Type I (IgE mediated hypersensitivity), type II (antibody mediated cytotoxic hypersensitivity), type III (Immune complex mediated hypersensitivity), type IV (delayed type hypersensitivity).

UNIT V:

MEDICAL APPLICATIONS OF IMMUNOLOGY

Autoimmunity - organ specific (insulin dependent diabetes mellitus, Graves' disease, myasthenia gravis) and systemic (systemic lupus erythematosus, multiple sclerosis, rheumatoid arthritis) autoimmune diseases, treatment of autoimmune diseases; Transplantation - immunological basis of graft rejection, immunosuppressive therapy (general and specific), immunoprophylaxis (attenuated, inactivated and DNA vaccines), immunology of cancer- tumour antigens, immune response to tumour, cancer immunotherapy.

Text Books:

1. Judith A. Owen, Jenni Punt, Sharon A.Stranford, "Kuby Immunology", 7th edition, W.H. Freeman, 2013.
2. Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt, "Roitt's Essential Immunology", 12th edition, John Wiley & Sons, 2011.

Suggested Reading:

1. Kenneth Murphy, "Janeway's Immunobiology", 8th edition, Garland Science, 2011.
2. Abdul K. Abbas, Andrew H. Lichtman, Shiv Pillai, "Cellular and Molecular Immunology 7th edition", Elsevier Health Sciences, 2011.
3. Sunil Kumar Mohanty and K. Sai Leela, "Text book of Immunology", 2nd edition, JP Medical Ltd, 2014.

16BT C15

INSTRUMENTAL METHODS IN BIOTECHNOLOGY

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives

Students are made to understand the following concepts during their course of time:

1. Types of Analytical methods and Instruments used for Analysis, Importance of microscopy.
2. Types of Instruments used for isolation of Biomolecules and Sub cellular organelles.
3. Types of centrifuges like low speed, high speed, ultra centrifuges.
4. Types of Chromatographic Techniques.
5. Charge based separation Techniques.
6. Spectrometric identification Techniques.

Course Outcomes

1. Solve the Analytical problems in instruments by Detection & sensitivity limits.
2. Assess the merits and demerits of instruments.
3. Discuss Principle, procedure and applications of different types of centrifugation.
4. Summarize Principle, Procedure and applications of chromatography's like TLC, paper.
5. Explain Principle procedure and applications of different electrophoresis like SDS, Agarose.
6. State the basic concepts of spectroscopy, Beers Lamberts law, Colorimeter, Nephlometry.

UNIT I:
ANALYTICAL METHODS AND MICROSCOPY

Types of Analytical Methods - Instruments for Analysis - Uncertainties in Instrumental measurements - Sensitivity and detection limit, accuracy and precision for instruments. Principle, procedure and applications of Bright field, Dark field, fluorescent and electron microscopy.

UNIT II:
INSTRUMENTS FOR ISOLATION TECHNIQUES

Cell disruption by French press, sonication, freeze thaw technique, use of liquid N2 and chemical approaches involved in cell disruption. Isolation of Biomolecules and cell organelles. centrifugation: basic principles of sedimentation, sedimentation coefficient, Svedberg Unit. Various types of centrifuges, their uses, rotors, fixed angle, vertical, swing bucket, zonal rotors. Preparative centrifugation, differential density gradient centrifugation, analytical ultra centrifugation. Materials used in preparation of density gradient- sucrose & cesium chloride.

UNIT III:
SEPARATION TECHNIQUES

Partition coefficient, partition chromatography, adsorption chromatography, Paper, TLC& GLC, adsorption media, solvent, continuous and gradient elution, fraction collection and detection of pure molecules. Methods based on size: Gel permeation chromatography, principle application- Molecular weight determination. Dialysis and its significance. Affinity chromatography, application & technique for purification of proteins and nucleic acids.

UNIT IV:
CHARGE BASED SEPARATION TECHNIQUES

Principle and application of Ion exchange chromatography, use of ion exchange- cation & anion exchangers, pH and salt gradients for elution of proteins, amino acids and nucleotides. Electrophoresis: Migration of charged molecules in electric field-moving boundary, paper, cellulose acetate, starch gel electrophoresis, SDS PAGE, Determination of molecular weight. Identification of specific proteins by western blotting. Agarose gel electrophoresis-separation of DNA recovery of DNA fragments from agarose gels, southern & northern blot techniques and their significance, pulse field gel electrophoresis.

UNIT V:
SPECTROMETRIC IDENTIFICATION TECHNIQUES

Basic concepts of spectroscopy, Visible & UV spectroscopy Beer lamberts law. Principles and application of Colorimetric & Flame photometry, Nephlometry. Principles and applications of Atomic absorption Spectrophotometer. Principles & applications of IR, ESR NMR & Mass spectroscopy.

Text Books:

1. Keith Wilson and John Walker, "Principles and Techniques of Biochemistry and Molecular Biology", 6th edition, Cambridge University Press, 2005.

2. Sivasankar, "Instrumental Methods of Analysis", Oxford higher education, OUP, India, 2012.

Suggested Reading:

1. GW Ewing, "Instrumental Methods of Chemical Analysis", 4th edition, Mc Graw Hill, 1985.
2. D. Muralidhara Rao, A V N Swamy, Dhaneeswar Reddy, "Instrumental Methods of Analysis", CBS Publishers, 2013.
3. Skoog DA, "Fundamentals of Analytical Chemistry", Thomson Brooks/Cole, 2004.

16BT C16

INDUSTRIAL BIOTECHNOLOGY

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. Student is made to discuss the scope and development of biotechnology and its products and made realized about the role of bioprocess engineer in biotechnological industries.
2. Students are taught the concepts, tools and techniques used in biotechnology.
3. Students are enlightened about fermenter and its process controls.
4. Students are taught about the production of primary and secondary metabolites used in day today life from different microorganisms.
5. Students are taught about the productions of commercial bioproducts such as beverages, enzymes, recombinant proteins having industrial and diagnostic importance.
6. Students are taught about the bioproducts that are used in agricultural, food and pharma ceutical industries.

Course Outcomes:

1. Student will be able to analyze the scope and evaluate development of biotechnology and its products.
2. Student will be able to use the concepts, tools and techniques for designing the solutions for complex biological problems.
3. Be able to use fermenter for the production of bioproducts.
4. Be able to apply the theoretical knowledge of production procedures for producing the bioproducts practically.
5. Be able explain the applications of different bioproducts.
6. Be able to apply the knowledge to face the challenges when placed in industry.

UNIT I:

INTRODUCTION TO BASICS OF BIOTECHNOLOGY

A historical overview on scope and development of biotechnology and products; biotechnology as an interdisciplinary enterprise; a brief survey of organisms, processes, products; areas of application of biotechnology.

UNIT II:

INTRODUCTION TO INDUSTRIAL BIOPROCESSES

Role of a bioprocess engineer in the biotechnology industry; introduction, development and maintenance and characterization of industrial microorganisms; primary and secondary screening of inoculum, starter and industrial cultures, analysis of microbial fermentation processes; batch and continuous fermentations, solid state fermentation; an overview of aerobic and anaerobic fermentation processes.

UNIT III:

PRODUCTION OF MICROBIAL METABOLITES

A brief outline of processes for the production of some commercially important organic acids (e.g. citric acid and lactic acid); amino acids (glutamic acid and lysine); alcohols (ethanol, and n-butanol). Production of beverages (beer, wine) Study of production processes for various classes of low molecular weight secondary metabolites-" antibiotics -classification of antibiotics, production of penicillins.

UNIT IV:

PRODUCTION OF MICROBIAL ENZYMES AND RECOMBINANT PROTEINS

Production of commercially important industrial enzymes-proteases, amylases, lipases, cellulase, pectinase, and isomerase, production of recombinant proteins: insulin, interleukins, tumor necrosis factor and interferons.

UNIT V:

PRODUCTION OF MICROBIAL PRODUCTS

Bio-pesticides; bio-fertilizers and plant growth factors; natural biopreservatives (nisin); biopolymers (Xanthan gum and PHB); single cell protein; high fructose corn syrup;

Text Books:

1. Crueger W and Crueger A, Biotechnology: Text Book of Industrial microbiology. 2nd edition, Panima Publisher, 2005.
2. Casida L. E., Industrial Microbiology, 1st edition, New Age International, 2006.
3. Patel A.H., Industrial Microbiology, 6th edition, Mc Millan India ltd, 2007.

Suggested Reading:

1. Samuel Cate Prescott, Cecil Gordon Dunn, "Industrial Microbiology", edition 2, Agrobios, India, 2009.
2. Bhatia S.C., "Industrial Biotechnology, Vol-I", Shree Publishers & distributors, 2011.
3. A V N Swamy, T.Md. Munawar "Basics of Industrial Bio-Technology", Lambert, 2013.

16MB C01

ENGINEERING ECONOMICS AND ACCOUNTANCY

Instruction	3 hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives: The Objectives of the course are:

1. to introduce managerial economics and demonstrate its importance in managerial decision making.
2. to develop an understanding of demand and relevance of its forecasting in the business.
3. to provide the basics of market structure and the concept of equilibrium in different market structures.
4. to examine the economic analysis of production process, types of inputs and to explain different costs and their relationship with the output.
5. to understand the importance of project evaluation in achieving a firm's objective.
6. to explain the concept of Accountancy and provided knowledge on preparation and analysis of Final accounts.

Course Outcomes: After completion of the course, student will be able to:

1. apply fundamental knowledge of Managerial economics concepts and tools.
2. understand various aspects of demand analysis and forecasting.
3. understand price determination for different markets.
4. study production theory and analyze various costs & benefits involved in it so as to make best use of resources available.
5. analyze different opportunities and come out with best feasible capital investment decisions.
6. apply accountancy concepts and conventions, Final accounts and financial analysis.

UNIT-I:

Introduction to Managerial Economics

Introduction to Economics and its evolution - Managerial Economics - its scope, importance, Its usefulness to engineers - Basic concepts of Managerial economics.

UNIT-II:

Demand Analysis

Demand Analysis - Concept of demand, determinants, Law of demand, its assumptions, Elasticity of demand, price, income and cross elasticity, Demand Forecasting - Types of Market structures. (Simple numerical problems).

UNIT-III:

Production and Cost Analysis

Theory of Production - Firm and Industry - Production function - input-out relations - laws of returns - internal and external economies of scale. Cost Analysis: Cost concepts - fixed and variable costs - explicit and implicit costs - out of pocket costs and imputed costs - Opportunity cost - Cost output relationship - Break-even analysis. (Theory and problems).

UNIT-IV:

Accountancy

Book-keeping, principles and significance of double entry book keeping, Journal, Subsidiary books, Ledger accounts, Trial Balance concept and preparation of Final Accounts with simple adjustments.

UNIT-V:

Capital Budgeting

Introduction to capital budgeting, Methods: traditional and discounted cash flow methods. Introduction to Working capital management. (Numerical problems).

Text Books:

1. Mehta P.L., "Managerial Economics - Analysis, Problems and Cases", Sultan Chand & Son's Educational publishers, 2013.
2. Maheswari S.N. "Introduction to Accountancy", Vikas Publishing House, 2013.
3. Panday I.M. "Financial Management", Vikas Publishing House, 11th edition, 2015.

Suggested Readings:

1. Varshney and KL Maheswari, Managerial Economics, Sultan Chand, 2014.
2. M.Kasi Reddy and S. Saraswathi, Managerial Economics and Financial Accounting, Prentice Hall of India Pvt Ltd, 2007.
3. A.R.Aryasri, Managerial Economics and Financial Analysis, McGraw-Hill, 2013.

16BT C17

IMMUNOLOGY LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
CIE	25 Marks
Credits	2

Course Objectives:

1. Students identifies significance of blood grouping.
2. The applications of Antigen antibody agglutination are demonstrated.
3. The applications of Antigen antibody Precipitation are demonstrated.
4. Students learn about diagnostic kits based on immunology.
5. Students learn to interpret results.
6. Students understand the significance of immunology and its application in medical arena.

Course Outcomes

1. Students are demonstrated how Antigens and Antibody interact.
2. The practical aspects of agglutination and precipitation are identified.
3. Student interprets the results based on the results of the antigen-antibody interaction.
4. Students analyze the importance of different Immunological techniques developed.
5. The importance of blood group matching in blood transfusions and other cases are practically demonstrated.
6. Graduates apply the practical implications of immunological based diagnostic kits.

List of Experiments:

1. ABO Blood Grouping and Identification of Rh typing.
2. Quantitative Precipitin Assay (QPA)(Rocket immuno electrophoresis).
3. Ouchterlony Double Diffusion for Antigen Antibody Patterns (ODD).
4. Immuno-electrophoresis (IEP).
5. Radial Immune Diffusion test (RID).
6. Widal test.
7. VDRL tests.

8. Total and Differential count of RBC & WBC by Micropipette method.
9. Erythrocyte sedimentation rate.
10. Enzyme Linked Immunosorbent Assay (ELISA) for Antigen capture and Antibody capture.
11. Estimation of Immunoglobullins by Precipitation with Saturated Ammonium Sulphate.

Suggested Reading:

1. Arti Nigam and Archana Ayyagari, Lab Manual in Biochemistry, "Immunology and Biotechnology", Tata McGraw Hill Education, 2007.
2. S. Ramakrishna and K.N. Sulochana, "Manual of Medical Laboratory Techniques", 1st edition, J.P. Medical Ltd, 2013.
3. Kanai L. Mukherjee and Swarajith Ghosh, "medical Laboratory Techniques, (Vol-I): Procedure Manual for Routine Diagnostic tests", 2nd edition, Tata McGraw Hill education.

16BT C18

INSTRUMENTAL METHODS IN BIOTECHNOLOGY LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
CIE	25 Marks
Credits	2

Course Objectives: Students are made to understand the following concepts during their course of time:

1. Demonstrate the pH meter and its function.
2. Verification of Beers Lamberts law using visible spectrophotometer.
3. Estimation of concentration of protein by Biuret method.
4. Separation of amino acids by TLC and Paper chromatography.
5. Demonstrate the Biosensors (Glucometer) and its function.
6. Separation of proteins in an unknown sample mixture by SDS-PAGE.

Course outcomes:

1. Adjust the pH of any analytical sample solution by using pH meter.
2. verify Beers Lamberts law using potassium di chromate solution.
3. Determine the concentration of unknown protein sample using visible spectrophotometer.
4. Separate and identify amino acids present in a sample mixture.
5. Demonstrate random blood glucose levels by using Accu-check Active Glucometer.
6. Separate the proteins present in sample mixture based on molecular weight.

List of Experiments:

1. The calibration of pH meter and measurement of pH for different solutions.
2. Estimation of Ascorbic acid by colorimetric assay.
3. Estimation of unknown samples by using conductivity meter.
4. Estimation of different macromolecules by visible spectrophotometer.
5. Verification of Lambert - Beers law by UV -VIS spectrophotometer.
6. Estimation of proteins and nucleic acids by U.V method.
7. Estimation of turbidity using Nephlometer.
8. The separation of different macromolecules by Paper, Thin layer chromatography.

9. The separation of different macromolecules by Paper, PAGE, SDS-PAGE.
10. Estimation of minerals by Flame photometry.
11. Estimation of Thiamine and Riboflavin by Fluorimetry.
12. Preparation of Standard curve using UV-VIS & Flame Photometry.
13. Fractionation of Plasma Proteins by Electrophoresis.
14. Subcellular fractionation studies by differential centrifugation.

Suggested Reading:

1. Sivasankar, "Instrumental Methods of Analysis", Oxford higher education, OUP, India. 2012.
2. Dr.A.V.N.Swamy,D.Dharaneeswara Reddy, D.Muralidhara Rao, "Instrumental Methods of Analysis", CBS Publishers & Distributors Pvt. Ltd., Delhi, India, 2013.