CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

BIOTECHNOLOGY
B. Tech I – Year

I - Semester

THEORY						
S.No	**Code**	**Subject**	**L**	**T**	**P/D**	**Credits**
1	EG 111	English - I	2	0	0	2
2	MT 112 BT 111	Engineering Mathematics – I for BiPC stream Basics of Biology – I for MPC stream	3	1	0	3
3	PY 113	Engineering Physics	3	0	0	3
4	CY 113	General Chemistry	3	0	0	3
5	CS 111	Programming and Problem Solving	3	1	0	3
6	BT 112	Fundamentals of Biotechnology	3	1	0	3
7	EE 111	Principles of Electrical Engineering	3	1	0	3
PRACTICALS						
8	EG 112	English Language Laboratory – I	0	0	2	1
9	PY 114/ CY 116	Engineering Physics Lab – I / Chemistry Lab – I	0	0	3	2
10	CS 114	Programming Lab - I	0	0	3	2
11	ME 115	Workshop Practice	0	0	3	2
TOTAL			**20**	**04**	**11**	**27**

II – Semester

THEORY						
S.No	**Code**	**Subject**	**L**	**T**	**P/D**	**Credits**
1	EG 121	English - II	2	0	0	2
2	MT 122 BT 121	Engineering Mathematics – II for BiPC stream Basics of Biology – II for MPC stream	3	1	0	3
3	PY 124	Biophysics	3	0	0	3
4	BT 122	Bio-organic Chemistry	3	0	0	3
5	CS 121	Object Oriented Programming through C++	3	1	0	3
6	CE 112	Environmental Studies	3	1	0	3
7	BT 123	Introduction to Anatomy and Physiology of Humans	3	1	0	3
PRACTICALS						
8	EG 122	English Language Laboratory – II	0	0	2	1
9	PY 126 BT 124	Biophysics Lab / Chemistry Lab – II	0	0	3	2
10	CS 122	Programming Lab - II	0	0	3	2
11	ME 122N	Engineering Drawing	0	0	3	2
TOTAL			**20**	**04**	**11**	**27**

EG 111

ENGLISH – I
(common to all branches)

Instruction	2L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	2

Course Objectives:

To enable the students to

- To understand the role and importance of communication and to develop their basic communication skills in English.
- To enable the students to communicate through listening, speaking, reading and writing.
- To achieve a sound foundation and acquaint the students in the basics of grammar.
- To develop vocabulary and to use appropriate idiomatic expressions, one word substitutes etc,.
- To ensure students use learning materials prescribed, and to inculcate the habit of reading for pleasure.
- To enhance imaginative creative and critical thinking through literary texts.
- To enable students to write composition and draft different kinds of letters.

UNIT-I

Effective Communication: Role and importance of communication, process of communication, types of communication , barriers to communication, Verbal communication and non verbal communication , formal versus informal communication.

UNIT-II

Review of Grammar: 1. Tense and aspect 2. Articles 3.Prepositions 4.Voice 5.Concord 6. Direct and indirect speech
Vocabulary Enhancement: 1.Synonyms2.Antonyms

UNIT-III

Reading comprehension and reading strategies.
Lessons Prescribed: 1. Barack Obama: A Trendsetter 2. Rendezvous with IndraNooyi
Text based exercises
Vocabulary Enhancement:1. Homonyms 2. Homophones 3. Homographs 4. Words often confused

UNIT-IV

Writing Skills: Paragraph writing, Essay writing , Letter of application, Resume writing, Complaint letter with response.
Vocabulary Enhancement: Idiomatic expressions and one word substitutes.

UNIT-V

Soft skills - Introduction to soft skills, soft versus hard skills, professional etiquette in formal and semi formal situations, telephonic etiquette, E-mail etiquette.

Text Books:

1. "Essential English"- E Suresh Kumar et al**.**(Orient Balck Swan PVT Ltd.)
2. "Communication Skills and Soft Skills: An Integrated Approach"- E Suresh Kumar et al**. (**Pearson Publications)

Suggested Reading:

1. "English Vocabulary in Use" - Michael McCarthy (Cambridge University Press)
2. "Developing Communication Skills" – Krishna Mohan &Meera Banerjee (Macmillan)
3. "Murphy's English grammar" (Cambridge University Press)
4. "English Phrasal Verbs in use" - Michael McCarthy (Cambridge University Press)
5. "Written Communication in English" –Sarah Freeman (Orient Longman)
6. "Model Business letters, E-Mails and Other Business Documents" - Shirley, Taylor (Pearson) "Effective Technical Communication" – M. Ashraf Rizvi (Tata- McGraw Hill)
7. "Business Correspondence and Report Writing – R.C Sharma and Krishna Mohan (Tata McGrawHill)
8. Soft Skills, Alex , Publishers S. Chand

MT 112

ENGINEERING MATHEMATICS – I
(for BiPC Stream)
(Bio-Tech)

Instruction	3L + 1T Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	2

UNIT-I

Trigonometry: Graphs and periodicity of trigonometric functions. Trigonometric ratios and compound angles, trigonometric ratios of multiple and sub multiple angles. Transformations-sum and product rules. Hyperbolic and Inverse Hyperbolic functions.

UNIT-II

Limits, Continuity: Intervals and neighborhoods, limits and concept of a limit. Standard limits and related problems. Continuity and applications.

UNIT-III

Differentiation: Derivatives of a function, Elementary properties. Derivatives of Trigonometric, Inverse Trigonometric, Hyperbolic and inverse Hyperbolic functions. Methods of differentiation, second and higher order derivatives.

UNIT-IV

Matrices: Types of matrices, multiplication of matrices, scalar multiplication. Inverse of matrix-determinant, singular, non-singular, minor, cofactors , adjoint, Rank-Echelon form, consistency, inconsistency Solutions of simultaneous linear equations.

UNIT-V

Curve Fitting: Residues, Principle of Least squares and Curve fitting by the method of least squares, Fitting of a straight line, parabola, Fitting of the curves of the form ab^x, ae^{bx}

Text Books:

1. Text Book of Mathematics by N. Krishnamurthy, Chand series Volume-I & II
2. Numerical Methods for scientists and engineers by B.S.Grewal

Suggested Readin

1. Matrices by A.R.Vasistha
2. Differential calculus by P.N.Chatterji / A.R.Vasistha
3. Calculus by David C.R

BT 111

BASICS OF BIOLOGY–I
(for MPC Stream)
(Bio-Tech)

Instruction	3L + 1T Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

UNIT-I: HISTORY OF LIFE AND EVOLUTION
History of earth, evolutionary concepts of origin of life. Experimental verification of chemical origin of life - Miller's Experiment. Darwinism, Natural selection, Sexual selection, Artificial selection, Mendelism, Hugo de Vries mutation theory, neo-darwinism, synthetic theory. Concept of species and speciation – allopatric speciation and sympatric speciation. Microevolution.

UNIT-II: PLANT SYSTEMATIC AND REPRODUCTION
Plant kingdom, salient features of classification. Alternation of generation of the plants. Type studies of Algae *(Spirogyra)*, Fungi *(Rhizopus)*, Bryophytes *(Pteris)*, Gymnosperms (*Cycas)* and general characteristics and life cycle of Angiosperms. Overview of modes of reproduction-Asexual: vegetative propagation, budding, sporulation, binary fission; Sexual reproduction: development of male & female gametophyte, pollination, fertilization, development of embryo, endosperm, fruit and seed formation. Apomixes, pathenocarpy, polyembrony type of reproduction.

UNIT-III: CELL STRUCTURE AND INTERNAL ORGANIZATION OF PLANTS
Cell as basic unit of life, overview of the plant cell, cell cycle, cell division, mitosis and meiosis. Concept of Growth, meristems (apical, intercalary and lateral) their functions. Simple tissue (parenchyma, collenchyma and sclerenchyma), complex tissues (xylem and phloem). Tissue systems (epidermal, ground and vascular). Anatomy of dicotyledonous and monocotyledons stem and root. Primary and secondary growth in dicot stem and root.

UNIT-IV: MICROBIOLOGY
Introduction and importance of classification – five kingdoms. General account of prokaryotes, bacterial viruses - T4, plant viruses – TMV, animal viruses – HIV, Protista, Fungi, Plantae and Animalia. Reproduction in bacteria (asexual - binary fission and sexual - conjugation) and viruses (lytic and lysogenic). Economic importance of beneficial bacteria (agriculture, industry, medicine and biotechnology) and harmful bacteria (with respect to diseases caused in plants and animals).

UNIT-V: PLANT PHYSIOLOGY AND CONCEPTS IN PLANT BIOTECHNOLOGY
Absorption of water – soil water, water potential, diffusion, imbibitions, osmosis, plasmolysis, absorption of water, ascent of sap, transportation. Plant growth regulators. Crop improvement -Introduction, methodology, selection (mass, pure line, clonal), Heterosis and mutation breeding. Plant tissue culture techniques and their applications. Mushroom culture – morphology, types of mushrooms, food value and cultivation methods.

Text books:

1. Text book of Botany, I and II year, Telugu Akademi, Hyderabad 2012.
2. Text book of Zoology, I and II year, Telugu Akademi, Hyderabad 2012.
3. Biology. Raven, Johnson, Losos, Mason, Singer. Tata Mc Graw Hill Publishing Co. Pvt. Ltd 9th edition, 2010.

Suggested Reading:

1. Beginning Science: Biology. B.S. Beckett. Oxford University Press.1 st edition, 1983.
2. University Botany I: (Algae, Fungi, Bryophyta And Pteridophyta). S.M. Reddy. New age International (P) Ltd. Publishers, New Delhi. 1st edition, 1996
3. Botany for Degree students. A.C. Dutta, Oxford University Press. 6th Edition, 1998
4. Introduction to Applied biology and Biotechnology. K Vaidhyanath, K Pratap Reddy and K Sathya Prasad. BS Publications. India. 2004

PY 113

ENGINEERING PHYSICS
(Bio-Tech)

Instruction	3L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

UNIT – I

Waves and Oscillations: Simple harmonic motion – Differential equation and its solution – Torsional pendulum – Superposition of two mutually perpendicular linear SHMs of same frequency – Lissajous figures – Damped vibrations – Differential equation and its solution – Logarithmic decrement - Relaxation time – Quality factor – Forced vibrations – Differential equation and its solution – Amplitude resonance.

Ultrasonics: Introduction – Production of ultrasonics by piezoelectric and magnetostriction methods – Detection of utrasonics – Determination of ultrasonic velocity in liquids – Engineering applications.

UNIT – II

Interference: Introduction – Division of amplitude & division of wavefront – Interference in thin films (reflected light) – Newton's rings – Fresnel's biprism.

Diffraction: Introduction – Distinction between Fresnel and Fraunhoffer diffraction – Diffraction at single slit & double slit – Diffraction grating (N Slits).

UNIT – III

Polarization: Introduction – Brewster's law – Malus's law – Double refraction – Nicol's prism – Quarter & Half wave plates – Optical activity – Laurent's half shade polarimeter.

Lasers &Holography: Introduction – Characteristics of lasers – Spontaneous & stimulated emission of radiation – Einstein's coefficients – Population inversion – Ruby laser – He-Ne laser – Semiconductor laser – Applications.

Basic principle of Holography – Recording & Reconstruction of hologram – Applications

UNIT - IV

Elements of Statistical Mechanics: Introduction – Ensembles – Phase space – Thermodynamical probability – Boltzmann theorem on entropy – Maxwell-Boltzmann, Bose-Einstein & Fermi-Dirac statistics – Photon gas – Planck's' law of black body radiation – Wien's law and Rayleigh-Jean's law from Planck's law.

UNIT – V

Elements of Quantum Mechanics: Introduction – Dual nature of light – de Broglie's hypothesis – Expression for de Broglie's wavelength – Heisenberg's uncertainty principle and its illustration (diffraction of a beam of electron at a slit) – Schrödinger time independent and time dependent wave equations – Interpretation of wave function – Infinite square well potential (particle in a box) – Potential step – Potential barrier (qualitative) – Tunneling effect.

Text Books:

1. M.N. Avadhanulu and P.G. Kshirsagar, *A Text BookEngineering Physics*, S. Chand Publications, 2014
2. S.L. Gupta and Sanjeev Gupta, *Modern Engineering Physics*, Dhanpat Rai Publications, 2011
3. V. Rajendran, *Engineering Physics*, McGahill Education Publications, 2013

Suggested Reading:

1. R. Murugeshan and Kiruthiga Sivaprasath, *Modern Physics*, S. Chand Publications S. Chand Publications, 2005
2. M. Arumugam, *Materials Science*, Anuradha Publications, 2002.
3. Satyaprakash and Agarwal, *Statistical mechanics*, Kedannath Publications
4. P.K. Palanisamy, *Engineering Physics*, Scitech Publications, 2012
5. Hitendra K Malik and A.K. Singh, *Engineering Physics*, Tata McGahill Education Publications, 2011

CY 113

GENERAL CHEMISTRY
(Bio-Tech)

Instruction	3L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

UNIT – I

Introduction to Organic Chemistry: History of organic Chemistry; Uniqueness of Carbon atom, General characteristics of organic compounds. Nomenclature of organic compounds, Hybridization; Functional Group properties- Carbonyl, carboxylic acid, Ester, Hydroxyl and Amine Functional Groups.

UNIT-II

Structure Reactivity Correlations of Organic Molecules: Electron displacements in a molecule-Inductive and mesomeric effect, resonance, hyper conjugation and electromeric effects; rules and effects of Organic reactions –Hoffman Rule, Saytzeff Rule and Markonikoff Rule, KharashEffect, Orientation Effect and Functional Group Effect, stearic effect.

UNIT-III

Types of Organic Reactions and Some Name Reactions: Types of Organic reactions- Nucleophilic, Electrophilic, free radical Substitution and Addition reactions, Elimination and Rearrangement (Oxime -rearrangement) reactions. Concepts of Aromaticity, Properties of aromatic compounds-Huckel's Rule. Name Reactions –Diels –Alder Reaction; Aldol Condensation, Hoffman Degradation, Perkin reaction.

UNIT –IV

Inorganic Chemistry-Chemical Bonding: Types of Bonds- Ionic bond, covalent bond-Characteristics. Bond length, Bond energy, polar and non-polar covalent bond. Dipole moment. Coordinate bond, Hydrogen bonding, vanderwal's forces. Molecular orbital theory-Molecular Orbital Energy Level Diagram (MOED) for O_2-and N_2-molecules.

UNIT-V

Physical Chemistry: Thermodynamics- First law of Thermodynamics, enthalpy, Hess's- law for a reaction. Bio-energetics.
Electrochemistry-Electrode potentials, electrochemical series.
Solutions- Ionic product of water(Properties of water), pH and Buffer solutions. Colloidal solutions, suspension, emulsions.

Text Books:

1. Organic chemistry 6^{th}ed -. Morison & Boyd, PHI (Prentice-Hall India)-Delhi.
2. Text Book of Inorganic Chemistry-Vol-I,IL Finar,Longman Group.
3. Text Book of Organic Chemistry-B.S.Bahl & Arun Bahl-S.Chand & Co. Delhi.
4. 4. Text Book of Organic Chemistry-B.S.Bahl & Arun Bahl-S.Chand & Co. Delhi.
5. Puri & Sharma, "Principles of Physical Chemistry

Suggested Reading:

1. Physical chemistry by P.W.Atkin (ELBS OXFORD PRESS)
2. Physical chemistry by W.J.Moore (Orient Longman)
3. Physical Chemistry by Glasstone

CS 111

PROGRAMMING AND PROBLEM SOLVING
(common to CSE, IT, ECE, EEE & Bio-Tech)

Instruction	3L + 1T Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

UNIT-I

Introduction to computers: Hardware Components, Functional block diagram, Operating Systems,Program Development Environments.

Programming languages: System Programming, Application Programming, Low-level, High-level, Classification of Programming languages.

Translators: Compiler, Interpreter, Loader and Linker.

Number Systems: Representationof Binary, Octal and Hexadecimal Numbers, Conversions, Negative Binary Numbers, Fractional Numbers.

UNIT-II

Problem solving: Algorithm: Key Features of an Algorithm, Strategy for designing an Algorithm. Tracing an Algorithm to depict logic. Specification for converting algorithms to programs, Flow chart and Pseudo codes.

Introduction to C Programming: Standardizations, Developing Programs In C, Parts and structure of C Program, character set ,Variable, Data types ,Statement, Declaration, Token, Operators and Expressions.

UNIT-III

Control Structures: Test Condition for Selection and Iteration, Conditional Execution and Selection, Iteration and Repetitive Execution, Break, Continue and go to statement, Nested Loops.

Functions: Concept of Functions, Types of functions, Parameter passing techniques, Scope and Extent, Storage Classes, Recursion.

Case Studies on Control structures and Functions (Tutorial Purpose only).

UNIT-IV

Arrays: Declaration, Initialization, Accessing Array Elements, Internal Representation and Variable Length Arrays of One-dimensional Array and Multidimensional Arrays, Passing Arrays to Functions, Searching and Sorting.

Pointers: Address Operator (&),Declaring and Initializing Pointers, Indirection Operator and Dereferencing, Pointer Arithmetic, Pointers to Pointers, Array of Pointers, Pointers to Functions, Dynamic Memory Allocation, Command Line Arguments.

Case Studies on Arrays and Pointers (Tutorial Purpose only).

UNIT-V

User-defined Data Types and Variables: Structures , Declaring Structures and Structure Variables, Accessing the members of a Structure , Initialization, Nesting of Structures, Arrays of Structures, Structures and Pointers, Structures and Functions, Union, Enumeration Types.

File Processing: Working with Text and Binary Files, Sequential and Random Access File, Files of Records.

A Case Study on Files (Tutorial Purpose only).

Text Books:

1. Pradip Dey and Manas Ghosh “Programming in C 2/e” Oxford University Press , 2nd Edition 2011.
2. B. W. Kernighan & D.M. Ritchie, "The 'C' Programming Language” Prentice Hall India, 2nd Edition. 1990.
3. R S Bichkar “Programming with C “University Press, 2012.

Suggested Reading:

1. Rajaraman V. "The Fundamentals of Computers" 4th Edition, Prentice Hall of India, 2006.
2. Behrouz A .Forouzan, Richard F.Gilberg “Computer Science : A Structured Programming Approach using C” Cengage Publishers, 2006.

BT 112

FUNDAMENTALS OF BIOTECHNOLOGY
(Bio-Tech)

Instruction	3L + 1T Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

UNIT-I: Introduction to Biotechnology
Definitions: Historical perspectives, scope and importance; an inter disciplinary challenge, Classical vs Modern concepts. Conventional practice of brewing, domestic fermented foods and milk. Introduction to prokaryotic cell and eukaryotic cell and its differences, origin of microbiology, types and importance of microorganisms. Developmental biology in evolution.

UNIT -II: Introduction to Biomolecules and Bioinformatics
Structure and functions of nucleic acids, lipids, carbohydrates, amino acids in brief. Introduction to Bioinformatics, role of bioinformatics in biotechnology, biological databases and their applications example - Human Genome project (PDB, Gene Data Bank).

UNIT –III: Molecular Basis of Biotechnology
Basic laws of inheritance; Mendalian ratios, Identification of genetic material, classical experiments, extra nuclear inheritance, structure of chromosome and it's functions, sex linked disorders. Central dogma of molecular biology, higher order chromatin organization. Basic concepts in plant tissue culture.

UNIT –IV: Medical Biotechnology
Basic concepts in Animal tissue culture. Elements of Immunology - Types of immunity (Acquired and Innate), structure and functions of antigen, types of antibodies, Hybridoma technology. Etiology of cancer. Production of rDNA products, example - Insulin and recombinant vaccine (Hepatitis B).

UNIT –V: Process Biotechnology
Upstream process - basic structure of fermenter, types of fermentation processes, aerobic and anaerobic process, construction of fermenter, Batch and Continuous fermentation. Downstream process - overview of downstream process in biotechnology. Case Studies - process flowchart for the production of β-lactam antibiotic, bioethanol production and biofertilizer production, bioremediation. Stoichiometry and carbon recovery in product formation, example - ethanol, citric acid and lactic acid.

Text Books:

1. Cell Biology. C.B. Powar. Himalaya publication. 2nd edition, 1981.
2. Principles of Genetics. John Gardner, Simmons and Snustad. John wiley and sons. 8th edition, 2006.
3. Principles of Genetics. P.K. Gupta. Rastogi Publication, Meerut, 2000.
4. Principles of Genetics. Simmons, Snustad and Jenkins. John wiley and sons. 8th Edition, 1997.
5. Bioinformatics: Methods and Applications. SC Rastogi, N Mendiratta & P Rastogi. PHI, New Delhi. 4th edition, 2005.
6. Bioseparations: Downstream processing for biotechnology. Paul A.Belter, E. L. Cussler and Wei-Shou Hu. Wiley, 1988
7. Kuby Immunology. Richard A. Goldsby, Thomas J.Kindt, Barbara A. Osborne. WH freeman company. 6th edition, 2006.
8. Introduction to the cellular and molecular biology of cancer. Edited by L.M. Franks, N.M.Teich. Oxford university press. 4th edition, 2005

Suggested Reading:

1. The Cell: A Molecular approach. Geoffrey M Cooper and Robert E. Hausman. Sinauer associates incorporated. 5th ed, 2009.
2. Principles of fermentation technology. Peter F. Stanbury, Allan Whitaker & Stephen J. Hall. Butterworth-Heinemann Limited, 1995
3. Industrial Microbiology. L.E. Casida. New age international, 2000.
4. Bioseparations: principles and techniques. B.Sivasankar: PHI learning Pvt Ltd, 2010.
5. Cell and Molecular biology eighth edition, Derobertis & Derobertis LippincoH Williams and Willins (2010)
6. Biotechnology: A text books of industrial microbiology. Wulf Crueger and Anneliese Crueger. Editor of English edition Thomas D. Brock. Sinauer Associates, 1990
7. Riott's essential immunology. Peter J. Delves, Seamus J. Martin, Dennis R. Burton and Ivan M. Riott. Wiley - Blackwell. 12th edition, 2011.
8. The Biology of Cancer. Robert A. Weinberg. Garland Science. 2nd edition, 2013.

EE 111

PRINCIPLES OF ELECTRICAL ENGINEERING
(common to CSE, IT & Bio-Tech)

Instruction	3L + 1T Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

UNIT – I

D.C. Circuits and network theorems: Electric Circuit parameters(R,L,C), Voltage, Current, Power, Kirchhoff's laws, mesh current and node voltage analysis, superposition theorem, Thevenin's theorem, Norton's theorem, maximum power transfer theorem.

UNIT – II

Electromagnetic Induction: Electromagnetic induction, Faraday's laws of electromagnetic induction, static and dynamically induced EMF

A.C. Circuits: Generation of alternating voltage and current, equation of alternating voltage and current, average and rms values of sinusoidal quantities, form and peak factors, phasor representation of sinusoidal quantities, ac through pure resistance pure Inductance, pure capacitance, AC series RL,RC,RLC circuits.

UNIT- III

D.C Generators: working principle, construction, types of armature winding, emf equation, types of excitation, characteristics of series, shunt and compound generators, losses and efficiency.

D.C Motors: working principle, back emf, types of excitation, torque equation, characteristics of series, shunt and compound motors, speed control of shunt and series motors.

UNIT - IV

Single phase transformer: Constructional details, working principle, Ideal transformer, emf equation, equivalent circuit, voltage regulation, losses and efficiency, condition for maximum efficiency, open circuit and short circuit test.

UNIT -V

Three phase Induction Motors: Construction, production of rotating magnetic field, working principle, types, slip, torque equation, starting torque, maximum torque, torque slip characteristics.

Text books:

1. Edward Hughes, Electrical Technology, 6th Edition, ELBS, 2001
2. V.K. Mehta, Principles of Electrical engineering, S.Chand & Co.

Suggested Reading:

1. B.L. Theraja & A.K. Theraja, Electrical Technology, Vol.I, S.Chand & Co.
2. P.V.Prasad & S. Siva Nagraju, Electrical Engineering: Concepts & Applications, Cengage Learning.

EG 112

ENGLISH LANGUAGE LABORATORY – I
(common to all branches)

Instruction	2 Periods per week
Duration of University Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	1

Comuter Assisted Language Learning Lab (CALL)

Introduction:
The language lab focuses on the production and practice of sounds of language and familiarizes the students with the use of English in everyday situations and contexts.
The following are the **objectives** of the course:

1. To make students recognize the sounds of English through audio – visual aids and computer software.
2. To help them overcome their inhibitions and self consciousness while speaking in English and to build their confidence. The focus shall be on fluency rather than accuracy.
3. To enable them to speak English correctly with focus on stress and intonation.
4. To expose the students to a variety of self instructional, learner friendly modes of communication.

Syllabus:
1. Introduction to English Phonetics: Introduction to auditory, acoustic and articulatory phonetics, organs of speech: the respiratory, articulatory and phonatory systems.
2. Sound system of English: Phonetic sounds and phonemic sounds, introduction to international phonetic alphabet, classification and description of English phonemic sounds, minimal pairs. The syllable : types of syllables, consonant clusters.
3. Aspects of connected speech: Strong forms, weak forms, contracted forms, elision.

Interactive Communication Skills Lab (ICS LAB)

Introduction:
The objective of the course is to enrich interpretation skills, problem solving skills, interpersonal skills, analytical skills and leadership skills of the students, the most essential requirement of communication skills for Engineering students. The course lays emphasis on the language integrated skills in simple and comprehensive manner.
The following are the **objectives** of the course:

1. To expose the students to a team environment and how best one works with teams while adapting themselves to a corporate environment and to make business presentations.
2. Use proper body language expressions in presentation and speeches.
3. Depict situations in the dialogue that are relevant and useful to the learner, retain the truth value in the dialogue.
4. Public speaking is to be shown in action by incorporating narrative examples and extracts from speeches relating directly to students actual life experiences.

Syllabus:
1. Situational dialogues & role plays.
2. Group discussions: Objectives of a GD, types of GD's, initiating, continuing and concluding of GD.
3. Public speaking: Advantages of public speaking, essentials of an effective speech,rehearsal techniques, planning and delivering speeches.

Suggested Reading:

1. E Suresh Kumar et al**. English for Success**(with CD), Cambridge University Press India Pvt Ltd. 2010.
2. T Balasubramanian**. A Textbook of English Phonetics for Indian Students**, Macmillan, 2008.
3. Kavita Tyagi and Padma Misra. **Professional Communication**, PHI Learning Pvt Ltd, 2011
4. J Sethi et al. **A Practical Course in English Pronunciation** (with CD), Prentice Hall India, 2005.
5. Meenakshi Raman and Sangeeta Sharma**. Technical Communication**, Oxford Universuty Press 2009.

PY 114

ENGINEERING PHYSICS LAB - I
(common to all branches except Chemical Engg)

Instruction	3 Periods per alternate week
Duration of University Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	2

1. Error Analysis – Estimation of errors in the determination of time period of a torsional pendulum
2. Newton's Rings – Determination of wavelength of given monochromatic source
3. Single Slit Diffraction – Determination of wavelength of given monochromatic source
4. Diffraction Grating – Determination of wavelengths of two yellow lines of mercury light
5. Malus's Law – Verification of Malus's law
6. Double Refraction – Determination of refractive indices of O-ray and E-ray of given calcite crystal
7. Polarimeter – Determination of specific rotation of glucose
8. Laser – Determination of wavelength of given semiconductor red laser
9. Fibre Optics – Determination of NA and power losses of given optical fibre
10. Recording & Reconstruction of Hologram

CY 116

CHEMISTRY LAB – I
(Bio-Tech)

Instruction	3 Periods per alternate week
Duration of University Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	2

I. Qualitative semi-micro analysis

1. Analysis of unknown salt mixture-I
2. Analysis of unknown salt mixture-II
3. Analysis of unknown salt mixture-III
4. Analysis of unknown salt mixture-IV

II. Volumetric Analysis

1. Estimation of amount of ferrous ion using $K_2Cr_2O_7$ solution
2. Estimation of temporary, permanent and total hardness of water

Text Book:

1. Vogel's text book of quantitative chemical analysis. J. Mendham, R.C. Denney, J.D. Barnes and M. J. K. Thomas. Pearson education Pvt. Ltd., New Delhi, 6^{th} edition, 2002.
2. Senior practical physical chemistry. B. D. Khosla, V. C. Garg and Adarsh Khosla. R. Chand and Co., New Delhi

CS 114

PROGRAMMING LAB- I
(common to all branches except Chemical Engg)

Instruction	3 Periods per week
Duration of University Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	2

1. Identify the hardware components, assembling of computers.

2. Basic of OS commands, Installation of OS (Linux, DOS and XP).

3. Familiarization of Editors.

4. Sin x and Cos x values using Series expansion.

5. Demonstration of switch case (menu driven).

6. Demonstration of Parameter passing in Functions.

7. Demonstration of Functions using Recursion.

7. Program to count No of lines, characters, blanks, tab and special characters.

8. Demonstration of arrays

   i) Search-Linear
   ii) Sorting-Bubble, Selection
   iii) Operations on Matrix

9. Generation of address labels using structures.

10. Implementation of string manipulation operations with and without library function.

11. Sequential file operations.

12. Random Access File Operations.

ME 115

WORKSHOP PRACTICE
(common to Chemical Engg & Bio-Tech)

Instruction	3 Periods per week
Duration of University Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	2

Trades for Practice

1.Carpentry	2.Plumbing	3.House Wiring	4.Welding and demonstration of lathe operations

Exercises in Carpentry

1. To plane the given wooden piece to required size
2. To make a cross lap joint on the given wooden piece according to the given dimensions.
3. To make a Tee lap joint on the given wooden piece according to the given dimensions.
4. To make a dove tail-joint on the given wooden piece according to the given dimensions.
5. To make a bridle joint on the given wooden piece according to the given dimensions.

Exercises in Plumbing

1. To make external threads for GI pipes using dies.
2. To connect the GI pipes as per the given diagram using taps, couplings & bends.
3. To connect the GI pipes as per the given diagram using, couplings, unions, reducer & bends.
4. To connect the GI pipes as per the given diagram using shower, tap & valves
5. Demonstration of above exercise by giving water connection.

Exercises in House Wiring

1. Wiring of one light point controlled by one single pole switch, a three pin socket controlled by a single pole switch, and wiring of one buzzer controlled by a bell push.
2. Wiring of two light points connected in series and controlled by single pole switch. Verify the above circuit with different bulbs.
3. Wiring of two light points connected in parallel from two single pole switches and a three pin socket
4. Stair case wiring-wiring of one light point controlled from two different places independently using two 2-way switches.
5. Go-down wiring.

Exercises in Welding

1. To make a butt joint using arc welding on the given MS work pieces
2. To make a lap joint using arc welding on the given MS work pieces
3. To make a T-fillet joint using arc welding on the given MS work pieces.
4. To make a corner joint using arc welding on the given MS work pieces.
5. To join two thin sheets of GI material using Electric Resistance welding.

Demonstration of operations on lathe

Facing, turning, taper turning, grooving, knurling and boring operations over a cylindrical mild steel bar

Note: A minimum of 12 exercises from the above need to be done

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY
BIOTECHNOLOGY
B. Tech. II – Year

I – Semester

THEORY						
S. No	**Code**	**Subject**	**L**	**T**	**P/D**	**Credits**
1	MT 213	Calculus for Biotechnology	4	0	0	3
2	BT 211	Process Engineering Principles	4	0	0	3
3	BT 212	Biochemistry	4	1	0	3
4	BT 213	Cell biology	4	0	0	3
5	BT 214	Microbiology	4	0	0	3
6	BT 215	Genetics	4	1	0	3
PRACTICALS						
7	BT 216	Biochemistry Lab	0	0	3	2
8	BT 217	Microbiology Lab	0	0	3	2
9	BT 218	Cell Biology and Genetics Lab	0	0	3	2
TOTAL			**24**	**2**	**9**	**24**

II – Semester

THEORY						
S. No	**Code**	**Subject**	**L**	**T**	**P/D**	**Credits**
1	MT 223	Computational numerical methods	4	0	0	3
2	BT 221	Chemical and Biochemical Thermodynamics	4	1	0	3
3	BT 222	Molecular Biology	4	0	0	3
4	BT 223	Immunology	4	1	0	3
5	BT 224	Instrumental Methods in Biotechnology	4	0	0	3
6	BT 225	Industrial Biotechnology	4	0	0	3
PRACTICALS						
7	BT 226	Molecular Biology Lab	0	0	3	2
8	BT 227	Immunology Lab	0	0	3	2
9	BT 228	Instrumentation Lab	0	0	3	2
TOTAL			**24**	**2**	**9**	**24**

MT 213

CALCULUS FOR BIOTECHNOLOGY

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

UNIT I:

Evaluation of Indeterminate forms

Types of indeterminate forms, L-Hospital's Rule, evaluation of indeterminate forms $0/0$; ∞/∞ ; $\infty-\infty$; 1^{∞} ; ∞^{0} ; 0^{0} ; $0x\infty$.

Problems on Newton's Law of cooling, problems on decay and growth.

UNIT II:

Infinite series

Definition of sequences and series, finite and infinite series, convergence, divergence and oscillating series. Geometric series, p-series, comparison test, Ratio-test, Cauchy's root test. Raabe's Test.Alternating series-Leibnitz test.Absolute and conditional convergence.

UNIT III:

Differential Calculus

Fundamental theorem, continuity and differentiability.Rolle 's Theorem and Mean Value theorems (statements and geometrical interpretation only)-related problems.Taylors and Maclaurin's and Taylors series for single variable. Radius of curvature(Cartesian and polar coordinates).Partial differentiation-Homogeneous functions-Euler's theorem on Homogeneous funcions. Taylor's series of two variables, maxima and minima.

UNIT IV:

Vector Differentiation

Definitions: scalar and vector point functions, vector differential operator, Gradient , Divergence and Curl. Solenoidal and Irrotational vectors. Properties of Gradient, divergence and curl(vector identities).

UNIT V:

Vector Integration

Multiple integrals: Double and triple integrals- change of order of integration.

Line integrals-circulation-work done. Greens theorem in a plane, Surface integrals-flux and volume integrals. Gauss divergence theorem and Stoke's theorem (Theorems without proofs)- related problems.

Text Books:

1. Mathematical Methods of Science and Engineering by KantiB.Datta (CENGAGE Learning)
2. Higher Engineering Mathematics by B.S.Grewal
3. Vector Calculus by Shanti Narayan

BT 211

PROCESS ENGINEERING PRINCIPLES

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

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

Vapour pressure and humidity

Vapor Pressure- Liquefaction & Liquid state, Vaporization, Boiling point, Effect of temperature on Vapor Pressure, Vapor Pressure plots, Vapor Pressure of immiscible liquids & solutions, Raoult's law and its limitations. Humidity- Relative and Percent saturation, Dew point, Wet and dry bulb temperatures, use of humidity charts.

UNIT- III

Material Balances

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- IV

Energy 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 – V

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.

Text Books:

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

Suggested Reading:

1. David M. Himmelblau, James B. Riggs, 2012, Basic Principles and Calculations in Chemical Engineering , 8th Edition, Prentice Hall
2. Silas Milton Henderson, Russell Lawrence Perry, J. H. Young, 1997, Principles of Process Engineering, 4th edition. ASAE
3. J. M. Coulson, J. F. Richardson, 2005, Coulson and Richardson's Chemical Engineering Vol.6, Elsevier
4. Michael L. Shuler, Fikret Kargı , 2002, Bioprocess Engineering basic concepts , 2nd Edition Prentice Hall
5. Michael R. Ladisch , 2001,Bioseparations Engineering Principles, Practice, and Economics , 1st edition ,Wiley
6. D.G.Rao, 2005, Introduction to Biochemical Engineering, 2nd Edition, Tata Mc Graw Hill
7. Pauline M.Doran ,2013,Bio-process Engineering Principles, 2nd Edition, Academic press
8. Warren Lee McCabe, Julian Smith, Peter Harriott, 2005,Unit operations of chemical engineering, Mc-Graw Hill, 7th Edition

BT 212

BIOCHEMISTRY

Instruction	4L + 1T Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

UNIT– I

Metabolism of Carbohydrates

Carbohydrate Metabolism- Glycolysis, Glycogenolysis, HMP, Citric Acid Cycle (TCA Cycle) and Oxidative Phosphorylation, Metabolic Pathways- Biosynthesis of Glucose, Glycogen and Starch.

UNIT– II

Metabolism of Lipids

Lipid Metabolism - Catabolism of Fatty Acids, Triglycerol and Cholesterol Metabolism; Metabolic Pathways- Biosynthesis of Saturated (Stearic acid) and Unsaturated (Oleic acid) Fatty Acids, Phospholipids and Sphingolipids; Glycoproteins and Glycolipids.

UNIT– III

Metabolism of Proteins and Nucleic Acids

Amino acids metabolism- Biosynthesis of Amino Acids, Peptides; Catabolism of Carbon skeletons of Amino Acids- Transamination, Oxidative Deamination and Oxidative Decarboxylation, Metabolic fate of Amino acids; Nitrogen Excretion and Urea Cycle; Nucleic Acid Metabolism- Biosynthesis of Purine and Pyrimidine, Ribonucleotides, synthesis of Deoxyribonucleiotides; Degradation of Purine and Pyrimidine Nucleotides.

UNIT– IV

Biochemical Pathway of Photosynthesis

Plant photosynthesis – Chloroplast-Organization of chloroplasts, chlorophylls trap solar energy; Photosynthetic pigments and photochemistry; Hill reaction; Photosynthetic reaction centers- Photosystem -I, Photosystem II; Oxygenic Photosynthesis-I; Photophosphorylation-Cyclic and Non-cyclic Photo Phosphorylation; Dark reaction - Carbon dioxide fixation (Calvin cycle).

UNIT– V

Enzymes, Coenzymes and Vitamins

Enzyme: nomenclature, classification, properties and functions; Coenzymes-Coenzymes in hydrogen transfer reactions (NAD+, FAD, Lipoic acid) and group transfer reactions(Biotin, TPP, Pyridoxal phosphate, Coenzyme A, Tetrahydrofolic acid); Vitamins - Classification (Water and Fat Soluble); Chemical Nature and Mechanism of Action of Vitamins; Biological Importance of Vitamins.

Texts Books:

1. David Lee Nelson and Michael M. Cox, 2013, Lehninger Principles of Biochemistry, 6th edition, W. H. Freeman.
2. Donald Voet and Judith G. Voet, 2011, Biochemistry, 4th edition, John Wiley & Sons, New York.

Suggested Reading:

1. Jeremy M. Berg, John L. Tymoczko and Lubert Stryer, 2002, Biochemistry, 5th Edition. W. H. Freeman and Company.
2. Robert Murray, David Bender, Kathleen M. Botham, Peter J. Kennelly, Victor Rodwell, P. Anthony Well, 2012, Harpers illustrated Biochemistry, 29th edition, McGraw Hill Professional.
3. Reginald Garrett and Charles Grisham, 2012, Biochemistry 5th edition, Cengage Learning.

BT 213

CELL BIOLOGY

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

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; apoptosis (programmed cell death).

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

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.

Text Books:

1. Geoffrey M. Cooper and Robert E. Hausman, 2013, The cell: A molecular approach, 6th edition, Sinauer Associates.
2. Gerald Karp, 2009, Cell and Molecular Biology: concepts and experiments, 6th edition, John Wiley & sons.

Suggested Reading:

1. Bruce Alberts, Dennis Bray, Karen Hopkin, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter, 2013, Essential Cell Biology, 4th edition, Garland Science
2. Rastogi S.C., 2005, Cell Biology, 3rd edition, New Age International
3. Powar, C.B., 2006, Cell Biology, Himalya Publishing house
4. De Robertis and De Roberits, 2002, Cell and Molecular biology, BI Waverly Pvt. Ltd

BT 214

MICROBIOLOGY

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

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.

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 Woese.

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), types of media (simple, routine lab, selective, differential, enrichment and enriched), isolation of pure cultures (streak, spread and pour plate methods). 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).

UNIT – IV

Microbial Physiology and Growth

Nutrition in microorganisms and assimilation of major nutrients; nutritional groups of microbes and their importance in fermentation industry; microbiological media and their application growth of microorganisms - growth factors, 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, diauxic growth, factors affecting bacterial growth (solutes, water activity, ph, temperature, oxygen concentration, osmotic pressure, radiation).

UNIT – V

Medical Microbiology

Microbial toxins – botulinum neurotoxin, tetanus toxin, staphylococcal toxin; enteric pathogens – salmonella, vibrio cholerae, extracellular pathogens – staphylococcus, streptococcus; facultative intracellular pathogen – mycobacterium, obligate intracellular pathogen – rickettsia, chlamydias; sexually transmitted disease – syphilis; viral diseases – influenza, measles and HIV; antimicrobial agents and drug resistance.

Text Books:

1. Michael T. Madigan, John M. Martinko, Kelly S. Bender, Daniel H. Buckley, David A-Stahl and Clark, 2010, Brock Biology of Microorganisms, 13th edition, Prentice Hall International Inc.
2. Joanne M. Willey, Linda Sherwook and Christopher J. Woolverton, 2013, Prescott's Microbiology, 9th edition, McGraw Hill higher education publication.

Suggested Reading:

1. Powar C.B. and Daginawala H.F., 2005, General Microbiology – Vol I & II, 2nd edition, Himalaya publishing house.
2. Arti Kapil, 2013, Ananthanarayan and Paniker's Text book of Microbiology, 9th edition, Orient Blackswan.
3. Pelczar Michael J., Krieg Noel R., Chan, E.C., 1993. Microbiology, 5th edition, McGraw Hill higher education.
4. Roger Y Stanier, 1999, General Microbiology, 5th edition, Palgrave Macmillan Limited.

BT 215

GENETICS

Instruction	4L + 1T Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

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

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

Suggested Reading:

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

BT 216

BIOCHEMISTRY LAB

Instruction	3 Periods per week
Duration of University Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	2

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 Ascorbic acid in foods

Suggested Reading:

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

BT 217

MICROBIOLOGY LAB

Instruction	3 Periods per week
Duration of University Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	2

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. Detection of food pathogens

Suggested Reading:

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

BT 218

CELL BIOLOGY AND GENETICS LAB

Instruction	3 Periods per week
Duration of University Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	2

List of Experiments:

1. Demonstration of cytochemical methods: Fixation of plant material /cells and nuclear staining for mitotic and meiotic studies
2. Study of various stages of mitosis using cytological preparation of plant tissues (Onion root tips)
3. Study of various stages of meiosis using cytological preparation of plant materials (Onion flower buds)
4. Solving genetic problems related to monohybrid and dihybrid ratio (minimum of six problems in each topic)
5. Solving genetic problems related to gene interaction (minimum of six problems in each topic)
6. Construction of linkage maps, two point test cross.
7. Chi-square test
8. Problems related to polygenic inheritance
9. T- test
10. Problems related to Drosophila genetics

Suggested Reading:

1. Chaitanya K. V., 2013, Cell and Molecular Biology : A Lab Manual, PHI Learning Pvt. Ltd.Delhi, ISBN 978-81-203-4800-4
2. Susan L. Elrod and William D. Stansfield, 2010, Schaum's Outline of Genetics, Fifth Edition (Schaum's Outline Series).
3. William D and Stansfield, 1991, Schaum's outline of theory and problems of genetics, 3rd ed.

MT 223

COMPUTATIONAL NUMERICAL METHODS

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

UNIT-I:
Solutions of algebraic and transcendental equations
Successive approximation method, Method of Bisection, Regular false method and Newton Raphson method.

UNIT-II:
Numerical solutions of simultaneous linear equations
Pivoting of elements, ill-conditioned and well condition system of equations,Gauss elimination method, Gauss seidal method of iteration and decomposition method.

UNIT-III:
Finite differences and interpolation
Finite differences- Forward differences, Backward differences and divided differences. Newton's forward interpolation formula (NFIF), Newton's backward interpolation formula (NBIF).Lagrange's interpolation formula for un-equal intervals, Newton's divided difference interpolation formula (NDDIF).

UNIT-IV:
Numerical differentiation and numerical integration
Numerical differentiation using NFIF, NBIF and NDDIF. Numerical integration, General quadrature formula,Trapezoidal- rule. Simpson's $1/3^{rd}$ - rule, Simpson's $3/8^{th}$ –rule

UNIT-V:
Numerical solutions of ordinarl differential equations
Picard's method, Taylor's series method, Euler's method, Classical Runge-kutta Method (4^{th} -order)and Predictor and corrector method.

Text Books:

1. Mathematical Methods of Science and Engineering by KantiB.Datta (CENGAGE Learning)
2. Numerical Analysis for scientists and Engineers- by Mittal
3. Numerical Methods by B.S.Grewal
4. Numerical Methods by S .S.Shastry

BT 221

CHEMICAL AND BIOCHEMICAL THERMODYNAMICS

Instruction	4L + 1T Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

UNIT – I

First law of Thermodynamics: System: Definition and Classification of system – based on number of components, homogeneity and heterogeneity and exchange of mass and heat. Processes: Based on flow [batch or flow] – based on thermodynamic properties (Isothermal, Isobaric, Isochoric, Adiabatic, Polytropic). 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 and cyclic processes. Application of I-law to an open system (steady state-steady flow process) I-law applied to flow processes – nozzle, turbine and compressor, throttling device (capillary tube)

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: II-law of thermodynamics: Limitations to I-law, qualitative statement of Kelvin Plank and Clausius versions of II-law, entropy – definition, entropy and heat calculations, Simple applications involving calculation of entropy change (for phase change, mixing) for ideal gases. Qualitative statement of III-law of thermodynamics.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 related mathematical expressions, 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). Derivation of most general Gibbs Duhem equation and its different forms. 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, property changes of mixing- not included. Activity and activity coefficients, correlations to calculate activity coefficients – Margules, Van Laar and Wilson equations simple applications involving binary systems (NRTL, UNIQUAC, UNIFAC – not included)

UNIT – IV

Topics In Phase Equilibria: Vapor-liquid equilibrium calculations for binary systems – P-x-y ,T-x-y diagrams, procedures to calculate Bubble Pressure, Bubble temperature, Dew pressure, Dew temperature**.** Introduction to Liquid-liquid equlibria, Solid-liquid equilibria - qualitative treatment only

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

Biochemical Thermodynamics: 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. Y.V.C.Rao , Revised edition , An introduction to thermodynamics ,Universities Press, 2004
3. K.V.Narayanan,2004,A Textbook of Chemical Engineering Thermodynamics, PHI Learning Pvt. Ltd
4. J.A.Roels, Energetics and kinetics in biotechnology , Elsevier, 1983

Suggested Reading:

1. Robert A.Alberty,2006,Biochemical Thermodynamics: Applications of Mathematica, John Wiley and Sons
2. Stanley I. Sandler,1999 ,Chemical and Engineering Thermodynamics, 3rd Edition, Wiley
3. Robert A. Alberty , 2005,Thermodynamics of Biochemical Reactions ,John Wiley and Sons

BT 222

MOLECULAR BIOLOGY

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

UNIT – I

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

Reference Books:

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

BT 223

IMMUNOLOGY

Instruction	4L + 1T Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

UNIT – I

Immume 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, 2013, Kuby Immunology, 7th edition, W.H. Freeman.
2. Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt, 2011, Roitt's Essential Immunology, 12th edition, John Wiley & Sons.

Suggested Reading:

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

BT 224

INSTRUMENTAL METHODS IN BIOTECHNOLOGY

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

UNIT – I

Analytical Methods And Microscopy: Types of Analytical Methods - Instruments for Analysis - Uncertainties in Instrumental measurements - Sensitivity and detection limit 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, Sonification, freeze thaw technique; use of liquid N_2 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 out, zonal rotors; preparative centrifugation, differential density gradient centrifugation, analytical ultra centrifugation; Materials used in preparation of density gradient- sucrose & cesium chloride; Isolation of sub cellular organelles and Biomolecules. Determination of molecular weight and purity of Biomolecules by analytical ultra centrifugation.

UNIT – III

Separation Techniques: Partition coefficient, partition chromatography, counter current distribution, 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 molecular weight, iso-electric focusing and its significance. Identification of specific proteins by western blotting. Agarose gel electrophoresis-separation of DNA & RNA, by agarose gel electrophoresis, 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 & Explain Beer lamberts law; Principles and application of Colorimetry & Flame photometry, Nephlometry; Principles and applications of Atomic absorption Spectrophotometry; Principles & applications of IR, ESR NMR & Mass spectroscopy; Explains the laws of photometry.

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. Hobert H Willard D.L.Merritt and J.R.J.A.Dean, Instrumental Methods of Analysis, CBS publishers & Distributors, 1992
3. Skoog DA, Fundamentals of Analytical Chemistry, Thomson Brooks/Cole, 2004

BT 225

INDUSTRIAL BIOTECHNOLOGY

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

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 and market economics relating to modern industrial biotechnology; concepts of tools and techniques used in biotechnology; 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, process controls, oxygen supply and demand, single and multiple bubble aeration, sparger aeration, foam control equipment, scale-up of fermentors; an overview of aerobic and anaerobic fermentation processes.

UNIT – III

Production of Primary and Secondary 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). study of production processes for various classes of low molecular weight secondary metabolites-" antibiotics, beta-lactams (penicillins), amino glycosides (streptomycin), macrolides (erythromycin), quinones, aromatics and vitamins (B-12).

UNIT – IV

Bioporducts Production: Production of beverages (beer, wine), 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

Speciality Bioproducts for Agricultural, Food and Pharmaceutical Industries: Bio-pesticides; bio-fertilizers and plant growth factors; natural biopreservatives (nisin); biopolymers (Xanthan gum and PHB); single cell protein; high fructose corn syrup; biotransformation of steroids ; production of semi-synthetic penicillins and cephalosporins; racemically pure drug intermediates.

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 by, edition 2, Agrobios, India, 2009
2. Bhatia S.C., Industrial Biotechnology, Vol-I, Shree Publishers & distributors, 2011
3. Poonam Singh nee' Nigam and Ashok Pandey, Biotechnology for agro industrial residue utilisation, 2nd edition, Springer, 2009
4. John E. Smith, Biotechnology, 3rd edition, Cambridge low price edition, 2009

BT 226

MOLECULAR BIOLOGY LAB

Instruction	3 Periods per week
Duration of University Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	2

List of Experiments:

1. Isolation of genomic DNA - from Plant tissues , Animal (Goat liver), Human Blood (Fresh / Stored / Frozen) & Microbes
2. Isolation of RNA form Yeast
3. Isolation of Plasmid DNA
4. Preparation of Agarose Gel and visualization of
    a) Genomic DNA
    b) Plasmid DNA
5. Determination of purity of DNA
6. Determination of Tm of DNA
7. Estimation of DNA by Diphenylamine (DPA) method
8. Estimation of RNA by Orcinol method
9. Demonstration of Polymerase Chain Reaction.
10. Separation of proteins using SDS-PAGE

Suggested Reading:

1. Chaitanya K. V., Cell and Molecular Biology: A Lab Manual, PHI Learning pvt. Ltd.Delhi, 2013
2. Priyanka Siwach and Namita Singh, Molecular Biology, Principles and practices, Laxmi Publications(P) Ltd., 2007

BT 227

IMMUNOLOGY LAB

Instruction	3 Periods per week
Duration of University Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	2

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.

BT 228

INSTRUMENTATION LAB

Instruction	3 Periods per week
Duration of University Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	2

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

With effect from the academic year 2015-16

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY
DEPARTMENT OF BIOTECHNOLOGY
B.Tech III – Year

SEMESTER – I

THEORY						
S. No.	**Code**	**Subject**	**L**	**T**	**P**	**Credits**
1	MT 311	Biostatistics	4	-	-	3
2	BT 311	Fluid Mechanics and Heat Transfer	4	-	-	3
3	BT 312	Protein Engineering and Enzyme Technology	4	-	-	3
4	BT 313	Bioreaction Engineering	4	-	-	3
5	BT 314	Genetic Engineering and rDNA Technology	4	-	-	3
6	CE 444	Human Values and Professional Ethics	2*	-	-	-
PRACTICALS						
7	BT 315	Fluid Mechanics and Heat Transfer Lab	-	-	3	2
8	BT 316	Enzyme Technology Lab	-	-	3	2
9	BT 317	Genetic Engineering Lab	-	-	3	2
10	EG 221	Soft Skills and Employability Enhancement	-	-	2	1
Total			**22**	**0**	**11**	**22**

L: Lecture, T: Tutorial, D: Drawing, P: Practical

* 21 periods per semester

SEMESTER – II

THEORY						
S.no.	**Code**	**Subject**	**L**	**T**	**P**	**Credits**
1	BT 321	Fermentation Technology	4	-	-	3
2	BT 322	IPR, Regulatory Affairs and Clinical Trials	4	-	-	3
3	BT 323	Bioinformatics	4	-	-	3
4	BT 324	Environmental Biotechnology	4	-	-	3
5	BT 325	Mass Transfer Operations	4	-	-	3
6	BT 351 BT 352 BT 353 BT 354	**Elective – I** 1. Virology 2. Phyto Chemicals and Herbal Products 3. Spectroscopic Analysis of Biomolecules 4. Medical Biotechnology	4	-	-	3
PRACTICALS						
7	BT 326	Bioprocess Lab	-	-	3	2
8	BT 327	Bioinformatics Lab	-	-	3	2
9	BT 328	Mass Transfer Operations Lab	-	-	3	2
10		Industry Visit	-	-	-	-
Total			**24**	**00**	**09**	**24**

MT 311

BIOSTATISTICS

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	2

Course Objectives:

1. Explain and apply principles of design, data collection and represent the data graphically
2. Understand properties of the normal curve
3. Infer properties of a population from a sample
4. Compute simple probabilities of events

Course Outcomes:

1. Demonstrate the ability to apply fundamental concepts in exploratory data analysis
2. Understand the concept of the sampling distribution of a statistic, and in particular describe the behavior of the sample mean
3. Understand the foundations for classical inference involving confidence intervals and hypothesis testing
4. Apply inferential methods relating to the means of Normal distributions
5. Demonstrate an appreciation of one-way analysis of variance (ANOVA)

UNIT – I DESCRIPTIVE STATISTICS

Types of data – Methods of collection of data-Graphical representation of data-Histogram-frequency polygon-Pie chart. Frequency distribution-Measures of central tendencies - Measures of dispersion (mean deviation and standard deviation) coefficient of variation and its significance

Measures of dispersion-Skewness- Kurtosis-Boweyl's coefficient-Karl Pearson's coefficient of skewness- correlation-Lines of regression- applications of Biotechnology

UNIT - II PROBABILITY

Classical approach- Axiomatic approach of probability. Basic theorems - addition and product theorem, conditional probability-Baye's theorem- applications to Biotechnology

UNIT – III PROBABILITY DISTRIBUTIONS

Random variable- types of Random variable-probability mass function-probability density functions-Expectation, variance, co variance and their properties.

Probability function-Moment generating function (M.G.F), Cumulant generating function (C.G.F) and Characteristic function (CF). Discrete Distributions- Binomial distribution, Poison distribution-their expectation, M.G.F, C.G.F and CF
Continuous distributions: Normal Distribution- mean, variance, M.G.F and C.G.F. Properties of Normal distribution

UNIT- IV INFERENCIAL STATISTICS I

Estimation-Hypothesis-Testing of Hypothesis-Types of Errors. Testing the single sample mean (σ known), Testing of single sample mean (σ unknown).Testing the single sample proportion- single sample variance
Testing the differences between two means, two proportions and two variances

UNIT-V INFERENCIAL STATISTICS II

Testing of many proportions- χ^2 – test independent of attributes-r x c-tables. Analysis of variance-CRD

Text Books:

1. Introduction to Bio-Statistics and Research Methods, by P.S.S Sunder Rao and J.Richard; fifth edition, PHI Learning Pvt. Ltd.2012
2. Fundamentals of Applied Statistics by S.C.Gupta and Dr.V.K.Kapoor, Tenth edition, Publishers: Sultan Chand & Sons

Suggested Reading:

1. Methods in Bio-Statistics by Mahajan, Japee Brothers Publishers, 2002
2. Text Book of Bio-Statistics; by A.K.Sharma Discovery Publishing House, 2005-Edition
3. Fundamentals of Mathematical Statistics A Modern Approach, by S.C.Gupta and Dr.V.K.Kapoor, 10^{th} edition, Publishers: Sultan Chand & Sons

BT 311

FLUID MECHANICS AND HEAT TRANSFER

Instruction	4L Periods per week
Duration of university Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

1. This course aims at providing knowledge on basic concepts in flow of fluids, flow field, flow past immersed bodies.
2. The course is designed to give an understanding on measurement of viscosity, flow measuring devices.
3. The course also deals with basic concepts in heat transfer, evaporation and condensation.

Course Outcomes: At the end of the course the students should

1. Be able to measure viscosity of different fluids
2. Explain the functions of different flow measuring and monitoring devices.
3. Explain the operation of various, evaporators, condensers, heat exchange equipment.
4. Calculate the heat transfer area, overall heat transfer co-efficient required for various processes.

UNIT-I BASIC CONCEPTS IN FLOW OF FLUIDS

Introduction, Nature of fluid, Rheology of fluids -Newton's law of viscosity. Concept of Newtonian and non-Newtonian fluids- Different types of non-Newtonian fluids with examples in bioprocessing. Measurement of viscosity using extrusion rheometer, plate and cone viscometer, coaxial cylinder viscometer etc.

UNIT-II FLOW FIELD

Friction losses in laminar flow through a circular tube (Hagen-Poiseuille equation), Friction losses in turbulent flow (Fanning equation), Pumping of fluids flow through pipes, average velocity, flow regimes, boundary layer concept. Laminar and turbulent flow -characterization by Reynold's number, pressure drop due to skin friction and form friction, friction factor chart, Hagen - Poiseuille equation.

UNIT-III FLOW PAST IMMERSED BODIES

Definition of drag and drag coefficient. Friction in flow through beds of solids, Brief introduction to flow of compressible fluids. Flow measuring and monitoring systems- valves, bends, elbows, prevention of leaks, mechanical seals, stuffing box. Flow measuring devices-manometers, orifice-meter, venturimeter and rotameter. Brief description of Pumps and Blowers

UNIT-IV BASIC CONCEPTS IN HEAT TRANSFER

Introduction and Mechanisms of heat transfer; Conduction heat transfer (through slab, cylinder & Sphere); Conduction through solids in series, Forced convection heat transfer inside pipes, Introduction to radiation heat transfer, Chilling and freezing of food and Biological materials. Heat transfer correlations, and calculations, basic heat exchange equipment

UNIT-V BASIC CONCEPTS IN EVAPORATION AND CONDENSATION

Introduction, Types of evaporation equipment and operation methods; Overall heat transfer coefficients in evaporators; simple material balances. Calculation methods for single effect evaporators, Evaporation of biological materials. Types of condensation, numerical problems and condensation equipment.

Text books:

1. W L McCabe and JC Smith, “Unit operations in Chemical Engineering”, 6th edition., McGraw Hill Intl. Ed, 2005
2. Christie J. Geankoplis, “Transport Processes and Unit Operations”, 3rd edition, Prentice Hall India Pvt. Ltd.

Suggested Reading:

1. Kothandaraman CP and Rudramoorthy. R, “Basic Fluid Mechanics”, New Age International Publishers, New Delhi, 1998
2. Sachdeva RC, “Fundamentals of Engineering Heat and Mass Transfer”, New Age International Publishers, New Delhi, 1996

With effect from the academic year 2015-16

BT 312

PROTEIN ENGINEEERING AND ENZYME TECHNOLOGY

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

1. The course aims at providing knowledge about structure and functions of proteins.
2. To understand the biosynthesis of proteins and analytical techniques for protein structure prediction.
3. To learn the commercial applications of enzymes in diverse fields namely medicine, food industry, diagnostic industries.
4. To understand the methods of enzyme immobilization and its mass transfer kinetics.

Course Outcomes:

1. The learning outcomes are assessed through mid semester exams, slip test and end exam.
2. At the end of the course the students able to draw the structure of proteins,
3. And be able to isolate and purify the given protein.
4. Be in a position to explain the advantages and disadvantages of enzyme in biotechnological process.

UNIT- I PROTEIN STRUCTURE AND FUNCTIONS

Peptide bond- Structure, functions, physical and chemical properties, chemical synthesis of peptides; liquid phase and solid phase techniques; Proteins-classification and Biological functions; Physico-chemical properties, forces stabilizing protein structure-primary structure and its determination, α-helical, β-pleated structure; Ramachandran plot; super secondary structure, tertiary and quaternary structure; Myoglobin Lysozyme, Ribonuclease A, Hemoglobin; structure and functional relationship; Fibrous protein (Collagen).

UNIT- II PROTEIN BIOSYNTHESIS AND STRUCTURE PREDICTION

Methods of protein isolation, purification and Quantification; large scale synthesis of proteins, design and synthesis of peptides, use of peptides in biology, methods of detection (peptide mass fingerprinting, MALDI-TOF) and analysis of proteins; examples of engineered proteins, protein design and examples. Random, site directed catalytic affectivity; Structure prediction and modeling of proteins.

UNIT- III PRODUCTION AND APPLICATIONS OF ENZYMES

Enzyme nomenclature and classification of enzymes; Production and purification of crude enzyme extracts from plant, animal and microbial sources; Methods of characterization of enzymes; development of enzymatic assays; Applications of commercial enzymes; Proteases; Amylases; Lipases; Cellulases; Pectinases; Isomerases in food, pharmaceutical and other industries; Enzymes for analytical and diagnostic purposes; Design of enzyme electrodes and their application as biosensors in industry, health care and environment.

UNIT- IV MECHANISMS AND KINETICS OF ENZYME ACTION

Mechanisms of enzyme action; Concept of active site and energetics of enzyme substrate complex formation; Specificity of enzyme action; Kinetics of single substrate reactions; Turn over number; Estimation of Michaeli-Menten parameters; Multi substrate reaction mechanisms and kinetics; Types of inhibition - Allosteric regulation of enzymes; Deactivation of kinetics.

UNIT - V ENZYME IMMOBILIZATION & MASS TRANSFER EFFECTS IN IMMOBILISED ENZYME SYSTEMS

Physical and chemical techniques for enzyme immobilization - adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding etc., examples; Advantages and disadvantages of different immobilization techniques; Overview of applications of immobilized enzyme systems; Analysis of Film and pore Diffusion Effects on kinetics of Immobilized Enzyme Reactions; Formulation of dimensionless groups and calculation of Effectiveness Factors.

Text Books:

1. Lenhinger, David Nelson, "Principles of Biochemistry", W H Freeman, 2006
2. Palmer Trevor, "Enzyme Technology", E.W.P, 2004
3. J.L. Jain, "Fundamentals of Biochemistry", Chand (S.) & Co Ltd , India,1999
4. Voet and Voet Biochemistry- J.G, 2nd edition, John C.Wiley and Sons (1994).
5. James M. Lee, Gerald Reed , Steve Taylor , "Biochemical Engineering", eBook Version 2.2. ii Academic Press, 3rd Ed, 2001
6. Enzymes by Paul R. Mathewson Eagan Press Handbook Series (1998)
7. Biocatalysis - Fundamentals and Applications Edited by Bommarius, Andreas Sebastian; Riebel, Bettina R. Wiley-VCH (2004).

With effect from the academic year 2015-16

BT 313

BIOREACTION ENGINEERING

Instruction	4L Periods per week
Duration of university Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives

1.This course aims at providing an insight into the kinetics of chemical reactions. 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.

Course Outcomes

1. The learning outcomes are assessed through mid semester exams, quiz or a slip test and a final exam.
2. The students are able to write rate equations for any given chemical reaction and are able to understand the basic design calculations of various reactors.

UNIT-1 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.

UNIT- II REACTION MECHANISM AND GROWTH KINETICS

Searching for mechanism - Arrhenius equation - Batch reactor analysis for kinetics, (synchronous growth and its application in product production).

Growth Kinetics: Batch growth quantifying cell concentration, growth profiles and kinetics in batch culture, fed batch growth, continuous growth and their growth kinetic quantification, chemostat growth, semi-continuous / exponential feeding strategy.

UNIT- III BIOREACTOR SYSTEMS

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.

UNIT- IV DESIGNING OF BIOREACTORS

Design equations for enzyme reactors, batch growth of microorganisms, Design equation of a plug flow reactor; Design of CSTR with washout concept; Stirred tank reactors with recycle of biomass; Continuous stirred tank fermentors in series without and with recycle of biomass; Estimation of kinetic parameters.

UNIT- V MULTIPHASE BIOREACTORS:

Different types of reactors: Cell lift reactor, Multipurpose tower reactor, Liquid impelled loop reactor, Pumped tower loop reactor, Fluidized-bed reactor, Packed bed reactor, Bubble-column reactors, Airlift 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. Harvey W Blanch, Douglas S Clark "Biochemical Engineering", 1st Edition, 1997
2. James E Bailey, David F Ollis, "Biochemical Engineering Fundamentals: Solutions Manual" McGraw-Hill Education, 1979.

Suggested Reading:

1. Scheper T, "Advances in Biochemical Engineering Biotechnology", Vol. 74. ed. Berlin: Springer-Verlag, 2002
2. Biochemical Engineering and Biotechnology Handbook, by Bernard Atkinson Ferda Mavituna, Grove's Dictionaries; 2nd Edition (1992) .
3. Bioreactor Systems for Tissue Engineering Series: Advances in Biochemical Engineering / Biotechnology , Vol. 112 Kasper, Cornelia; van Griensven, Martijn; Pörtner, Ralf , Springer. (2009).
4. S.Aiba, A.E. Humphrey and N.R. MHH, "Bio-chemical Engineering", Second Edn. Academic Press, 1973.

BT 314

GENETIC ENGINEERING AND rDNA TECHNOLOGY

Instruction	4L Periods per week
Duration of university Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives

1. To provide theoretical concepts and principles in understanding the techniques in nucleic acid isolation, quantification and various enzymes and tools used in rDNA technology.
2. To understand the theoretical principles, various techniques and tools involved in construction of cloning vectors from various sources, detection and analysis of cloned genes.
3. To understand expression of recombinant gene in various host system
4. To know the applications of Genetic engineering tools in medicine, agriculture and human research.

Course Outcomes

1. The undergraduate students will be able to understand the basic principles and tools used in rDNA research starting from isolation of nucleic acid, restriction digestion, ligation, sequencing, amplification of DNA fragments using PCR technology,
2. The students gains theoretical knowledge on various cloning vectors their use in genetic transformation and analysis of recombinant protein using SDS PAGE
3. The undergraduates will be able to implement their theoretical concepts and knowledge while handling the practical experiments in their course work.

UNIT-I: ISOLATION, MANIPULATION AND IDENTIFICATION OF DNA

Isolation and purification of nucleic acids (DNA & RNA); Host controlled restriction and modifications; Enzymes used in cloning - restriction endonuclease (classification, nomenclature, target sites), polymerases, ligases, phosphatases, kinases, nucleases; Restriction mapping; Blotting techniques – Southern, Northern and Western Blotting.

UNIT- II: CLONING VEHICLES

Essential features of cloning vectors, plasmid vectors, pBR 322, pUC 18/19; Phage vectors - λgt11, λZAP, λEMBL4; M13 derived vectors –M13mp18; Phagemids- Blue script vectors; Cosmids – strategies to generate genomic library, artificial chromosomes - BAC, YAC, PAC, expression vectors - pET vectors, Animal Viral vectors - SV40, retroviral vectors, Plant vectors – Ti and Ri Plasmid.

UNIT- III: POLYMERASE CHAIN REACTION AND MOLECULAR MARKERS

PCR – Principle, Designing of primers, PCR Methodology, RT-PCR, Multiplex PCR, PCR for site directed mutagenesis, Identification of PCR products, Applications of PCR; Molecular marker – RFLP, RAPD, AFLP, gene chip, and micro array.

UNIT- IV: **CLONING STRATEGIES**

Construction of genomic and cDNA libraries; Basic concept of blunt end and cohesive end ligation, homopolymer tailing, use of linkers, adaptors, T/A cloning of PCR products. Introduction of cloned genes into hosts- Transformation, Transfection, packaging phage DNA *In vitro*, Particle Bombardment; Detection of clones with desired gene; Methods of gene sequencing: - Maxam-Gilbert method, Sanger's dideoxy chain termination method, Pyrosequencing, automation of DNA sequencing.

UNIT- V: EXPRESSION OF RECOMBINANT PROTEINS AND APPLICATIONS OF DNA TECHNOLOGY: High level expression of proteins in different host systems *(E. coli,* yeast, Insect, mammalian cells); Applications of Gene cloning and r-DNA Technology in Medicine (Recombinant Insulin, Human Growth Hormone, Recombinant Factor VIII), Agriculture (BT plants, Golden rice); Transgenic animals; Gene silencing (RNAi) Introduction to Gene therapy (*Ex vivo* & *In vivo*), case study of ADA as an example. Safety guidelines for rDNA research.

Text books:

1. Brown TA, "Gene Cloning and DNA Analysis: An Introduction", 6th edition., Wiley Blackwell , A John Wiley & Son Ltd publications, UK, 2010
2. Primrose SB and Twyman RM, "Principles of Gene manipulation and Genomics", 7th edition, Blackwell Publishing. 2006

Suggested Reading:

1. Glick BR, Pasternak JJ and Patten CL, "Molecular Biotechnology: Principles and applications of Recombinant DNA", 4th edition, ASM Press, 2009
2. Desmond S T Nicholl, "An Introduction to Genetic Engineering", 3rd edition, Cambridge University Press, 2008
3. Richard J. Reece, "Analysis of Genes and Genomes", Wiley, 2004

CE 444

HUMAN VALUES AND PROFESSIONAL ETHICS
(common to all branches of B.E/B.Tech)

Instruction	21L Periods per semester (7 x 3)
Duration of University Examination	2 Hours
University Examination	50 Marks
Sessionals	-
Credits	-

Course Objectives:

1. To develop the critical ability among students to distinguish between what is of value and what is superficial in life
2. To enable the students understand the values, the need for value adoption and prepare them meet the challenges
3. To enable the students develop the potential to adopt values, develop a good character and personality and lead a happy life
4. To motivate the students practice the values in life and contribute for the society around him and for the development of the institutions /organization around they are in.
5. To make the students understand the professional ethics and their applications to engineering profession

Course Outcomes:

1. Students develop the capability of shaping themselves into outstanding personalities, through a value based life.
2. Students turn themselves into champions of their lives.
3. Students take things positively, convert everything into happiness and contribute for the happiness of others.
4. Students become potential sources for contributing to the development of the society around them and institutions / organizations they work in.
5. Students shape themselves into valuable professionals, follow professional ethics and are able to solve their ethical dilemmas.

UNIT-1 Concepts and Classification of Values – Need and challenges for value Adoption

Definition of Values - Concept of Values - Classification of Values - Hierarchy of Values - Types of Values -Espoused and Applied Values - Value judgement based on Culture - Value judgement based on Tradition - Interdependence of Values

Need for value education - Findings of Commissions and Committees- Corruption and illegal practices - Science and Technology without values- Exploitation of nature - Increasing use of violence and intoxicants - Lack of education in values - Implications of education in values - Vision for a better India. Challenges for Value adoption - Cultural, Social, Religious, Intellectual and Personal challenges

UNIT – 2 Personal Development and Values in Life

Personal Development: Enlightened self-interest - Accountability and responsibility - Desires and weaknesses - Character development - Good relationships, self-restraint, Spirituality and Purity - The quest for Character - Tests of Character - The key to good character

Values in Life: Building an ethical policy - Integrating values in everyday life - Archaic Social Values - Parenting practices - Critical Thinking - Analyzing and Prioritizing values - Practicing Yoga and Meditation

UNIT – 3 Practicing Values for the Development of Society

Resentment Management and Self-analysis - Positive Thinking and Emotional Maturity - The importance of Women , Children and Taking care of them - Helping the poor and needy - Fighting against addictions and atrocities - Environmental awareness - Working for the Sustainable development of the society

Values in Education system: Present Scenario- Engineering education –Current trends- Need for quality improvement- Adoption of value education – Principles of Integrity-Institutional Development.

UNIT – 4 Basic Concepts of Professional Ethics

Ethics, Morals and Human life , Types of Ethics, Personal Ethics, Professional ethics, Ethical dilemmas, Indian and Global thoughts on ethics, Profession, Professional and Professionalism, Ethical role of a professional Basic ethical principles, Some basic ethical theories, use of ethical theories. Science, Religion Ethics, Genders and ethics, Media and ethics, Computer Ethics, Case Studies on Professional Ethics, Exemplary life sketches of prominent Indian personalities

UNIT-5 Ethics in Engineering Profession

Engineering profession-Technology and Society-Engineering as Social Experimentation-Engineering ethics-Ethical obligations of Engineering Professionals-Role of Engineers-Engineers as Managers-Professional responsibilities of Engineers- Engineers Responsibility for Safety- A few Case Studies on Risk management

Conflicts of Interest- Occupational Crimes- Plagiarism-Self plagiarism-Ethics Audit-Consideration for ethics audit-Ethics Standards and Bench Marking

Text Books:

1. Subramanian R., " Professional Ethics " , Oxford University Press , 2013
2. Nagarajan R.S., " A Text Book on Human Values and Professional Ethics " New Age Publications , 2007
3. Dinesh Babu S., " Professional Ethics and Human Values " , Laxmi Publications , 2007

Suggested Reading:

1. Santosh Ajmera and Nanda Kishore Reddy " Ethics , Integrity and Aptitude " ,Mc Graw hill Education Private Limited , 2014
2. GovindaRajan M., Natarajan S., Senthil Kumar V.S." Professional Ethics and Human Values " PHI Private Limited , 2012

Course Material for Post Graduate Diploma In "Value Education & Spirituality " Prepared by Annamalai University in Collaboration with Brahma Kumaris , 2010

With effect from the academic year 2015-16

BT 315

FLUID MECHANICS AND HEAT TRANSFER LAB

Instruction	3P Periods per week
Duration of university Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	2

Course Objectives

1. This lab course is designed to understand the mechanics of fluid flow, analysis of various processes viz., Flow measuring devices (Venturimeter, Mouth piece, and Triangular notch.), heat exchangers.

Course Outcomes

1. Course outcomes are based on a continuous evaluation basis, like viva voce, calculations etc., and a final exam.
2. Students must be able to demonstrate various experimentation methods with skill and precision

LIST OF EXPERIMENTS

1. Determination of discharge coefficient for orifice meter and venturi meter and their variation with Reynolds number
2. Determination of weir meter constant K for v-notch and rectangular notch
3. Calibration of rotameter and study of variation of flow rate with tube to float diameter
4. Determination of viscosity of Glycerol - water solutions at different temperatures
5. Determination of friction factor for flow of water through annulus using Farmings and Davos equations.
6. Determination of friction factor for flow through straight pipes of different diameters and study of variation of friction factor with Reynolds number.
7. Determination of friction losses in pipe fittings
8. Determination of Thermal conductivity of homogeneous wall insulating powder under steady state conditions.
9. Determination of interface temperatures in composite wall under steady state conditions.
10. Determination of heat transfer coefficient in Natural convection.
11. Determination of overall heat transfer coefficient in unsteady state heat transfer
12. Determination of inside heat transfer coefficient in coil heat exchangers
13. Determination of overall heat transfer coefficient and effectiveness in a Double pipe heat exchange
14. Determination of heat transfer area in a 1-2- shell and tube heat exchanges
15. Determination of heat transfer coefficient on a single tube by film wise and drop wise condensation.

BT 316

ENZYME TECHNOLOGY LAB

Instruction	3P Periods per week
Duration of university Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	2

Course Objectives

1. The course aims at providing knowledge about the preparation of buffers and chemicals for isolation and purification of enzymes.
2. The students understand the methods of immobilization of enzymes and their kinetics.

Course Outcomes

1. Course outcomes are assessed through conducting viva-voce, mid exams and end practical exam.
2. The students able to analyze the effect of various physical parameters and Michelis-Menten kinetics (K_s, V_{max}) activity of enzyme.
3. The students able to choose the suitable methods for immobilization of enzymes.

LIST OF EXPERIMENTS

1. Preparation of buffers
2. Isolation and extraction of enzymes (Microbial, plant and animal source).
3. Effect of pH on enzyme activity.
4. Effect of temperature on enzyme activity.
5. Effect of substrate concentration on enzyme activity.
6. Effect of time interval on enzyme activity.
7. Development of Enzyme Assay
8. Evaluation of Michelis Menten kinetic parameters.
9. Kinetic studies of enzyme inhibition.
10. Determination of growth curve of a supplied microorganism and to determine substrate degradation profile.
11. Studies on immobilization of enzyme/cell by gel entrapment method.
12. Comparative study of activities of free and immobilized enzyme systems.

BT 317

GENETIC ENGINEERING LAB

Instruction	3P Periods per week
Duration of university Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

1. To provide an opportunity to experimentally verify the concepts of genetic engineering and rDNA technology already studied.
2. To provide hands on training to students to practically prove the theoretical concepts studied with respect to isolation, quantification, amplification, sequencing of DNA genome /fragments and analysis of recombinant protein from transformed bacterial cultures

Course Outcomes:

1. The students will be able to individually isolate nucleic acids, subject to restriction digestion, ligate, amplify it using PCR technology.
2. The students can sequence DNA fragments, handle experiments in transforming bacterial cells with recombinant plasmids and analyze the recombinant proteins using SDS –PAGE techniques

LIST OF EXPERIMENTS

1. Isolation of genomic DNA
2. Isolation of plasmid DNA
3. Visualization of Genomic and Plasmid DNA on Agarose gels
4. Restriction digestion
5. Restriction mapping of DNA fragments
6. Gel elution
7. DNA ligation
8. Preparation of competent cells
9. Genetic transformation and screening for recombinant bacterial cells
10. Blotting techniques- southern blotting
11. Amplification of DNA fragments by Polymerase Chain Reaction (PCR)
12. DNA sequencing- Sanger's Method
13. Analysis of Recombinant Proteins using SDS-PAGE

Suggested Reading:

1. Sambrook J and Russell DW, "Molecular Cloning-A laboratory manual", Vol I, II and III, Cold spring Harbor Laboratory Press, 2001

EG 221

SOFT SKILLS AND EMPLOYABILITY ENHANCEMENT
(common to all branches of B.E and B.Tech)

Instruction	2 Periods per week
Duration of University Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	1

Course Objectives: To help the students

1. Participate in group discussions 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.

Course Outcomes: The students will be able to

1. Be effective communicators and participate in group discussions 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 manage 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.

Exercise 1
Communicative Competence – The Art of Communication, basic grammar, Indianisms, Effective listening skills, using English in different situations

Exercise 2
Group Discussion – 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 3
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 4
Personality Development – Effective Time Management, setting realistic goals, self confidence and assertiveness, stress management,
moral values.

Exercise 5
Corporate Culture – Grooming and etiquette, communication media etiquette
Academic ethics and integrity

Suggested Reading:

1. Madhavi Apte , “A Course in English communication”, Prentice-Hall of India, 2007
2. Leena Sen , “Communication Skills”, Prentice-Hall of India, 2005
3. Dr. ShaliniVerma, “Body Language- Your Success Mantra”, S Chand, 2006
4. Edgar Thorpe and ShowickThorpe , “Objective English”,2nd edition, Pearson Education, 2007
5. Ramesh, Gopalswamy, and Mahadevan Ramesh, “The ACE of Soft Skills”, New Delhi: Pearson, 2010
6. Gulati and Sarvesh, “ Corporate Soft Skills”, New Delhi: Rupa and Co. , 2006
7. Van Emden, Joan, and Lucinda Becker, “Presentation Skills for Students”, New York: Palgrave Macmillan, 2004
8. Covey and Stephen R, “The Habits of Highly Effective People”, New York: Free Press, 1989

BT 321

FERMENTATION TECHNOLOGY

Instruction	4L Periods per week
Duration of university Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives

1. The course aims at providing knowledge to students on scope and chronological development of fermentation technology.
2. To understand the types of fermentation process and design of fermentation.
3. To learn about the ancillaries of fermentor and its applications.
4. To gain in-depth knowledge about the working principles and operation of fermentors.

Course Outcomes

1. The learning outcomes are assessed through mid semester exams, slip tests and end exam.
2. At the end of the course the student
   a. Be able to explain the types of fermentation media and media design.
   b. Explain the control of fermentation by various physical and chemical process parameters.
   c. Explain the scale up of fermentors and working principles.

UNIT-I INTRODUCTION TO FERMENTATION PROCESSES

The range of fermentation processes; the chronological development of fermentation industry; Industrial applications; Future trends in fermentations; Aseptic transfer of spore suspension; Transfer of inoculums from seed tank to Fermentor.

UNIT- II FERMENTATION PROCESSES AND MEDIA DESIGN

General requirements of fermentation processes, Basic design and construction of fermentor and ancillaries, Main parameters to be monitored and controlled in fermentation processes;
Typical media, Media formulation, energy resources, carbon and nitrogen components
Solid-substrate, slurry fermentation and its applications

UNIT- III AERATION AND AGITATION IN FERMENTATIONS

Basic Mass transfer concepts; Oxygen transfer from gas bubble to cells; Oxygen transfer in fermentations; Bubble aeration and Mechanical agitation; Correlations for mass transfer coefficients; Gas Hold up; Power consumption concepts; Determination of oxygen transfer rates, K_La values; Other Factors affecting the values of mass transfer coefficients in fermentation vessels.

UNIT- IV SCALE UP AND RHEOLOGY IN FERMENTATIONS

Scale up of fermentation processes; Principles, theoretical considerations and techniques used; Scale down methods; The Rheology of fermentation broths; Rheological models; Measurement of rheological parameters; Rheological Control of fermentations; Mixing concepts, power requirement for mixing and improvement of mixing in fermentations.

UNIT - V FERMENTORS

Batch, Fed-batch and Continuous Fermentation systems; Dual and multiple fermentations; Comparison between batch and continuous fermentations; Steady state, unsteady state continuous fermentation theories; Examples of continuous fermentation; Practical problems with continuous operations. Monitoring and Control of fermentations, behavior of microbes in different reactors (air lift, fluidized, batch, and continuous fed batch condition).

Text Books:

1.Stanbury PF, Whitaker A and Hall S J, "Principles of Fermentation Technology" 2nd edition, Elsevier, 2013,
2.Bailey JE and Ollis DF, "Biochemical Engineering Fundamentals", 2nd edition, McGraw Hill, 1986
3.Pauline M. Doran, "Bioprocess Engineering Principles", Academic press, 1995

Suggested Reading:

1.Shuler M and Kargi F, Bioprocess Engineering, Prentice Hall of India Pvt. Ltd., New Delhi, 2002
2.Harvey W. Blanch, Douglas S. Clark, "Biochemical Engineering" 1st edition, CRC, 1997
3.Srivastava ML, "Fermentation Technology", Narosa Publishing House, 2008
4.Brian McNeil and Linda Harvey, " Practical Fermentation Technology" Wiley, 2008
5.Crueger W and Crueger A, "Biotechnology: A Text Book of Industrial Microbiology", 2nd Edition, Panima Publishing Corporation, New Delhi, 2000

BT 322

IPR, REGULATORY AFFAIRS AND CLINICAL TRIALS

Instruction	4L Periods per week
Duration of university Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course objectives

1. Intellectual property rights and their importance, National and international regulatory affairs, GCP &ICH guidelines.
2. A comprehensive introduction to Regulatory Affairs as typically practiced by Regulatory Affairs professionals in medical device and biopharma companies.
3. Current trends in Clinical research and regulations

Course outcomes

1. Students will know the importance of IPR and how to apply for a patent.
2. Students will have the knowledge of ICH, GCP, FDA guidelines
3. Understand the phases of clinical trials and the basis of approval of new drugs, their outcome in new drug discovery and have the comprehensive knowledge on clinical trials.

UNIT- I INTELLECTUAL PROPERTY RIGHTS

Intellectual property rights, and intellectual property protection, patents and methods of application of patents, trade secret, copy rights, trade marks, legal implication, trade related aspects (TRIPS), farmers rights, plant breeder's rights.

UNIT – II REGULATORY AFFAIRS - INDIA

Indian contest- requirements and guidelines of GMP, understanding of Drugs and Cosmetic Act 1940 and rules 1945 with reference schedule M, U & Y. The Narcotics Drugs and Psychotropic Substances Act
Medicinal and Toilet Preparations (Excise Duties) Act, 1955
The Pharmacy Act, 1948 Types of ANDA filing (Para I, II, III, IV filing)
Clinical trial approval by Drug Controller General of India (DCGI)
Exclusivities (NCE, NS, NP, NDF, PED, ODE, PC)

UNIT – III REGULATORY AFFAIRS - GLOBAL

Introduction to FDA, WHO, Code of federal Regulations, ICH Guidelines, Related quality systems- objectives and guidelines of USFDA, WHO & ICH, European Medicines Agency and its responsibility, EU clinical trial directive. Requirement of GLP: Guidance and recommendation on Dissolution and Bio-equivalence requirement. Hatch Waxmann Act.

UNIT – IV DOCUMENTATION AND PROTOCOLS

Documentation: Types related to pharmaceuticals industry, protocols, harmonizing formulation development for global fillings, NDA, ANDA, IND, BLA, CTD, DMF, Dealing with post approval changes- SUPAC, handling and maintenance including electronic documentation, 510K device application.

UNIT – V INTRODUCTION TO CLINICAL RESEARCH

History, Importance and Scope, stake holders in clinical research, Framework of clinical research, Declaration of Helenski, 2000 amendment, medical and clinical research terminology, Principles of GCP, Roles and responsibilities in clinical research according to ICH GCP, Sponsor, Investigator, IRB/IEC, Essential documentation, Confidentiality issues. Clinical data management system, Double data entry.

Text Books:

1. Good Clinical Practices, Central Drugs Standard Control Organization, Govt. of India
2. Drugs and Cosmetics Act, 1940
3. Dominique PB and Gerhardt Nahler, International Clinical Trial, Volume 1&2, , Interpharm Press, Denver, Colorado

Suggested Reading:

1. Code of Federal Regulations by USFDA-Download
2. ICH-GCP Guidelines-Download
3. Fleming DA, Hunt DL, "Biological Safety Principles and Practices", 3rd edition, ASM Press, Washington, 2000

With effect from the academic year 2015-16

BT 323

BIOINFORMATICS

Instruction	4L Periods per week
Duration of university Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

1. To provide elementary knowledge in bioinformatics and biological information available to biologist on the web and learn how to use these resources on their own
2. To learn fundamentals of biological databases and sequence alignment
3. To understand evolutionary relationship among organisms
4. To learn methods for determining the order of the nucleotide and to predict gene
5. To aid in understanding structural bioinformatics and biochemical databases

Course Outcomes:

1. Graduates will have the knowledge of basics of bioinformatics
2. Graduates will be able to use bioinformatics search tools on the internet for data mining, pair wise and multiple sequence alignments, genome sequencing, predict gene and protein structure, evolutionary tree and biochemical databases.

UNIT-I INTRODUCTION TO BIOINFORMATICS AND BIOLOGICAL DATABASES

Need of Computers in Biotechnology Research, Elementary commands and protocols, ftp, telnet, http; Bioinformatics- Introduction, Scope of Bioinformatics, Applications; Introduction to biological databases, types of biological database, file formats for biological sequence (NCBI, EMBL, SWISSPROT, FASTA); Information retrieval from biological Databases.

UNIT- II SEQUENCE ALIGNMENTS AND DATAMINING

Sequence Alignment-Local, Global alignment; Methods of pairwise sequence alignment; Multiple Sequence alignment methods; Comparison of pair wise and multiple alignment; Sequence database search- FASTA, BLAST, various versions of BLAST and FASTA; Amino acid substitution matrices- PAM and BLOSUM; Data Mining and Visualization.

UNIT- III PHYLOGENETIC ANALYSIS

Understanding Evolutionary process; Origin of Molecular Phylogenetics; Relationship of phylogenetic Analysis to sequence alignment; Concept of evolutionary trees; Methods of Phylogenetic analysis, Tree Evaluation, Problems in Phylogenetic Analysis, Automated Tools for Phylogenetic Analysis; Ultrametric trees.

UNIT-IV GENOME MAPPING AND GENE PREDICTION

DNA sequencing- Map assembly, Genome Mapping; Genome sequencing, cDNA sequencing, Genome sequence assembly, Comparative Sequence Analysis; Gene Annotation; Human Genome Project (HGP); Basis of Gene Prediction, Gene predictions in Microbial genomes and eukaryotes, Gene Prediction Methods, Other Gene Prediction Tools.

UNIT V STRUCTURAL BIOINFORMATICS AND BIOCHEMICAL DATA BASES

Protein structure basics, protein structure classification, visualization and comparison, protein secondary structure prediction and protein tertiary structure prediction; Introduction to Biochemical databases- KEGG, BRENDA. Molecular Modeling Databases (MMDB)

Text Books:

1. David Mount, "Bioinformatics Sequence and Genome Analysis", 2nd edition, CBS Publishers and Distributors Pvt. Ltd., 2005
2. Rastogi SC, Mendiratta N and Rastogi P, "Bioinformatics: Methods and Applications Genomics, Proteomics and Drug discovery", 3rd edition, PHI Learning Private Limited, New Delhi, 2010

Suggested Reading:

1. Baxebanis AD and Francis Ouellette BF, "Bioinformatics a practical guide the analysis of genes and proteins", 2nd edition, John Wiley and Sons, Inc., Publication, 2001
2. Vittal R Srinivas, "Bioinformatics: A modern approach. PHI Learning Private Limited", New Delhi, 2009
3. Ji Xiong, "Essential Bioinfomatics", Cambridge University Press, 2006

With effect from the academic year 2015-16

BT 324

ENVIRNOMENTAL BIOTECHNOLOGY

Instruction	4L Periods per week
Duration of university Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives

1. To provide theoretical concepts and a comprehensive knowledge on bioremediation methods, bio leaching etc.
2. To impart theoretical basics on various methods used in treatment of waste water.
3. To update the students with the available information on biotechnological applications in hazardous waste management

Course Outcomes

1. The undergraduates will have the theoretical knowledge in bioremediation methods for its applications in practice
2. The students will be able to apply the theoretical concepts and principles studied in the treatment of waste water, environmental pollution, in hazardous waste management and also in recovering useful materials.

UNIT – I: BIOREMEDIATION

Introduction; Constraints and priorities of Bioremediation, Biostimulation of naturally occurring microbial activities
Bio-augmentation; *In situ, Ex situ*, Intrinsic and Extrinsic Bioremediation; Solid phase bioremediation- Land farming, Prepared beds, Soil pipes, Phyto-remediation, Liquid phase bioremediation.

UNIT – II: METAL BIOTECHNOLOGY AND BIOFUELS

Mining and metal biotechnology; Microbial transformation; Accumulation and concentration of metals; Metal leaching; Metal Extraction and future prospects.
Microorganisms and their role in energy requirements of mankind. Role of carbon credits in Industries, present scenario around the world. Production of non-conventional fuels: Methane (Biogas), Hydrogen Alcohols and Algal Hydrocarbons.

UNIT – III: BIOLOGICAL WASTE WATER TREATMENT

Biological processes for domestic and industrial waste water treatment. Usage of algae and bacteria for waste water treatment. Aerobic systems – Activated sludge process, trickling filters, Biological filters, Rotating biological contractors (RBC), Fluidized bed reactor (FBR), Expanded bed reactor, Inverse fluidized bed bio-film reactor (IFBBR), Packed bed reactors. Anaerobic biological treatment-Contact digesters, Packed column reactors, UASB.

UNIT- IV: DEGRADATION OF XENOBIOTIC COMPOUNDS

Introduction- Xenobiotic compounds; Recalcitrants- hazardous wastes. Biodegradation of Xenobiotics present in Environment. Decay behavior and degradative plasmids; Hydrocarbons, and substituted Hydrocarbons. Oil Pollution and Bioremediation of Contaminated soils. Biological Detoxification, Cyanide detoxification; Detoxification of Toxic Organics- Phenols.

UNIT- V: HAZARDOUS WASTE MANAGEMENT

Biotechnological applications to hazardous waste management. Examples of Biotechnological applications to hazardous waste management; Global Environmental problems and Biotechnological approaches for management. Treatment of nuclear wastes.

Text books:

1. Foster CF, John Ware DA, "Environmental Biotechnology", Ellis Horwood Ltd. 1987.
2. Karnely D, Chakrabarthy, Omen GS, "Biotechnology and Biodegradation, Advances in Applied Biotechnology" series Vol-4 –, Gulf publications co., London, 1989.
3. John T, Cookson Jr, "Bioremediation Engineering: Design and application", McGraw Hill, Inc., 1985.

Suggested readings

1. Stanier RY Ingram JL., Wheelis ML & Painter RR "General Microbiology" Mcmillan Publications, 1989
2. Environmental Biotechnology By Priv.-Doz. Dr.Hans-Joachim Jördening, Prof. Dr. Josef Winter, Wiley-VCH Verlag GmbH & Co. KGaA. 2005.
3. John. T. Cookson "Bioremediation Engineering: Design And Application" by, Jr. Mc Graw Hill, Inc. 1995

BT 325

MASS TRANSFER OPERATIONS

Instruction	4L Periods per week
Duration of university Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

1. To provide the students with knowledge about various unit operations such as absorption, distillation, extraction, leaching.
2. To give insight about various membrane separation processes such as adsorption, Ion-exchange, dialysis and the application of these unit operations in commercial aspects of biotechnology.

Course Outcomes: At the end of the course student should

1. Explain Molecular diffusion in solids, liquids and gases
2. Be able to determine the number of trays needed for the separation
3. Carry out material balances accurately.
4. Explain the principles of the various separation processes involved in the downstream processing of products, especially those of biological origin
5. Explain the principles and application of membrane separation processes.

UNIT- I PRINCIPLES OF MASS TRANSFER

Introduction to Mass transfer and Diffusion, Molecular diffusion in Gases, Molecular diffusion in Liquids, Molecular diffusion in Biological solutions and gels, Molecular diffusion in Solids, Inter phase mass transfer and Mass transfer coefficients.

Gas - Liquid operations: Equilibrium relations between phases, Mass transfer between phases, Choice of solvent for absorption, Single stage and multi stage co current and counter current operations, Estimation of Mass transfer coefficient, Calculation of HTU, NTU concepts, equipments mechanically agitated vessels, packed columns and plate columns.

UNIT- II PRINCIPLES OF VLE FOR BINARY SYSTEM

Phase rule and Raoult's law, Boiling point diagrams and x-y plots, Relative volatility, Flash distillation, Differential distillation, Simple steam distillation. Distillation with reflux and McCabe - Thiele method. Special Cases for rectification using McCabe - Thiele; Stripping column distillation, Enriching Column distillation, Rectification with direct steam injection, Rectification with single side stream.

UNIT- III LIQUID - LIQUID EXTRACTION AND LEACHING

Introduction to Extraction process: Equilibrium relations in extraction, Analytical and graphical solutions for single and multi stage operations co-current and counter current operations without reflux. Equipments for liquid-liquid extraction: mixer-settlers for extraction, Plate and Agitated Tower Contactors for Extraction, Packed and spray Extraction towers.

Introduction to leaching process: Equilibrium diagrams for leaching, analytical and graphical solutions for single and multi stage counter current operations.

UNIT - IV BASIC CONCEPTS IN DRYING OF PROCESS MATERIALS

Methods of drying, Equipment for drying; Free moisture content of materials; Concept of bound and unbound moisture content of biological materials; Rate of drying curves; Calculation methods for constant-rate & falling rate drying methods; Freeze drying of biological materials.

UNIT- V ADSORPTION AND MEMBRANE SEPARATION PROCESS

Theory of adsorption, Industrial adsorbents, Adsorption equilibria, Frendlich equation-single and multiple operations- processing variables and adsorption cycles

Introduction and Types of Membrane separation process: Principles of ion exchange. Dialysis, Gas permeation membrane processes, types of membranes and permeability's for separation of gases, Introduction to types of flow in gas permeation.

Text Books:

1. C J Geankopolis, "Transport Processes in chemical Operations", 4th edition, Prentice Hall India
2. Robert ETreybal, "Mass Transfer operations", 3rd edition. McGraw-Hill
3. Warren L, McCabe, Julian C. Smith, Peter Harriot, "Unit operations of Chemical Engineering", 5th Edition, McGraw-Hill

Suggested Reading:

1. Jaime Benitez, "Principles and Modern Applications of Mass Transfer Operations", 2nd edition, 2009
2. J M Coulson and J F Richardson, "Chemical Engineering", Vol-II, 3rd edition, Pergamom Press.
3. Sahay K M and KK Singh, "Unit operation of Agricultural Processing", Vikas Publishing House Pvt. Ltd, New Delhi, 1994
4. Earle RL, "Unit operation in Food processing", Pergamon Press, Oxford, 1996
5. Mc Cabe WL, Smith JC and Harriot P, "Unit operations of chemical engineering", 3rd edition, McGraw Hill ,1993

With effect from the academic year 2015-16

BT 351

VIROLOGY
(ELECTIVE –I)

Instruction	4L Periods per week
Duration of university Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course objectives

1.To study a brief account on the properties, types and cultivation studies of viruses
2.Structural and the taxonomical studies and the diseases of animal and plant viruses

Course outcomes

1.The student will get a comprehensive knowledge about various properties, types, morphological properties of animal and plant viruses
2.The students get the knowledge about the classification and diseases caused by plant and animal viruses

UNIT- I INTRODUCTION TO VIROLOGY

Brief outline of discovery of Viruses; Properties of Viruses; Morphology of Viruses-Structure, Capsid Architecture, Envelopes and peplomers; Chemistry of Viruses- Viral Proteins, Genome- Structure and Types; Study of sub viral agents- Brief account on Diseases caused by Viroids- PSTV, Cadang cadang; Prions- Scrape, Cruetzfeldy jakob. Satellite viruses; Satellite RNA's.

UNIT- II CULTIVATION OF VIRUSES I

General methods of cultivation of viruses- in embryonated eggs, cultivation of animal and plant viruses; Isolation and purification of viruses- plant viruses, animal viruses; Criteria of purity, Maintenance and preservation of infectivity; Characterization of viruses- Electron microscopy, X-ray crystallography, sedimentation analysis;

UNIT- III CHARACTERIZATION OF VIRUSES II

Enumeration viruses- By electron microscopy, plaque assay, acid end point method, Haemagglutinin assay; Detection of viruses- By serological characterization, detection of viral antigen, detection of viral nucleic acid; chemical determination Ultra structure and life cycles of Bacteriophages- Ml3, Mu, T3, T4 & lambda

UNIT- IV PLANT VIRUSES

Taxonomy; Symptoms of diseases caused by plant viruses (Morphological, Physiological and Histological); Ultra structure and life cycles of TMV and CaMV; transmission of plant viruses- Mechanical and biological (vector and non-vector); Basic control measures of plant diseases- vector and chemical control.

UNIT- V ANIMAL VIRUSES

Taxonomy; Detailed structure and brief account on life cycles of RNA viruses- Polio, Influenza, Measles, Rota virus and HIV; Ultra structure and brief account on life cycles of DNA viruses- Vaccina, HSV, Adeno, SV40 and Hepatitis Virus; Viral vaccines- types and preparation of conventional vaccines

Text Books

1. Dimmock NJ and Primrose SB, "Introduction to Modern Virology", 4th edition, Blackwell Scientific Publications, 1994.
2. Matthews REF "Fundamentals of Plant Virology". Academic Press, San Diego, 199**2**

Suggested books

1. Carter J and Saunders V "Virology: Principles and Applications" John Wiley and Sons ltd, 2007
2. Morag C, Timbury M, Chrchill Livingstone, "Medical Virology", London, 1994

BT 352

PHYTOCHEMICALS AND HERBAL PRODUCTS
(ELECTIVE –I)

Instruction	4L Periods per week
Duration of university Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course objectives

1. To impart knowledge on medicinal plants and extraction of crude drugs.
2. To provide a comprehensive knowledge on analysis, types and detection of phytochemicals and adulterants.
3. To impart knowledge on the applications of various phytochemicals and herbal products.

Course outcomes

1. The undergraduates will know the sources of various crude drugs and their medicinal values.
2. The students will understand the procedures involved in the detection, extraction and analysis of crude drugs and adulterants.
3. The undergraduates will be able to implement their theoretical concepts and knowledge of extraction and their applications in herbal preparation for implementing the same practically.

UNIT I: CRUDE DRUGS, MEDICINAL AND AROMATIC PLANTS

Crude Drugs - Scope and Importance, Classification (Taxonomical, Morphological Chemical, Pharmacological); Collection and processing of Crude Drugs. Utilization of Medicinal and Aromatic Plants in India. Genetics as applied to Medicinal herbs. Biogenesis of Phytopharmaceuticals.

UNIT II: ANALYSIS OF PHYTOCHEMICALS

Methods of Drug evaluation (Morphological, Microscopic, Physical and Chemical). Preliminary screening, Assay of Drugs - Biological evaluation / assays, Microbiological methods, Chemical Methods of Analysis and Detection of Adulterants: Chemical estimations. Drug adulteration - Types of adulterants

UNIT III: TYPES OF PHYTOCHEMICALS

Carbohydrates and its derived products- Structures, types and extraction methods : Glycosides - Digitalis, Aloe, Dioscorea ; Volatile Oils - Clove, Mentha; Alkaloids - Taxus, Papaver, Cinchona; Flavonoids-and Resins. Tannins (Hydrolysable and Condensed types).

UNIT IV: APPLICATIONS OF PHYTOCHEMICALS

Application of phytochemicals in industry and healthcare; Biocides, Bio-fungicides, Biopesticides.

UNIT V HERBAL PRODUCTS

History, Scope, and Current aspects of herbs and herbal medicines; Classification of active components of therapeutic plant and herbal products; Preparation of standardized extracts of Garcinea, Forskolin, Garlic, Turmeric and Capsicum, issues of licencing of herbal drugs.

Text books:

1. Kokate CK, Purohit AP and Gokhale SB, "Pharmacognosy", 4th edition, Nirali Prakashan, 1996.
2. Trease and Evans WC Evans, " Pharmacognosy" , 14th edition, Harcourt Brace & Company. 1989.
3. Hornok L, "Cultivation & Processing of Medicinal Plants" Chichister, U. K: J. Wiley & Sons.1992

Suggested Reading:

1. Natural Products in medicine: A Biosynthetic approach Wiley. 1997
2. Chaudhri RD, "Herbal Drugs industry, A practical approach to Industrial Pharmacognosy" Eastern publishers, 2nd reprint, New Delhi. 1999.

BT 353

SPECTROSCOPIC ANALYSIS OF BIOMOLECULES
(ELECTIVE –I)

Instruction	4L Periods per week
Duration of university Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives

1.To understand selected biochemical techniques to determine bimolecular structure and function as well as spatial distribution of biomolecules and molecular complexes in cells.

Course Outcomes

1.Graduates are able to detect and characterize biomolecules by various spectroscopic techniques

UNIT- I INTRODUCTION TO SPECTROSCOPY AND IR SPECTROSCOPY

Interaction of radiation with matter, Definitions- Frequency, Wavelength, Wave Number; Types of Electromagnetic radiation, Interparticle forces and energies; energy levels; Population of energy levels, Scattering, Absorption and Emission.
Measurement of Infrared spectrum; Physical basis of infrared spectra. Infrared of polyatomic molecules; Biological examples; Infrared of oriented samples.

UNIT- II ULTRAVIOLET AND VISIBLE SPCTROSCOPY

Electronic energy levels; Electronic transitions; Selection regime, Absorption range of biological chromophores; Transition metal d-d transition; Charge transfer spectra; Application of UV spectra to proteins; Properties associated with the transition dipole moment and interaction between them, Measurement of molecular dynamics by Fluorescence spectroscopy.

UNIT- III NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY

The Phenomenon, Magnetization-Measurement; Spectral Parameters in NMR, Intensity, Chemical Shift, Spin-spin coupling, Tl and T2 relaxation times, Line widths, Nuclear over Hauser effect, Chemical exchange paramagnetic centers, Applications of NMR in Biology, assignment in NMR, Studies of Macromolecules, Ligand binding, lionization studies and pH kinetics, Molecular Motion.

UNIT-IV ELECTRON PARAMAGENTIC RESONANCE SPECTROSCOPY

Introduction- Resonance condition; Measurement- Spectral Parameters; Intensity of g values; Spectral Anisotropy, Time scale of EPR, Spin labels, Transition metal ions, Spin trapping.

UNIT V MASS SPECTROMETRY

Mass spectroscopy: introduction, theory and instrumentation (components and their significance). Mass spectrum, molecular-ion peak, types of fragmentation, rearrangement and nitrogen rule. Chromatography combined mass spectroscopy techniques like Combined gas chromatography - mass spectrometry (GC/MS), High performance liquid chromatography-mass spectrometry (HPLC/MS). Theory and principle of Electro-spray mass spectroscopy (ES-MS), Chemical ionization mass spectrometry (CMS), Field ionization mass spectroscopy (FTMS) and Fast atom bombardment mass spectroscopy (FAS). Applications of the above techniques for characterization of biomolecules.

Text books:

1.Campbell I D, Dwek R A, "Biological Spectroscopy", Benjamin Cummins and Co., 1986
2.Gordon G. Hammes, "Spectrocopy for the Biological Sciences", John Wiley & Sons, 2005

Suggested Reading:

1.Rodney F Boyer, "Biochemistry Laboratory: Modern Theory and Techniques", 1st edition, Prentice Hall, 2005
2.Laskin Julia Lifshitz Chava, "Principles of Mass Spectrometry Applied to Biomolecules", Wiley-Interscience
3.Robin Jon Hawes Clark, Ronald E Hester, "Biomolecular spectroscopy", Wiley & Sons, 1993

BT 354

MEDICAL BIOTECHNOLOGY
(ELECTIVE –I)

Instruction	4L Periods per week
Duration of university Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives

1. To understand the scope and importance of tools used in medical biotechnology.
2. The course aims at providing knowledge about the working principles and types of advanced materials used in medical field.
3. To gain the in-depth knowledge about the clinical applications of stems cells &banking
4. To understand the differences between the normal cells and cancer cells and various diagnostic methods used in cancer detection.
5. To learn current molecular therapies and controversial issues

Course Outcomes: At the end of the course the students should

a. Be able to use the tools for the diagnosis of diseases
b. Be in a position to design the prototype of medical instruments.
c. Explain the potentiality of stem cells and purpose of banking.
d. Explain about the uses of molecular therapies and how which led to controversy in society.

UNIT - I INTRODUCTION TO MEDICAL BIOTECHNOLOGY

Introduction, scope and importance of medical biotechnology; The genetic basis of the disease; chromosomal disorders; single gene disorders-modes of inheritance, Thalassemia, sickle cell anaemia, cystic fibrosis, Tay sachs disease, Fragile –X- syndrome; polygenetic disorders; Alzheimers disease,Type-1diabetis and mitochondrial disorders (neurological disorders).

UNIT - II MEDICAL INSTRUMENTATION AND DIAGNOSTICS

Concepts in Biomedical Engineering; principle, properties and applications of different types of biomedical devices; pacemakers, drug coated stents, knee replacement implants, dental implants, prosthetics, Molecular diagnosis by immunological approaches to detect protein biomarkers of the disease (types of ELISA), DNA approaches (Taq MAN approach, RT-PCR, epigenetic markers, detection of SNP by mass spectrometry; Applications of biosensors in medicine.

UNIT- III STEM CELL TREATEMENT

Cellular therapy, stem cells- definition, types, properties and uses of stem cells; sources of embryonic and adult stem cells; concept of tissue engineering; role of scaffolds; clinical applications of stem cells; stem cell banking and ethical issues.

UNIT- IV MEDICAL ONCOLOGY

Cancer types; Normal cells vs. cancer cells; cancer genetics; oncogenes and their proteins; tumor suppressor genes and their functions, diagnosis of cancer, Treatment of cancer; Radiation therapy, chemotherapy.

UNIT - V MOLECULAR THERAPEUTICS AND BIOETHICAL ISSUES

Types of molecular therapies; Gene therapy (*ex vivo* and *in vivo*); protein therapy by recombinant MAB, Enzymes (DNase-1, Alpha -1 antitrypsin), Lactic acid bacteria by Leptin, antisense therapy, immunotherapy by immunotoxins and recombinant vaccines.

Bioethical issues in IVF, surrogacy and cloning technologies.

Text Books:

1.Judith Pongracz, Mary Keen, "Medical Biotechnology", illustrated edition, Elseiver health sciences, 2009
2.Bernard R Glick, Cheryl L.Patton, Terry L.Delovitch, "Medical biotechnology", 1st edition, ASM press,2013

Suggested Reading:

1.Truepenny PD, Emerys "Elemental Medical Genetics", 14th edition, Churchill Livingstone, 2012
2.Strachnan and Reed, "Human Molecular Genetics", 3rd edition, Garland publishing Inc, US, 2003
3.R.J.B.King, Robins, "Cancer biology", 3rd edition, Prentice Hall, 2006
4.Subdery, "Human Molecular Genetics", 2nd edition, Prentice Hall, Pearson education.

With effect from the academic year 2015-16

BT 326

BIOPROCESS LAB

Instruction	3P Periods per week
Duration of university Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	2

Course Objectives

1. The course aims at providing knowledge about the methods of sterilization of cells and Thermal death kinetics of spores.
2. The students understand the types of reactors and its instrumentation.

Course Outcomes

1. Course outcomes are assessed through conducting viva, mid exams and end practical exam.
2. The students acquire the knowledge and precision about the operation and design of fermentor.

LIST OF EXPERIMENTS

1. Sterilization techniques (chemical, physical and filter methods) and thermal death kinetics.
2. Media optimization (placket- Burman design)
3. Bioreactor instrumentation and its control.
4. Microbial production of fine chemicals (Eg: citric acid and alcohol).
5. Study of growth substrate utilization.
6. Product formation kinetics in shake flask cultures.
7. Fed batch fermentation kinetics.
8. Measurement of K_La by sodium sulphite (Na_2SO_3) oxidation method.
9. Estimation of residence time distribution in tubular reactor.
10. Studies on immobilized enzyme/cells in packed bed reactor.
11. Estimation of rheological parameters in fermentation broths.

Suggested Reading:

1. Gunasekharan P, Laboratory manual in Microbiology, 2009
2. Chellapandi P, Laboratory manual in Industrial Biotechnology, Pointer publishers, 2007

BT 327

BIOINFORMATICS LAB

Instruction	3P Periods per week
Duration of university Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	2

Course Objectives

1. To provide practical instructions to the students on using the specific databases and learn how to use these resources on their own

Course Outcomes

1. Graduates are able to explore bioinformatics search tools on the internet on their own

LIST OF EXPERIMENTS

1. Searching Bibliographic databases for relevant information.
2. Sequence retrieval from DNA and Protein databases.
3. BLAST services.
4. FASTA services.
5. Pair wise comparison of sequences (Local and global alignment).
6. Multiple Sequence Alignment.
7. Evolutionary studies/Phylogenetic Analysis.
8. Protein Databank retrieval and visualization.
9. Structure Exploration of Proteins.
10. Restriction Mapping.
11. Identification of Genes in Genomes.
12. NCBI ORF Finder.
13. Primer Design.

With effect from the academic year 2015-16

BT 328

MASS TRANSFER OPERATIONS LAB

Instruction	3P Periods per week
Duration of university Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	2

Course Objectives:

1. This lab course is designed to understand and study the behavior of different reactors. Eg: Batch, CSTR, PFR, analysis of various processes viz., Diffusion, Distillation VLE

Course Outcomes:

1. Course outcomes are based on a continuous evaluation basis, like viva voce, calculations etc., and a final exam.
2. Students must be able to demonstrate various experimentation methods with skill and precision

LIST OF EXPERIMENTS

1. Diffusion of organic vapor in air
2. Liquid - liquid diffusivity
3. Surface evaporation
4. Wetted wall column
5. Simple distillation
6. Steam distillation
7. Packed bed distillation
8. Liquid - liquid equilibrium
9. Liquid - liquid extraction
10. Vapor liquid equilibrium
11. Batch reactor
12. Continuous stirred tank reactor
13. Saponification in a tubular reactor
14. Mixed flow reactors in series
15. Temperature dependency
16. Flow control system
17. Level control system.
18. Temperature control system

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY
DEPARTMENT OF BIOTECHNOLOGY
B.Tech IV – Year

SEMESTER – I

THEORY						
S. No.	**Code**	**Subject**	**L**	**T**	**P**	**Credits**
1	BT 411	Downstream Processing	4	-	-	3
2	BT 412	Bioprocess Dynamics and Control	4	-	-	3
3	BT 413	Plant Biotechnology	4	-	-	3
4	BT 414	Animal Biotechnology	4	-	-	3
5	MB 216	Principles and Practice of Management	4	-	-	3
6		Elective – II	4	-	-	3
	BT 461	Developmental Biology				
	BT 462	Cancer Biology				
	BT 463	Genomics and Proteomics				
	BT 464	Pharmaceutical Biotechnology				
PRACTICALS						
7	BT 415	Downstream Processing Lab	-	-	3	2
8	BT 416	Tissue culture Lab	-	-	3	2
9	BT 417	Project Seminar	-	-	3	1
Total			**24**	**0**	**9**	**23**

L: Lecture, T: Tutorial, P: Practical

SEMESTER – II

THEORY						
S.no.	**Code**	**Subject**	**L**	**T**	**P**	**Credits**
1	BT 421	Computer Applications in Bioprocess Industries	4	-	-	3
2	BT 422	Bioprocess Economics and Plant Design	4	-	-	3
3		Elective – III	4	-	-	3
	BT 471	Molecular Modeling and Drug Design				
	BT 472	Immunodiagnostics				
	BT 473	Tissue Engineering				
4		Elective-IV	4	-	-	3
	BT 481	Bioprocess Validations and Current good manufacturing Practices				
	BT 482	Food Biotechnology				
	BT 483	Nanobiotechnology				
	ME 464	Entrepreneurship				
5	BT 423	Seminar	3	-	-	1
6	BT 901	Project	6	-	-	9
Total			**25**	**-**	**-**	**22**

L: Lecture, T: Tutorial, P: Practical

DOWNSTREAM PROCESSING

BT 411

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

1. Student is made to understand the role and, importance of downstream processing.
2. Students are taught the various techniques of cell disruption and the principles of solid liquid separation processes, filtration and centrifugation
3. Students are made to understand the principles of membrane based separations and their applications.
4. Students are enlightened about chromatographic separations, types and their importance in product purification.
5. Students are made to study the principle of crystallization, drying and lyophilisation.
6. The students are made to understand the choice and sequence of bioseparations by case studies.

Course Outcomes:

1. Student will be able to know the key aspects of Downstream Processing from both a technical and economic perspective.
2. Be able to learn the various techniques of cell disruption and unit operations for separation of insolubles
3. Student will be able to design mineral water plant
4. Be able to design and select chromatographic separation process for different bioproducts and scale up
5. Be able to learn various techniques of product polishing and formulation.
6. Be able to analyze and summarize scientific results from real examples and use them to choose the best operational conditions for a particular unit operation.

UNIT- I: ROLE OF DOWNSTREAM PROCESSING IN BIOTECHNOLOGY

Role and Importance of Downstream Processing in Biotechnological Processes; Characterization of Biomolecules and fermentation broths; Physico-Chemical basis of Bio-separations; Characteristics of Bio-separations; Process design criteria for bioproducts; Downstream process economics.

UNIT- II: PRIMARY SEPARATION ANDRECOVERY PROCESSES

Cell Disruption methods for intracellular products- Mechanical, Chemical and Enzymatic Methods; Removal of Insolubles, Biomass separation techniques; Flocculation; Sedimentation; Centrifugation; Filtration: Theory, Equipment-Depth filters, Plate and frame filters, Pressure leaf filters, Continuous rotary drum filters, filter media and filter aids, Problems on specific resistance of the cake, time taken for filtration and, compressibility of cake.

UNIT- III: PRODUCT ENRICHMENT OPERATIONS

Membrane-based separations-Types of membranes, solution diffusion model, capillary flow model; Types of flow-Cross flow, Tangential flow and mixed flow; Types of membrane based separations: Micro-filtration, Ultra-filtration, Dialysis, Electro dialysis, Reverse Osmosis; Theory, design and configuration of membrane separation equipment, Applications; Aqueous Two-phase extraction of proteins; Precipitation of proteins with salts and organic solvents; Adsorption processes.

UNIT- IV: PRODUCT PURIFICATION AND POLISHING

Chromatographic separations- Principles, Classification, General description of column chromatography; IMAC, Bio-affinity Chromatography; Design and selection of chromatographic matrices; Design of large-scale chromatographic separation processes

UNIT- V: NEW AND EMERGING TECHNOLOGIES:

Pervaporation, super critical fluid extraction; Electrophoretic Separations; Final Product Polishing- Crystallization: nucleation, crystal growth, Industrial crystallizers, Drying: drying terminologies, drying curve, Industrial dryers Lyophilization: principles and applications; Formulation Strategies; Case studies (Citric acid / Penicillin and Low volume high value product like recombinant proteins).

Text Books:

1. Bio-separations: Principles And Techniques (2008)Prentice-hall Of India Pvt Ltd
2. Separation processes in Biotechnology by Sivasankar B,J M Asenjo, Marcel-Dekker, (1993).
3. Bio-separations- Downstream Processing for Biotechnology- Paul A Belter, E L Cussler, Wei-shouHu, Wiley Inter-science Publications, 1988.
4. Principles and Techniques of Practical Biochemistry by Keith Wilson, John Walker, John M. Walker 5th edition Cambridge University Press, (2000).

Suggested Reading:

1. Product Recovery in Bioprocess Technology- BIOTOL series, Butterworth Heinmann, (1992).
2. Separations for Biotechnology- M S Verall, M J Hudson, Ellis Harwood Ltd. (1990).
3. Bio-separations Science and technology Roger Todd Rudge Petreides Process Biotechnology Fundamentals by SN Mukhopadhya, Wankat PC. Rate controlled separations, Elsevier, (1990).
4. Bioseparations by Belter PA and Cussler E., Wiley (1985).
5. Product Recovery in Bioprocess Technology, BIOTOL.' Series, VCH, (1990).
6. Separation processes in Biotechnology Asenjo J.M., (1993), Marcel Dekkere Inc.
7. Downstream Process Technology by Nooralabettu Krishna Prasad PHI publications.
8. Bioseparations by Siva Shankar PHI publications.

BT 412 **BIOPROCESS DYNAMICS AND CONTROL**

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sectionals	25 Marks
Credits	3

Course Objectives:

1. The course aims at providing dynamics of system process, flow, level and temperature etc.
2. The course aims at incorporating with concepts of response of first order system for non interacting and interacting systems.
3. The course aims at providing knowledge the design of control system for open and close loop control.
4. The course aims at inculcating concepts of the control of pH of process and biochemical reactions.

Course Outcomes:

1. Students will use the knowledge of dynamics in the process control of level, temperature, flow etc in biotechnology industries.
2. Students will apply this expertise of first order system of non interacting and interacting system in biotech industries.
3. Students will incorporate the knowledge of open and close loop system for control of Bioreactors in biotechnology industries.
4. Students will adopt the skill set of fine tuning the process variable in biotech industries.
5. Students will exhibit the knowledge of control wall sizing in the design of control valve system in bioprocess units.
6. Students will apply the knowledge of controlling of pH of bioreactor in bioprocess industry for achieving good product conversions.

UNIT I: PROCESS DYNAMICS

Process variables, Dynamics of simple processes – Flow, level, Temperature, Pressure and Concentration; Transfer function – Properties, response of simple processes for Step, Impulse and Sinusoidal Forcing functions.
Concept of Time Constant, Linearization, Response of first order systems in series - Non-interacting and Interacting systems.

UNIT II: CONTROL ACTIONS AND CONTROLLERS

Controller and Control system – measuring and final control elements, Open and Closed loop control, Negative and Positive feedback control, Servo and Regulatory problems.
Ideal transfer functions –Control valve, Controllers, Proportional, Integral and derivative actions – P+I. P+D and P+I+D controls.
Block diagram- Development of block diagram, Description of system, reactor transfer function, effect of time delay Over all Transfer function for single loop system, overall transfer function for change in set point.

UNIT III: OPTIMUM CONTROLLER SETTINGS

Controller Tuning – Evaluation criteria with l/4th decay ratio, IAE. ISE, ITAE.
Tuning - process reaction curve method, Continuous cycling method, damped oscillation method. control of processes with a time delay.

UNIT IV: FINAL CONTROL ELEMENT

I/P Converter– pneumatic, electric and hydraulic actuators. Control valves – Construction, valve sizing, valve characteristics, valve positioner. Control of Globe, Butterfly and Diaphragm valves.

UNIT V: ADVANCED CONTROL STRATEGIES

Feed forward control, Ratio control, Cascade control.
Dynamics and Control of pH process and Biochemical reactor.

Text Books:

1. Sarkar PK, “Process Dynamics and Control”, PHI, 2013.
2. Seborg, Edgar, Mellichamp, Doyle, “Process Dynamics and Control”, 3rd edition John Weily and Sons, 2010
3. Harriott P, “Process control”, Tata McGraw-Hill publishing Co., New Delhi, Reprint 1991.

Suggested Reading:

1. Principles of Process Control by Patranabis D, 2nd ed., Tata McGraw-Hill publishing Co., New Delhi, Reprint 1997.
2. Automatic process control, Eckman D.P., Wiley Eastern Ltd., New Delhi, (1993).
3. Process Systems Analysis and Control, Donald R.Coughanowr, 2nd ed., McGraw Hill Inc., 1991.

BT 413 **PLANT BIOTECHNOLOGY**

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

1. The students should be able to understand explicitly the basic concepts of Plant Tissue culture.
2. To understand the developmental pathways of callus induction and plant regeneration.
3. To understand the techniques for production of secondary metabolites in *in vitro* using plant cell and tissue culture
4. To understand the methods of gene transfer in plants for production of transgenics.
5. To understand the various strategies and sources of trangenes for crop improvement.

Course Outcomes:

1. Provides opportunity to understand the theoretical concepts behind establishment of *in vitro* techniques.
2. Enables student to understand the importance and applications of various in vitro techniques
3. The course enables to exploit plant tissues for production of biologics at commercial scale.
4. Helps to understand the transgenes utilized in the production of trangencis resistant to biotic, abiotic stress resistant and improved quality etc.
5. The course enables the students to understand the appropriate vectors and gene transfer methodology for production of transgenics
6. Course enables the student to overall get an insight in to the basic concept and advances in plant biotechnology field

UNIT I: INTRODUCTION TO PLANT TISSUE CULTURE

Introduction to cell and tissue culture: History, Totipotency, Cell Theory, Tissue culture media (composition, preparation); Initiation and maintenance of callus and cell suspension culture, Organogenesis and Embryogenesis and their applications.

UNIT II TISSUE CULTURE IN CROP IMPROVEMENT

Micropropagation for virus-free plants, Somaclonal variation, Haploids in plant breeding, Germplasm conservation (Cryopreservation). Protoplast isolation, culture and fusion: Somatic hybridization.

UNIT III MOLECULAR FARMING & INDUSTRIAL PRODUCTS

Application of Plant biotechnology for the production of quality oil, Industrial enzymes, Antigens, Edible vaccines. Production of secondary metabolites from plant cell cultures using Cell suspension cultures, Immobilized cell systems Precursor feeding (elicitation) and hairy roots. Bioreactor systems and models for mass cultivation of plant cells.

UNIT-IV PLANT GENETIC ENGINEERING –I TECHNIQUES

Agrobacterium mediated gene transfer and cloning; Types of plant vectors and their use in genetic manipulation; and their application. Direct gene transfer methods; chemical methods, electroporation, microinjection, particle bombardment. Transient gene expression.

UNIT-V PLANT GENETIC ENGINEERING –II PRODUCTIVITY PERFORMANCE

Transgenics in crop improvement: Biotic Stress resistance: Herbicide,Insect, Disease, virus etc., Abiotic stress tolerance: Drought, Temperature, Salt. Transgenics for improved nutrional quality, storage, longer shelf life.

Text Books:

1. Bhojwani SS and Razdan, Plant Tissue Culture Theory and Practice, Elsevier Science, 2004
2. Chawla HS, Introduction to Plant Biotechnology, 4th edition, Oxford and IBH publishers, (2002

Suggested Reading:

1. Surabh Bhatia, Kiran Sharma, Randhir Dahiya and, Tanmoy Bera, Modern applications of Plant Biotechnology in Pharmaceutical Sciences, Elsevier publication, Academic press, 2015

BT 414 ANIMAL BIOTECHNOLOGY

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

1. The students are expected to understand the technical procedure involved to culture animal cells.
2. Students will learn various steps involved in the establishment of primary culture and their maintenance
3. Students will know about cell viability and cytotoxicity
4. Students are expected to know about stem cells and their applications
5. Students will describe embryo transfer, cloning and gene transfer methods for generation of transgenic animals and its applications
6. To know various application of animal cell culture in different fields

Course Outcomes:

1. The students will learn the animal cell culture requirements and procedure
2. Students are able to learn how to establish and maintain animal cell culture
3. Students will describe the procedure used to know the cell viability and cytotoxicity
4. Students are able to learn about stem cells and their applications
5. Students will know various methods for embryo transfer, cloning and generation of transgenic animals and their applications
6. Students will come to know various applications of animal biotechnology.

UNIT- I ANIMAL CELL TISSUE CULTURE

History and scope of animal cell tissue culture, advantages and disadvantages of tissue culture; laboratory facilities for animal tissue culture; aseptic techniques; the substrate on which cells grow; treatment of substrate surfaces; Feeder layers on substrates; Culture media for cells and tissues; Culture procedures; Tissue culture Slide, Flask and test tube cultures, Organ culture, Whole embryo culture.

UNIT- II PRIMARY CULTURE AND CELL LINES

Isolation of tissue, Disaggregation (Enzymatic and Mechanical) of tissue and Primary culture. Culture cells and evolution of cell lines. Maintenance of cultures- Cell lines, Cell separation, Cell synchronization; Cloning of cell lines. Cell transformation, Bioreactors for animal cell culture; Scaling-up of animal cell culture, large scale cultures in Biotechnology.

UNIT- III STEM CELLS, CELL VIABILITY AND TOXICITY

Stem cells, types of stem cells, embryonic stem cells and their applications; measurement of cell viability and cytotoxicity, Measurement of cell death; Senescence, Apoptosis, necrosis.

UNIT- IV EMBRYO TRANSFER, CLONING AND TRANSGENIC ANIMALS

Artificial insemination, *in vitro* fertilization and embryo transfer, nuclear transplantation; cloning of animals - Reproductive cloning, therapeutic cloning; Gene transfer or Transfection methods; targeted gene transfer; Transgenic animals- Mice, Sheep, Pig, Rabbit, Goat, Cow and fish.

UNIT - V APPLICATIONS OF ANIMAL BIOTECHNOLOGY

Application of animal cell culture; Mammalian cell products; viral vaccines produced from animal cell cultures. Three dimensional culture and tissue engineering, Somatic cell genetics.

Text Books:

1. Ian Freshney, "Culture of Animal Cells: A manual of basic technique and specialized applications" seventh edition, John Wiley and Sons, 2015
2. John Masters, " Animal Cell culture: A practical approach" OUP Oxford, 2000

Suggested Reading:

1. Gupta PK, "Biotechnology and Genomics" Rastogi Publications, 1st edition, 6th reprint, 2013
2. A.K. Srivastava, R.K. Singh, M.P. Yadav, "Animal Biotechnology" Oxford & IBH Publishing Co. Pvt. Ltd., 2005.
3. Ranga MM, "Animal Biotechnology", 3 reprint, Agrobios, India, 2010.

MB 216 **PRINCIPLES AND PRACTICE OF MANAGEMENT**

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives: This course helps the students to understand:
1. Basic principles, concepts and functions of management in industry.
2. Key competencies and skills required for problem-solving and decision-making in managerial situations.
3. The different organizational designs and structures.
4. Materials, operations and marketing management.
5. The role and functions performed by HR managers.

Course Outcomes: At the end of the course, student will be able to apply the
1. Managerial skills for managing a Unit / Branch.
2. The different operations / functional areas to process industry as an organization.
3. Assess the situations in an organization by critical examination and provide better decisions.
4. Dynamics of business and sense to formulate the direction of change.
5. Purchasing objects and principles to material management
6. Concept of marketing management to a global scenario.

UNIT - I
Management definition, Administration Vs Management Principles and Functions of Management, levels of management - System and Contingency approach to management - steps in Planning - Decision making process - organization: Definition, Line, staff, functional and matrix type organization, span of control (Graicuna`s Formulae), Centralization Vs Decentralization.

UNIT - II
Communication - Process, Grapevine, Networks and Barriers of communication - Managerial grid, Theory of X, Y and Z; Job Enrichment Vs Job enlargement - Control process - Introduction to Personnel Management: Functions, staffing process, need for HRD, Training & Development (TWI Programme)

UNIT - III Measurement of Morale - Job Design -Industrial Relations: Human relation Vs Industrial relations, Trade Unionism, Industrial Unrest, Wage and Incentive concepts - Role of ILO - MIS in industry - Management of public enterprises.

UNIT - IV Introduction to Financial Management : Sources of Finance, Capital & its Structure (CFS & FFS) Financial statements, cost sheet - Introduction to Purchase & Material management Purchasing objects and principles, types of purchasing, Vendor selection, rating, evaluation & Development - Inventory control, ABC analysis, stores organization and pricing of issues - concept of Warehousing.

UNIT - V Production and marketing Management: Types of Production, Quality control (Tools used), PPC, Maintenance management - Marketing management ; Definition and concept of marketing, functions of marketing, market research, Types of markets, Sales Forecasting, Promotion mix - Pricing - Product Identification - A brief note on International Marketing.

Text Books:
1. Harold Koontz and Heinz Weihrich, "Essentials of Management-An International Perspective", 9th Ed., Tata McGraw-Hill Edu Pvt. Ltd, 2012.
2. Khan & Jain, "Financial Management", 7th Ed., Tata McGraw-Hill Edu Pvt. Ltd, 2014.

Suggested Readings:
1. David A. DeCenzo, David A, Robbins, Stephen P, "Fundamentals of Human Resource Management", 11th Ed, John Wiley and Sons Inc, 2015.
2. Elwood S Buffa, Rakesh K. Sarin, "Modern Production/Operations Management", 8th Ed, Wiley India Pvt. Ltd., 2007.
3. Jennifer George and Gareth Jones "Understanding and Managing Organizational Behavior", Published by Pearson Education Inc., 2013.
4. I. M. Pandey, "Financial Management", 10th Ed. Vikas Publishing House, 2013.
5. Gary Dessler, "Human Resources Management", 11th Eastern Economy Ed., 2011.

Elective-II

DEVELOPMENTAL BIOLOGY

BT 461

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

1. Students are made to understand the basic concepts of developmental biology.
2. Students are taught the structure of gametes, and how they are generated.
3. Students are taught the influence of genes on body axis formation in Drosophila and Mammals.
4. Students are enlightened about the later embryonic developments i.e Organogenesis.
5. Students are made aware of sex determination in Drosophila and Mammals.
6. The concept of Ramifications of developmental biology is introduced to the students.

Course Outcomes:

1. Students understand the basic concepts of Developmental Biology.
2. Students understand the Anatomy of gametes and Biochemistry in its recognition.
3. Analyze the role of genes in the body axis formation of Drosophila and Mammals.
4. Understand the importance and differentiation of germinal layers in to different organs.
5. Compare the role of genes in the sex determination of Drosophila and Mammals.
6. Be able to explain the genetic anomalies leads to diseases.

UNIT-I INTRODUCTION TO DEVELOPMENTAL BIOLOGY

The Anatomical approach to developmental biology: Mathematical modeling for development: The frog life cycle: Evidence for Genomic equivalence (Potency of cells), Specification (Autonomous, Conditional and Morphogenic Gradients: Commitment, Induction (Paracrine Factors) and Competence.

UNIT-II EARLY EMBRYONIC DEVELOPMENT (Gametogenesis and Fertilization)

Structure of Gametes, Spermatogenesis and oogenesis in Mammals, Recognition of egg and sperm: Mammalian Fertilization (Fusion of Gametes and prevention of Polyspermy), External Fertilization in Sea urchin.

UNIT-III LATER EMBRYONIC DEVELOPMENT (Morphogenesis)

Cleavage and gastrulation in Drosophila and Mammals: Early Drosophila developments: Genes that pattern the Drosophila body axis: The generation of dorsal, ventral polarity: The origin of anterior, Posterior polarity: Segmentation genes (Gap Genes, pair rule genes and segment polarity genes), The homeotic selector genes: The anterior and posterior axis formation in Mammals.

UNIT-IV ORGANOGENESIS AND SEX DETERMINATION

The emergence of Ectoderm-The Central nervous system and epidermis development: the function of mesoderm – osteogenesis and myogenesis: Lateral plate mesoderm and endoderm – the development of heart, blood cells, digestive and respiratory systems, Sex determination in Drosophila and Mammals: regeneration of liver in Mammals.

UNIT-V RAMIFICATIONS OF DEVELOPMENTAL BIOLOGY

Medical Implications of Developmental biology, genetic errors of human development, infertility, *in vitro* fertilization (IVF) and teratogenesis (disruptors of teratogenesis): Developmental biology and future of medicine.

Text Books:

1. Jam PC, "Elements of Developmental Biology", Vishal Publications, New Delhi, 1998.
2. Manju Yadav, "Molecular Developmental Biology" Discovery Publishing, September, 2008.
3. Scott F Gilbert, Michael JF Barresi. "Developmental Biology", 10th edition, Sinauer Associates, Inc, 2013.

Suggested Reading:

1. Raven, P, "Developmental Physiology", 1st edition, Pergamon Press, Newyork, 1959.
2. Snustad P, Simmons and Jenkins, "Principles of Genetics", 2nd Edition, John Wiley Publications, 1999.
3. P.C.Jain , "Elements of Developmental Biology" International Publications, 2013.

Elective-II
CANCER BIOLOGY

BT462

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

1. Student is made to understand the role of cell cycle and diet in cancer.
2. Students are taught the Molecular aspects of cell cycle control.
3. Importance of physical and chemical carcinogens taught by showing effects of mutagens on cell cycle.
4. Students are enlightened about discovery of proto-oncogenes and their activation.
5. Students are made to understand the diagnosis and treatment of cancer.
6. The concept of cancer pharmacology is introduced to the students.

Course Outcomes:

1. Apply to real life situations, the concept of diet and cell cycle.
2. Incorporate the fundamentals of cell biology and Molecular biology to under stand how they are responsible for cancer.
3. Be able to explain the types of carcinogens and the effect of mutagens on cell cycle.
4. Be able to describe the structure of retrovirus and how they led to discover the oncogens.
5. Be aware of no of stages of cancer, detection of cancer and treatment of cancer.
6. Be in a position to explain the ADME properties of anticancer drugs.

UNIT- I: FUNDAMENTALS OF CANCER BIOLOGY

Definition and hall marks of cancer, Cell cycle control, regulation of the cell cycle by cyclins, cyclin-dependent kinases, cdk inhibitors, Mutations that cause changes in signal molecules, Effects on receptor, Signal switches, Tumor suppressor genes, Different forms of cancer(Case studies for carcinoma ex: breast cancer and stomach cancer), Diet and cancer.

UNIT- II: PRINCIPLE S OF CARCINOGENESIS

Natural History of Carcinogenesis, Types of Carcinogenesis, Chemical Carcinogenesis, Metabolism of Carcinogenesis, Targets of Chemical Carcinogenesis, Principles of Physical Carcinogenesis, Ionizing radiation and UV radiation mechanism of Carcinogenesis.

UNIT- III: PRINCIPLES OF MOLECULAR CELL BIOLOGY OF CANCER

Oncogenes, Identification of Oncogenes, Retroviruses and Oncogenes, Detection of Oncogenes, Growth factor and Growth factor receptors that are Oncogenes, Activation of protooncogens to oncogens. Growth factors related to transformations.

UNIT- IV: CANCER METASTASIS AND TREATEMENT

What is Metastasis, Classic theory of tumor Metastasis, Clinical significance of invasion, Heterogeneity of metastatic phenotype, Three-step theory of invasion (Basement Membrane disruption, role of Proteinases in tumor invasion and tumor cell locomotion).Diagnosis of cancers, Advances in Cancer detection(Biomarkers technology and nanotechnology), Different forms of therapy- Chemotherapy, Radiation therapy and immunotherapy.

UNIT- V:PRINCIPLES OF CANCER PHARMACOLOGY:

Pharmacokinetics and pharmacodynamics of antineoplastic drugs. Metabolism of anticancer drugs, inter individual differences in response to anticancer drugs, mechanisms of anticancer drug resistance. Molecular targets for drug development, mechanism of gene silencing (antisense, ribozymes, RNAi) and chemoprevention studies.

Text Books:

1. Franks LM and N.M.Teich , "Introduction to Cellular and Molecular Biology of Cancer", 2nd edition, Oxford Medical Publications, 1991.
2. Raymond W. Ruddon "Cancer Biology", 3rd edition, Oxford University Press, USA 1995.
3. King, Roger J B, Robins, Mike W, "Cancer Biology", 3rd edition, Prentice Hall, USA.2003.

Suggested Reading:

1. Fiona Macdonald, Christopher Ford, Alan Casson, "Molecular Biology of Cancer", 2nd Edition, Taylor & Francis, 2004.
2. Robert A. Weinberg, "The Biology of Cancer", 5th edition, Garland Science.2006.
3. Robin Hesketh, "Introduction to Cancer Biology" Cambridge University Publishers, Jan, 2013.

Elective-II
GENOMICS AND PROTEOMICS

BT 463

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

1. Student is made to understand the fundamentals of genome
2. Students are taught about the transposable elements and their importance.
3. Students are made to understand DNA sequencing and various DNA sequencing methods.
4. Students are enlightened about construction and screening of cDNA libraries.
5. Students are made to understand the basics of proteomics, tools for proteomics and protein modifications
6. The concepts of metabolomics and pharamacogenomics are introduced to the students.

Course Outcomes:

1. Be able to know about genomes, types of genomes and the advanced techniques used for analysing genome.
2. Be able to explain the occurrence of genome variations due to the implication of transposable elements in the genome.
3. Be able to start self-employment from the knowledge obtained from various DNA sequencing methods.
4. Be able to construct cDNA libraries and explain the importance of cDNA libraries in the identification of functional genes in the genome
5. Be able to modify proteins for better use
6. Be able to design personalized medicines and explain their uptake, action and metabolism.

UNIT- I: STRUCTURAL GENOMICS

Overview of genome-Types, analysis of genomes; comparative homologies; evolutionary changes; Genetic analysis: Linkage mapping and analysis, High resolution chromosome maps, Physical mapping, YAC, BAC, Hybrid mapping strategies, microarrays, Sequence specific tags(SST),Sequence tagged sites(STS),FISH, RFLP and RAPD

UNIT- II: TRANSPOSABLE ELEMENTS

Transposable elements: General features of transposable element, Bacterial transposable elements: IS elements, composite transposons, Tn3 elements; Eukaryotic Transposable elements: AC/DC elements of corn, Ty elements of Yeast, P elements in drosophila, Human retro transposons; Transposition-mechanism; Implication of Transposable elements in the genome, Genome variation.

UNIT- III: FUNCTIONAL GENOMICS

Construction and screening of cDNA libraries; cDNA microarrays, Gene disruptions, Serial analysis of gene expression (SAGE), SAGE Adaptation for Downsized Extracts (SADE); Applications of DNA arrays

UNIT- IV: PROTEOMICS AND TOOLS USED FOR PROTEOMICS

Protein structure, Protein databases, data mining, Sequence alignment, Algorithms in proteomics, Applications of proteomics: proteome mining, protein expression profiling, protein-protein interactions, protein modifications; Protein digestion techniques; Mass spectrometry: MALDI-TOF, Mass analyzers, peptide Mass Fingerprinting, Protein arrays.

UNIT- V: METABOLOMICS AND PHARMACOGENOMICS

Metabolomis-Basics; Pharmacogenomics-Basics, Diseased genes and their identification; Drug uptake an metabolism; Drug targets; Designer medicine; Genomics perspective of bioterrorism; Ethical and legal implications.

Text Books:

1. Sahai S, "Genomics and Proteomics-Functional and Computational Aspects", Plenum Publications, 1999.
2. Rastogi SC, Mendiratta N, Rastogi P, "Bioinformatics-Methods and Application, Genomics, Proteomics, and drug discovery", 2nd edition, Prentice Hall of India, New Delhi, 2003.
3. Lieber DC, "Introduction to Proteomics, Tools for the new biology", Humana Press, UK, 2000
4. Hunt SP, Levessy FJ, "Functional genomics" Oxford University Press, UK, 2000

Suggested Reading:

1. Proeomics in practice,A laboratorymanualof proteome analysis by JohnWiley-YCH,UK1999
2. 'Genomics'by cantor, CR, Joohn Wiley, UK 1999

Elective-II

BT464 PHARMACEUTICAL BIOTECHNOLOGY

Instruction	4L Periods per week
Duration of university Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

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

1. Origin, Scope and importance of pharmaceutical biotechnology.
2. ADME of Drugs. Pharmacokinetics and Pharmacodynamics of drugs.
3. Materials and Formulations of pharmaceuticals.
4. Collection, processing and storage of whole human blood.
5. Ideal requirements of Poly vinyl Pyrollidine and Dextran 40.
6. Steroidal and Nonsteroidal drugs, Antacids, Alkaloids and Biological extracts.

Course Outcomes:

After completion of the course students gain knowledge in the following concepts:

1. Types of microorganisms for production of secondary metabolites used as drugs.
2. Types of drug delivery systems like oral, parenteral, transdermal etc
3. Types of excepients. Labelling, preservation and release of drugs in to the market.
4. Fractionation of human RBC, dried human plasma, HPPF, from whole human blood.
5. Control of blood transfusion products to avoid infectious diseases (HepatitisB, HIV)
6. Therapeutic activity and dosage of drugs to treat the diseases.

UNIT- I: FUNDAMENTALS OF BIOPHARMACEUTICALS

Pharmaceutical Biotechnology: An introduction, Origin, definition, Scope and Importance. Human protein replacements, Therapeutic agents for human diseases: Tissue Plasminogen activator, Interferon, Recombinant vaccines. Methods of Biotechnology and their applications of Gene transfer, Biotechnology production of Secondary Plant Metabolites.

UNIT- II: DRUG METABOLISM AND PHARMACOKINETICS

ADME properties- Mechanism and Physiochemical properties of Drug Absorption, Distribution, metabolism (Biotransformation) and Excretion. Pharmacokinetics and Pharmacodynamic Basic considerations. Drug interactions, Surgical supplies, Oral, Parenteral, Transdermal, Ophthalmic, Intravaginal and Intrauterine Drug Delivery systems.

UNIT- III: THE DRUG MANUFACTURING PRACTICES

Types of Tablets and capsules. Materials and Formulations for Manufacture of Tablets, Capsules. Excepients and its ideal properties, Parenteral solutions, Oral liquids, Emulsions, Ointments, Suppositories, Aerosols.

UNIT-IV: BLOOD AND PLASMA SUBSTITUTES

Blood grouping, Rh Compatibility, Collection, processing and storage of whole human blood, concentrated human RBC, dried human plasma, Human plasma protein fraction, Dried human serum, Human fibrinogen, Human thrombin, Human normal Immunoglobulin, Plasma substitutes- Ideal requirements, PVP, Dextran 40, control of Blood products, Transfusion products

UNIT-V: PHARMACEUTICAL PRODUCTS

Fundamentals of Therapeutic categories such as Analgesics, Antipyretic, Anti-inflammatory drugs, Anesthetics, Antacids, Alkaloids, Glycosides, Anti-neoclassic drugs, Biologicals (Immunizing agents and allergenic extracts), Chemoterapy of Tuberculosis and Urinary tract infections.

Text books:

1. Brahmankar DM and Sunil B Jaiswal, “Biopharmaceutics and Pharmacokinetics- A Treatise”, Vallabh Publications, Prakashan, 2006,
2. Purohit SS, Kakrani HN and Saluja AK., “Pharmaceutical Biotechnology”, Student Edition Jodhpur, 2003
3. Cooper and Guns, “Pharmaceutics”, CBS publishers, 1989

Suggested Reading:

1. David B Troy and Paul Beringer, “Remington’s:The Science and practice of Pharmacy”, Vol 1 and 2, Lippincott Williams & Wilkins Publications, 2006
2. Tripathi, K.D. "Essentials of Medical pharmacology", Jaypee Brothers Medical Publishers 6th Edition , John Wiley, New Delhi,2000.

BT 415 DOWNSTREAM PROCESSING LAB

Instruction	3L Periods per week
Duration of University Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	2

Course Objectives:

1. To provide an opportunity to experimentally verify the theoretical concepts studied.
2. To give extensive exposure to various unit operations of downstream processing.
3. Students are explained how to design protocol for separation of bioproduct based on characteristics

Course Outcomes:

1. Be able to understand the fundamentals of downstream processing for biochemical product recovery.
2. Be able to calculate operating parameters for a given downstream processing unit operation.
3. Be able to develop their skills in the purification of bioproducts from fermentation broths.
4. Be able to design chromatographic separation process for a given compound.
5. Be able to arrange unit operations into an appropriate sequence for the purification of a given type of biological product.
6. Be able to analyze and summarize scientific results

LIST OF EXPERIMENTS:

1. Cell Disruption of microorganism using sonicator.
2. Cell Disruption of microorganisms using lysozyme.
3. Homogenization of microbes / plant material using pestle and mortar.
4. Recovery of bulk proteins by Aqueous Two Phase Extraction.
5. Separation of solids from liquid by Sedimentation
6. Separation of micro organisms from fermentation broth by Microfiltration.
7. Separation of solute particles by Dialysis.
8. Separation of alpha amylase by Ammonium Sulphate Precipitation.
9. Isolation and quantification of casein from milk by Isoelectric Precipitation.
10. Separation of biomolecules by Gel Exclusion Chromatography.
11. Purification of lysozyme from chicken egg white extract by Ion Exchange Chromatography.
12. Purification of proteins by Affinity Chromatography.
13. Determination of purity and molecular weight of proteins by SDS-PAGE
14. Extraction of Enzymes.
15. Extraction of Ethanol.

Text books:

1. David Plummer, "An introduction to Practical Biochemistry" 3rd edition, John Wiley & Sons
2. Principles and Techniques of Biochemistry and Molecular Biology by Keith John Walker John Walker,Cambridge University Press; 6 edition (2005).
3. Laboratory Manual in Biochemistry By J. Jayaraman, Kunthala Jayaramanj, New Age International

BT416 **TISSUE CULTURE LAB**

Instruction	3L Periods per week
Duration of University Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	2

Course Objectives:

1. The students should be able to understand explicitly the concepts of Plant Tissue culture and Animal tissue culture.
2. Develop their skills in plant tissues culture techniques.
3. Get extensive exposure to various techniques of plant cell and tissue culture.
4. To develop a protocol for genetic transformation using *Agrobacterium* strains.
5. The students will handle animal cell culture.

Course Outcomes:

1. Provides an opportunity to experimentally verify the theoretical concepts studied.
2. The course helps in gaining hands on training in developing protocols for various in vitro techniques: callus cultures, cell and suspension cultures etc.
3. The course experiences the students to establish *in vitro* techniques of micropropagation of crop/horticulture and medicinal plants.
4. The course enables student to establish a system of genetic transformation using Agrobacterium strains.
5. The handling experience of Protoplast isolation and culture helps them to produce somatic hybrids.
6. The course enables student to handle animal cell culture.

LIST OF EXPERIMENTS

1. Preparation of Plant tissue Culture Media
    i. Preparation of MS stock solutions
    ii. Preparation of MS callus induction media
2. Surface sterilization
3. Callus induction: Embryo Culture.
4. Meristem tip culture
5. Micro propagation of horticultural/medicinally important plants
6. Cell suspension cultures initiation and establishment.
7. Organogenesis and Embryogenesis.
8. Production of synthetic seeds.
9. Protoplast isolation (demo)
10. *Agrobacterium* mediated gene transfer: induction of Hairy roots
11. Preparation of Animal cell culture media
12. Preparation of cheek epithelium cells
13. Preparation of Primary cell lines
14. Cell counting and viability
15. Staining of animal cells
16. Preservation of cells

BT 417 **PROJECT SEMINAR**

Instruction	3L Periods per week
Sessionals	25 Marks
Credits	1

The objective of the project seminar is to actively involve the student in the initial work required to undertake the final year project. Dealing with a real time problem should be the focus of the under graduate project.

It may comprise of

- Problem definition and specifications.
- A broad understanding of the available techniques to solve a problem of interest.
- Presentation (Oral & written) of the project.

The department should appoint a project coordinator who will coordinate the following.

- Grouping of students as project batch(a maximum of 3 in group)
- Allotment of projects and project guides
- Project monitoring at regular intervals.

Each project group/batch is required to

1. Submit a one page synopsis of the seminar to be delivered for display on notice board.
2. Give a 30-40 minute's presentation followed by 10 minutes discussion.
3. Submit a technical write up on the talk delivered.

Three (3) teachers will be associated with the evaluation of the project seminar for the award of the sessional marks which should be on the basis of performance on all the three items stated above.

BT 421 COMPUTER APPLICATIONS IN BIOPROCESS

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

1. This course aims at providing knowledge on basic concepts in software development processes, Algorithm design and Process Models.
2. The course is designed to give an understanding on obtaining. solutions of differential equations by Euler`s, Modified Euler`s, Runge-Kutta methods
3. This course aims at providing an insight into the solution of set of simultaneous equations by Gauss elimination, Gauss Jordan and Gauss Seidel methods.
4. The aim of the course is also to give the students an understanding of obtaining solutions of numerical methods.

Course Outcomes:

At the end of the course student should

1. Be able to distinguish between different process models
2. Be able to formulate process models leading to set of ordinary differential equations and solution procedures numerical methods.
3. Be able to formulate process models leading to set of linear simultaneous equations and solution procedures.
4. Be able to formulate process models leading to transcendental and polynomial equations and solution procedures.
5. Understand the steps involved in optimization that are a prerequisite for the development of process flow sheets.
6. Be able to optimize biochemical process.

The Programs are to be written in "C" only

UNIT-I Computers and Software

Computers and Software: Computing environments, The software development processes, Algorithm design, Program composition, Quality Control, Documentation, Storage and •Maintenance, Software strategy. Process Models: Uses, Distributed & Lumped parameter models, Linear and Nonlinear models, Steady state and Dynamic models, Continuous and Discrete models, Empirical models. Formulation of Process Models: Momentum, mass and energy balances, constitutive rate equations, transport rate equations, biochemical kinetic rate expressions, thermodynamic relations.

Review on "C" Language Fundamentals.

UNIT-II Function Approximation

Function Approximations by Linear and nonlinear least square analysis, Formulation Process Models leading to set of ordinary differential equations and solution procedures by Eulers, Modified Eulers and Runge Kutta methods.

UNIT-III Formulation of Process Models

Formulation of Process Models leading to set of linear simultaneous equations and solution procedures by Method of determinants, Gauss Elimination, Gauss Jordan, Jacobi and Gauss-Seidel methods.

UNIT-IV Process Models Leading to Transcendental and Polynomial Equations

Formulation of Process Models leading to transcendental and polynomial equations and solution procedures by Bi-section, Reguli-falsi, Newton Raphson, Richmond, Muller's and Bairstow methods

UNIT-V

Process Optimization **:**Nature and organization, basic concepts and elements of Optimization, single variable functions, direct, indirect and random search methods – with and without acceleration Elimination methods for unrestricted and exhaustive search, Fibonacci search, Dichotomous search, Golden-section (gradient) search methods.

Text Books:

1. Higher engineering mathematics by DR. B.S. Grewal, Khanna publishers (1998)
2. Numerical methods for Engineersby Steven C. Chapra and Raymond P Canale, 2nd edition, MCGraw Hill International edition, 1988.

Suggested books:

1. Computer Applications in Bioprocessing by Henry R. Bungay Volume 70/(2000) Springer.
2. Edger T.E., and Himmelbau D.M., “Optimization of chemical processes”, McGraw Hill international edition, 1988
3. Bioprocess engineering Enrique Galindo and Octavio T. Ramírez Volume 16, Issue 7, (1998).

BT422 BIOPROCESS ECONOMICS & PLANT DESIGN

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

1. To provide the students with knowledge about basic concepts in Interest, capital investment tax and depreciation;
2. Measures of economic performance.
3. This course aims at providing an insight into capital, overhead and manufacturing costs estimation
4. The course is designed to give an understanding of process design development and general design considerations.
5. This course aims at providing knowledge on design of batch and continuous sterilizers**,** Design calculations for immobilized enzyme kinetics.
6. To give insight about various types of valves, pumps, steam traps, spargers and impellers used in biotech industries.

Course Outcomes:

At the end of the course student should

1. Be able to carry out interest calculations and prepare balance sheets for business transactions.
2. Be able to determine the economic analysis of bioprocesses.
3. Carry out cost estimations for different industrial productions.
4. Develop process design, flow diagrams.
5. Carry out material and energy balances accurately
6. Be able to design filters for air sterilization, batch and continuous sterilizers, valves etc.

UNIT-I ECONOMIC EVALUATION

Capital cost of a project; Interest calculations, nominal and effective interest rates; basic concepts in tax and depreciation; Measures of economic performance, rate of return, payout time; Cash flow diagrams; Cost accounting-balance sheet and profit loss account; Break even and minimum cost analysis.

UNIT- II BIOPROCESS ECONOMICS

Bio-Products regulations; Economic analysis of bioprocess; Capital, overhead and manufacturing costs estimation; Case studies of antibiotics (Penicillin and Streptomycin), recombinant products, single cell protein, anaerobic processes and other fine chemicals.

UNIT- III INTRODUCTION TO PLANT DESIGN

Process design development: design procedures, design information and flow diagrams, material and energy balances, comparison of different process and design specifications; Optimization; General design considerations: Health and safety hazards, Environment protection, plant location and plant layout, plant operation and control;

UNIT- IV BASIC DESIGN PROBLEMS

Design examples on continuous fermentation, aeration, and agitation; Design calculation of filter for air sterilization; Design of batch and continuous sterilizers; Design calculations for immobilized enzyme kinetics; Practical considerations in designing of Bioreactor/Fermentor construction.

UNIT- V

Introduction to different types of valves, pumps, steam traps, spargers and impellers used in fermentation industries; Design exercise on trickle flow fermentor; Problems associated with design equations.

Text Books:

1. Plant Design and Economics for Chemical Engineers, 5/e
   Max S. Peters, Ronald E. West, (2003) McGraw-Hill Higher,
2. Biochemical Engineering -Humphrey, A. E.; Millis, JSTOR 1966.
3. Biochemical Engineering, by Harvey W. Blanch, Douglas S. Clark CRC; 1st edition (1997).
4. Biochemical Engineering Fundamentals by James; Ollis, David F. Bailey,1977, McGraw-Hill.

Suggested Reading:

1. Biochemical Engineering and Biotechnology Handbook by Bernard Atkinson, Ferda MavitunaGrove's Dictionaries; 2 edition (1992).
2. Bioprocess Engineering:Basic Concepts. Michael L. Shuler / Fikret Kargi, Reihe:Prentice ,(2001) Hall.
3. Plant Design and Economics for Chemical Engineers" by M. Peters and K. Timmerhaus, McGraw-Hill.
4. Bioprocess and Biosystems Engineering Dirk Weuster-Botz, ISSN: 1615-7591 Journal no. 449, Springer.

Elective-III

MOLECULAR MODELING & DRUG DESIGN

BT 471

Instruction	4L Periods per week
Duration of university Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

1. Empirical force fields and Hydrogen bonding in different molecules.
2. Simulation methods to calculate Thermodynamic properties of molecules.
3. Molecular dynamics simulation of molecules by simple and continuous potential.
4. Practical aspects in setting and running the molecular dynamics simulation.
5. Montecarlo simulation method for rigid and flexible molecules.
6. QSAR between different protein ligand interactions.

Course Outcomes:

After completion of the course students gain knowledge in the following concepts:

1. Calculate Total energy of molecule by using force field potentials.
2. Calculate Internal energy, Heat capacity, Temperature, pressure.
3. Hard sphere potential, Continuous potential by Finite differential method.
4. Choosing the initial configuration and analyzing the results of computer simulation.
5. Simulation of polymers by Random walk method, Self avoiding walk method.
6. Classification of Drug Design. CADD to treat Alzheimer's and Tuberculosis diseases

UNIT- I: EMPIRICAL FORCE FIELDS AND MOLECULAR MECHANICS

Introduction to Molecular Mechanics, Coordinate system, Molecular graphics, Force fields, Bond stretching, Angle bending, Torsions, Out of plane bending motions, Electrostatic interactions, Vanderwalis interactions, Effective pair potentials, Hydrogen bonding.

UNIT- II: COMPUTER SIMULATION METHODS

Calculation of Thermodynamic properties, Phase space, Practical aspects of computer simulation, Periodic boundary condition, Boundaries monitoring Equilibrium, Truncating the potential and minimum image convention, Long range process, Analyzing results of simulation and estimating errors**.**

UNIT- III: MOLECULAR DYNAMICS SIMULATION METHODS

Molecular Dynamics using simple modules, Molecular Dynamics with continuous potentials: Finite difference methods and Predictor corrector integration method, Constraint Dynamics, Transport properties, Time dependent properties, Molecular Dynamics at constant Temperature and Pressure.

UNIT-IV: MONTECARLO SIMULATION METHODS

Metropolis methods, Importance of Hamiltonian equation, Montecarlo simulation of Rigid and Flexible molecules, Montecarlo simulation of Polymers: Lattice model & continuous polymer model, calculating chemical potential, Differences between Molecular dynamics & Montecarlo simulation method.

UNIT-V: APPLICATIONS OF MOLECULAR MODELING AND DRUG DESIGN

Production of Drugs in Pharmaceutical companies, CADD: Strucure Based Drug Design and Ligand Based Drug Design, Quantiative Structural Activity Relationship (QSAR) studies in Protein- Ligand interactions, Case studies of Alzheimers disease, Tuberculosis and Cancer etc.

Text books:

1. Molecular modeling principles and Applicatios AR Leach, Longman, (1996).
2. Molecular Dynamics simulation -Elementary Methods- John Wiley and Sons, (1997).

Suggested Reading:

1. Protein Engineering - Moody PCE and AJ Wilkinson. IRL press.
2. Introduction to protein structure by C. Brandon and J. Tooze, Garland, 2nd edition, (1998).
3. Essentials of Drug Designing V. Kothakar, Dhruv publications

Elective-III

BT472 IMMUNODIAGNOSTICS

Instruction	4L Periods per week
Duration of university Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

1. The students will learn the basic principles, procedures and applications of immunodiagnostic tests.
2. The students are introduced to engineer antibody by using rDNA technology
3. The students are illustrated to the steps involved in the develop, production and applications of monoclonal antibody technology
4. The students will learn the development of preventive agents such as vaccines
5. The students also learn the novel methods used for immunodiagnostics
6. Students will be introduced to immunoproducts IPR and its patenting.

Course Outcomes:

1. Students will demonstrate competence in diagnosing various diseases by using different types of immunodiagnostic tests.
2. Students can explain the concepts of validation and quality control as applied to antibody-based analytical systems.
3. Students will learn about development of monoclonal antibodies diagnosis, treatment and prevention of disease by using monoclonal antibody.
4. New methods of treating various diseases are being explored by vaccine development
5. The course is helpful to learn the novel techniques used in immunodiagnostics.
6. Students will learn what is patenting and how immunoproducts are patented

UNIT I INTRODUCTION

Principles of immunodiagnostic tests and their development, classification of immunodiagnostic tests, Immunodiagnostics techniques – Precipitation, Immunoelctrophoresis, Agglutination, RIA, ELISA, Fluoroimmunoassay, Luminescent immunoassay, Immunofluorescence, Cell separation techniques, Western blotting, Selection and preparation of reagents, Assay design, Antibody engineering, Catalytic antibodies, Applications of nanoparticles in immunodiagnostics.

UNIT II HYBRIDOMA TECHNOLOGY

Immunodiagnostics and preparation of tools: Hybridoma technique, monoclonal antibodies production, choice of host for immunization and myeloma cells, choice of immunogen, preparation of antigen for immunization, growth of myeloma cell lines, preparation of cells for fusion, cell fusion, selection and Screening of Hybridoma, purification and application (biochemical research, clinical diagnosis and treatment) of monoclonal antibodies.

UNIT III VACCINES

Whole organism Vaccines, Subunit vaccines - Herpes Simplex virus, Foot and Mouth disease, SARS, Peptide vaccines - Foot and Mouth disease, Malaria, Live recombinant vaccines- Cholera, Salmonella, Vector vaccines - directed against viruses and bacteria, Purified vaccines, Conjugate polysaccharide vaccines, DNA vaccines, Antifertility vaccines.

UNIT IV NOVEL TECHNIQUES IN IMMUNODIAGNOSTICS

Imaging as an Immunodiagnostic Tool, Multicolor Flow Cytometry, Immunoglobulin and Free-light Chain Detection, Methods for Autoantibody Detection, Immunodiagnostic of Allergy, Multiplex Analysis of Cytokines, Immunomonitoring of Clinical Trials, Immunological Assays Used in Vaccine Clinical Trials

UNIT V IPR ON IMMUNO PRODUCT

Intellectual Property Rights, Patenting, General Agreement on Trade and Tariff, Application of transgenic organisms for the production of immune product, Patenting of biological material.

Text books:

1. Edwards R, “Immunodiagnostics: A practical approach” Oxford University Press, 1999.
2. Rastogi SC, “Immunodiagnostics Principles and Practice” New Age Publishers, 1996

Suggested Reading:

1. Thomas J. Kindt, Barbara A. Osborne, Richard Goldsby, W. H. Freeman, “ Kuby Immunology”, 6th edition, 2006.
2. Ralph M. Aloisi Lea & Febiger Principles of Immunology and Immunodiagnostics by, 1988.

Elective-III

BT 473 TISSUE ENGINEERING

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

1. Understand the fundamental principles and elements of tissue engineering.
2. Get insight into the roles of cells, tissue organization and matrix in tissue engineering.
3. To learn the practical approach of carrying out tissue culture.
4. Learn about the different materials use as biomaterials.
5. Understand the role of stem cells in tissue engineering.
6. Gain knowledge into the medical applications of tissue engineering.

Course Outcomes:

1. Graduates are aware of the upcoming concept of tissue engineering.
2. The importance of the cell matrix in tissue engineering is highlighted to the graduates.
3. The graduates learn about in vitro culturing and the parameters of importance.
4. Students are able to discuss the potential of stem cells in tissue engineering for wound healing.
5. Graduates understand the need of compatible biomaterials to support growth and differentiation of stem cells into functional organs.
6. The graduates understand the scope of tissue engineering in producing organs for therapeutic applications.

UNIT – I INTRODUCTION TO TISSUE ENGINEERING

Basic definition and overview; General scientific issues; History of Tissue engineering, Basic steps in tissue engineering; Ethical issues.

UNIT - II CELLS AND TISSUE ORGANIZATION

Cells- cell growth and death; cell differentiation; Cells in tissues and organs.
Cell to cell interactions; cell adhesion molecules (CAM)
Organization of cells into higher ordered structures- Mesenchymal cells; EMT, MET; Molecular mechanisms and control of EMT process.
Tissues- Epithelial, connective; Vascularity; angiogenesis; wound healing.
ECM (extra cellular matrix) –components; dynamics of cell-ECM interaction.

UNIT – III FUNCTIONAL TISSUE ENGINEERING

Cell and tissue culture- media; culture initiation; transformation and immortalization; validation; differentiation; maintenance of cells in vitro; cryopreservation.
Stem cells in tissue engineering
Bioreactors for tissue engineering- Bioreactor design requirements; Spinner flask bioreactors . Rotating-wall bioreactors , Compression bioreactors, Strain bioreactors, Hydrostatic pressure bioreactors, Flow perfusion bioreactors, Combined bioreactors

UNIT- IV BIOMATERIALS OF TISSUE ENGINEERING

Scaffolds- fabrication; 3D scaffolds
Biodegradable polymers; synthetic polymers; hybrid of synthetic and biological polymers; prosthetic devices.
Engineering biomaterials for tissue engineering.

UNIT-V APPLICATIONS OF TISSUE ENGINEERING

Tissue replacement –crucial factors
Skin grafting
Bone tissue engineering; Cardiac tissue engineering; Neural tissue engineering; Vascular tissue engineering; as models in cancer and drug discovery.

Text Books:

1. Principles of tissue engineering. Robert.P.Lanza, Robert Langer & Vacanti. Academic Press. 2nd edition 2000.
2. Tissue engineering. B. Palsson, J.A. Hubbell, R. Plonsey & J.D. Bronzino. CRC Taylor & Francis.

Suggested Reading:

1. Tissue engineering- Design, practice & reporting, Bernard prish. Woodhead Publishing Ltd. Cambridge. UK 2009.
2. Methods of tissue engineering. Atala O.P & Lanza.L. Woodhead Publishing Ltd. Cambridge. UK 2009.

Elective-IV

BIOPROCESS VALIDATIONS & CURRENT GOOD MANUFACTURING PRACTICES

BT481

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

1. Student is taught with the concepts of prospective process validations and analytical methods validations.
2. Students are explained the development of validation protocol and methods of evaluation.
3. Students are explained with good laboratory practices with suitable examples.
4. Students are enlightened thoroughly the (SOP) of biotech process.
5. Students are taught with proper illustrations with the concept of waste minimization and zero contamination.
6. Students are taught and explained about health hygiene of persons involved.

Course Outcomes:

1. Apply prospective process validation and analytical methods in biotechnology industries.
2. Students will be capable of developing validation protocols and methods of evaluation in Quality control department of biotechnology industry.
3. Students will apply good laboratory practices in real life situations in bio process industriesand laboratories of R&D and quality control units.
4. Students will apply SOP in process operations of biotech industries.
5. Students will apply the concepts of waste minimization and zero contamination in process units of biotechnology industries.
6. Students will apply the concepts of personal hygiene of employees of biotech industries and implementation of good health practices.

UNIT- I: BIOPROCESS VALIDATIONS

Validations- Prerequisites, Process Design & testing process characterization, Process Optimization, Validation Options, Prospective process validation, Retrospective validations, Concurrent validations, Revalidation, Organizing validation studies, Analytical methods validation, cleaning validation, pre-validation verification, Documentation, Control of cleaning materials & ancillary tools, frequency of cleaning, Development of validation protocol, Method of Evaluation.

UNIT- II: GOOD LABORATORY PRATICES (GLP)

Introduction to Good Laboratory Practices, Responsibilities in GLP, Quality assurance and facilities for GLP, Computational processes in GLP.

UNIT III: STANDARD OPERATING PROCEDURES (SOP)

Standard Operating Procedures (SOP) and Guidelines and regulations of PDA and ICH for GLP and GMP.

UNIT- IV: GOOD MANUFACTURING PRACTICES (GMP)

Introduction to GMP; Manufacturing & Quality control facilities; Sanitation & Hygiene; Control of raw materials, Packaging Materials, manufacturing processes, Minimization or Zero Contamination, and finished products; Documentation and compliance of GMP.

UNIT- V:GMP FOR BIOLOGICAL PRODUCTS

Products based on immunological principles, Layouts and Designs of Manufacturing Areas, Equipment designs and operations, Standard operating procedures for Production, Quality control, Labeling, Records and Waste Disposal; Health & hygiene of Persons involved.

Text Books:

1. How to Practice GMPs-PP Sharma.
2. Good Laboratory Practice: The Why and the How by Jurg P. Seiler, Springer-Verlag Berlin.

Suggested Reading:

1. Bioprocess Validation: The Present and Future by PhD Trevor Deeks, pub: PDA/DHI (2007).
2. Process Validation in Manufacturing of Biopharmaceuticals: Guidelines, Current Practices, and Industrial Case Studies (Biotechnology and Bioprocessing Series),Informa HealthCare; 2 edition (2005).
3. The L&K Process Guide, The tool for biopharmaceutical drug development, Pub: L&K Biosciences.
4. Bioprocess Engineering: Basic Concepts, 2/E Michael L. Shuler, Fikret Kargi, Dokuz ISBN-13: 9780130819086, Publisher: Prentice Hall (2002).

Elective-IV

BT482 **FOOD BIOTECHNOLOGY**

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

1. Student is made to understand the importance of food biotechnology and its nutritive value.
2. Students are taught the types of food available in the nature and its consumption value.
3. Students made to understand the food spoilage.
4. Students are enlightened about the importance of food processing.
5. Students are made aware of chemical and physical methods of food processing.
6. Student is made to understand the methods of food preservation and its control in food spoilage.

Course Outcomes:

1. Apply the fundamentals of food biotechnology to their real life situation.
2. Be able to differentiate types of food and explain their consumption value.
3. Be able to describe the types of pathogens and their effect on food.
4. Be able to describe the physical and chemical methods of food processing.
5. Be in a position to preserve the food material to avoid food spoilage.
6. By understanding the principles of biotechnology able to work in a suitable food industry.

UNIT-I SCOPE AND IMPORTANCE OF FOOD BIOTECHNOLOGY

Introduction to Scope and importance of food biotechnology, Nutritive value of the food ; consumption and structure of foods and the importance of industrial processing of foods, various technologies and methods in food preservation, processing and packaging, food grade polymers.

UNIT- II FOOD PRODUCTS

Introduction to Probiotics, Nutraceuticals and GM foods ; Development of Industrial Food products: High Fructose Corn syrup, Single Cell Protein and Fermented foods, Bakery Products, Beverages, Milk Products and Mushroom Development; Food labeling, Food standards.

UNIT- III FOOD SPOILAGE AND FOOD MICROBIOLOGY

Food spoilage, Bacterial agents of food borne illness; Clostridium, Salmonella, Vibrio and Shigella, non bacterial agents; helminthes, Protozoa, Algae, Fungi and Viruses.

UNIT- IV FOOD PROCESSING

Bio-processing : Enzymes and chemicals used in food processing for flavor development; Processing of meat, fisheries, vegetables, dairy products; Thermal processing of foods; Microwave heating; Thermal inactivation of microorganisms; Freezing and thawing methods of food processing.

UNIT- V FOOD PRESERVATION

Food preservation using Irradiation: Characteristics of Radiations of Interest in food preservation, Principles underlying the destruction of microorganisms by irradiation, Processing of foods for Irradiation, Legal status of food irradiation, Effect of Irradiation of Food constituents and Storage Stability; Food Preservation with low and High Temperatures and Preservation of foods by Drying, equipment for Drying.

Text Books:

1. Roger Angold, Gordon Beech & Taggart, "Food Biotechnology" 1st edition, Cambridge University Press, 1989.
2. Frazier, William, C.Westhoff, Dennisc , "Food Microbiology" 2nd Edition TATA Mcgraw Hill Publishers, 1989.
3. Norman Potter, Hotch Kiss, "food science" 2nd edition, chapman Publishers, 1996.
4. Kalidas Shetty, Gopinadhan Paliyath, Anthony Pometto, Robert E. Levin, "Food biotechnology" 2nd Edition, CRC Press, 1999.

Suggested Reading:

1. Ashok Pandey, "Biotechnology:Food Fermentation" Asia Tech Publishers Inc,New Delhi,1999.
2. J.M.Jay, M.J.Loessner and D.A.Golden, "Modern food microbiology", 7th edition,Springer,2006.
3.Romeo T. Toledo, "Fundamentals of Food Process Engineering", 3rd edition, Springer, February, 2007.

Elective-IV

BT483 NANOBIOTECHNOLOGY

Instruction	4L Periods per week
Duration of university Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives

1. To introduce the concept of nanotechnology and nanobiotechnology
2. To educate students about significance of nano-size
3. To gain knowledge on the synthesis of nanomaterials
4. To gain knowledge on the characterization of nanomaterials
5. To have awareness about different types of Nanostructures
6. To get familiarize with applications of nanobiotechnology in different fields

Course Outcomes

1. Students will acquire the knowledge of multidisciplinary nature of nanotechnology
2. Students will be able to explain the nanoscale paradigm in terms of properties at the nanoscale dimension.
3. Students will be able to describe different methods used for the synthesis of nanomaterials
4. Students will have the knowledge of characterization of nanomaterials
5. Students will have awareness of nanostructures
6. Students will learn various applications of nanobiotechnology

UNIT-1 INTRODUCTION AND SIGNIFICANCE OF NANO DOMIAN

Nanotechnology - A Historical Perspective, definition of nanoscale with special reference to biosystems, scope and future prospects of Nanotechnology, Nanobiotechnology and Bionanotechnology, Opportunities and Challenges of Bionanotechnology; Limitations of micron size, need for nano-size—surface volume ratio significance, significance and key features of nano-Size, derivation of Bohr's atomic radius of a hydrogen atom, comparison of particle behavior at nano-size to Macro Size: Gold and Titania, advantages of scaling down—nano-size.

UNIT- II SYNTHESIS AND CHARACTERIZATION OF NANOMATERIALS

Synthesis of Nanomaterials – Top-down and bottom up approaches with examples, physical, chemical and biological methods, characterization of nanomaterials- Optical (UV-Visible/fluorescence), X-ray diffraction, Imaging and size-(Electron Microscopy- SEM, TEM), Atomic force microscopy, Scanning tunneling microscopy, Spectroscopy- NMR, Raman FT-IR and Plasma Resonance.

UNIT- III NANOSTRUCTURES

Smart materials, nanoscale biostructures, carbon nanotubes, nanowires, nanoshells, quantum dots, dendrimers, nanosomes, liposomes, virosomes, polymersomes.

UNIT- IV. GENERAL APPLICATIONS OF NANOBIOTECHOLOGY

Application of nanotechnology in medical diagnosis, drug discovery, drug development, drug delivery, Photodynamic Therapy.

UNIT- V. CURRENTAPPLICATIONS OF NANOBIOTECHOLOGY

Application of nanotechnology in Protein Engineering, Tissue engineering, Agriculture, Environment, food processing, Nanotechnology and Nanoparticles: Clinical, Ethical, and Regulatory Issues.

Text books:

1. Christof M. Niemeyer and Chad A. Mirkin, "Nanobiotechnology: Concepts, Applications and Perspectives" Wiley Publishers, April 2004.
2. Mark Ratner and Daniel Ratner, " Nanotechnology: A Gentle Introduction to Next Big Idea", Low Price edition, Third Impression, Pearson Education

Suggested Reading:

1. David S Goodsell, "Bionanotechnology", John Wiley & Sons, 2004.
2. Debasis Bagchi, Manashi Bagchi, Hiroyoshi Moriyama, Fereidoon S hahidi, "Bio-Nanotechnology: A Revolution in Food, Biomedical and Health Sciences" Wiley -Blackwell, 2013.
3. Elisabeth S P, Aravind P, "Bionanotechnology", Morgan & Claypool publishers, 2007

Elective-IV

ME 464 Entrepreneurship (for Mech, Prod, Civil, EEE & CSE)

Instruction	4L Periods per week
Duration of university Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives:

1. To understand the essence of Entrepreneurship
2. To know the environment of industry and related opportunities and challenges
3. To know the concept a procedure of idea generation
4. To understand the elements of business plan and its procedure
5. To understand project management and its techniques
6. To know behavioral issues and Time management

Outcomes: After completing this course, students will be able to:

1. Apply the entrepreneurial process
2. Analyze the feasibility of a new business plan and preparation of Business plan
3. Evaluate entrepreneurial tendency and attitude
4. Brainstorm ideas for new and innovative products or services
5. Use project management techniques like PERT and CPM
6. Analyze behavioural aspects and use time management matrix

UNIT-I

Indian Industrial Environment: Competence, Opportunities and Challenges, Entrepreneurship and Economic growth, Small Scale Industry in India, Objectives, Linkage among small, medium and heavy industries, Types of enterprises, Corporate Social Responsibility.

UNIT-II

Identification and characteristics of entrepreneurs: First generation entrepreneurs, environmental influence and women entrepreneurs, Conception and evaluation of ideas and their sources, Selection of Technology, Collaborative interaction for Technology development.

UNIT-III

Business plan: Introduction, Elements of Business Plan and its salient features, Technical Analysis, Profitability and Financial Analysis, Marketing Analysis, Feasibility studies, Executive Summary.

UNIT-IV

Project Management: During construction phase, project organization, project planning and control using CPM, PERT techniques, Human aspects of project management, Assessment of tax burden

UNIT-V

Behavioral aspects of entrepreneurs: Personality, determinants, attributes and models, Leadership concepts and models, Values and attitudes, Motivation aspects, Change behavior

Time Management: Approaches of time management, their strengths and weaknesses. Time management matrix and the urgency addiction

Text Books:

1. Vasant Desai, "Dynamics of Entrepreneurial Development and Management", Himalaya Publishing House, 1997.
2. Prasanna Chandra, "Project-Planning, Analysis, Selection, Implementation and Review", Tata Mcgraw-Hill Publishing Company Ltd. 1995.
3. S.S. Khanka, "Entrepreneurial Development", S. Chand & Co. Pvt. Ltd., New Delhi

Suggested Reading:

1. Robert D. Hisrich, Michael P. Peters, "Entrepreneurship", Tata Me Graw Hill Publishing Company Ltd., 5lh Ed., 2005
2. Stephen R. Covey and A. Roger Merrill, "First Things First", Simon and Schuster Publication, 1994.
3. Sudha G.S., "Organizational Behavior", National Publishing House, 1996.

BT423 **SEMINAR**

Instruction	3L Periods per week
Sessionals	25 Marks
Credits	1

Oral presentation is an important aspect of engineering education. The objective of the seminar is to prepare the student for a systematic and independent study of state of the art topics in a broad area of his /her specialization.

Seminar topics may be chosen by the students with advice from the faculty members. Students are to be exposed to following aspects of seminar presentations.

- Literature survey
- Consolidation of available information
- Power point Preparation
- Technical writing

Each student is required to:

1. Submit a one page synopsis of the seminar talk for display on the notice board.
2. Give twenty(20) minutes presentation through OHP/ PPT/ Slide Projector followed by Ten (10) minutes discussion
3. Submit a report on the seminar topic with list of references and hard copy of the slides.

Seminars are to be scheduled from 3rd week to the last week of the semester and any change in schedule should be discouraged.

For the award of sessional marks students are judged by three (3) faculty members and are based on oral and written presentations as well as their involvement in the discussions during the oral presentation.

Note: Topic of the seminar should be from any peer reviewed recent journal publications.

BT 901 **PROJECT**

Instruction	6L Periods per week
University Examination	Viva-voce
University Examination	100 Marks
Sessionals	50 Marks
Credits	9

Dealing with a real time problem should be the focus of under graduate project.
All projects will be monitored at least four times in the II-semester through individual presentations (Project batch wise).

Every student should maintain a project dairy, wherein he/she needs to record the progress of his/her work and get it signed at least once in a week by the guide(s). If working outside and college campus, both the external and internal guides should sign the same.

Sessional marks should be based on the marks, awarded by a project monitoring committee of faculty members as well as the marks given by the guide.

Common norms are established for final documentation of the project report, the students are directed to download from the website regarding the guidelines for preparing the project report and the project report format.

The project report shall be evaluated for 100 Marks by the External Examiner.

If the project work found inadequate in the end examination, the candidate should repeat the project work with a new problem or improve the quality of work and report it again.

Break up for 100 Marks in the end examination:

1. Power point presentation 20 Marks
2. Thesis/Report preparation 40 Marks
3. Viva-voce 40 Marks