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