SCHEME & SYLLABUS

OF

V & VI SEMESTERS

B.E. BIO-TECHNOLOGY

2016-17

VISION AND MISSION OF THE DEPARTMENT

VISION:

To provide self-reliant skilled manpower required to meet the challenges in large scale application of Biotechnology, research and development in the areas of environment, healthcare and industry for socio-economic improvement.

MISSION:

The Department is committed to develop proficient professionals by offering necessitate based curriculum in Biotechnology Engineering areas like plant-, animal-, microbial-, environmental- nano-biotechnology and computational biology, promoting research and innovation, centre of excellence and to train the students for higher study, life-long learning and societal responsibility. The department is also committed to provide work-ready biotech engineers and entrepreneurs, excellent learning environment to inculcate professional ethics and skills in our students and to provide engineering services to the society.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

Within three to five years after graduation, the Biotechnology graduates will be able to achieve the following objectives.

PEO#1. Graduates of the program will practice Engineering profession as competent professionals using state-of-the-art knowledge and technical skills

[Theme: Practice engineering profession as capable professionals]

PEO#2. Graduates of the programme will apply the Bioengineering concepts for development of industrial applications and entrepreneurship skills to start biotech industries.

[Theme: Team work and Entrepreneurship]

PEO#3. Graduates of the programme will excel in higher education on applied science subjects and to engage in life-long learning process with effective communicative and analytical skills.

[Theme: Higher education, Life-long learning and Communicative skills]

PEO#4. Graduates of the programme will practice their profession with social and ethical responsibilities.

[Theme: Initiated to Society and ethical practice]

PROGRAMME OUTCOMES (POs)

The following is the list of programme outcomes that describes what graduates are expected to know and be able to do at the time of graduation. Graduates at graduation:

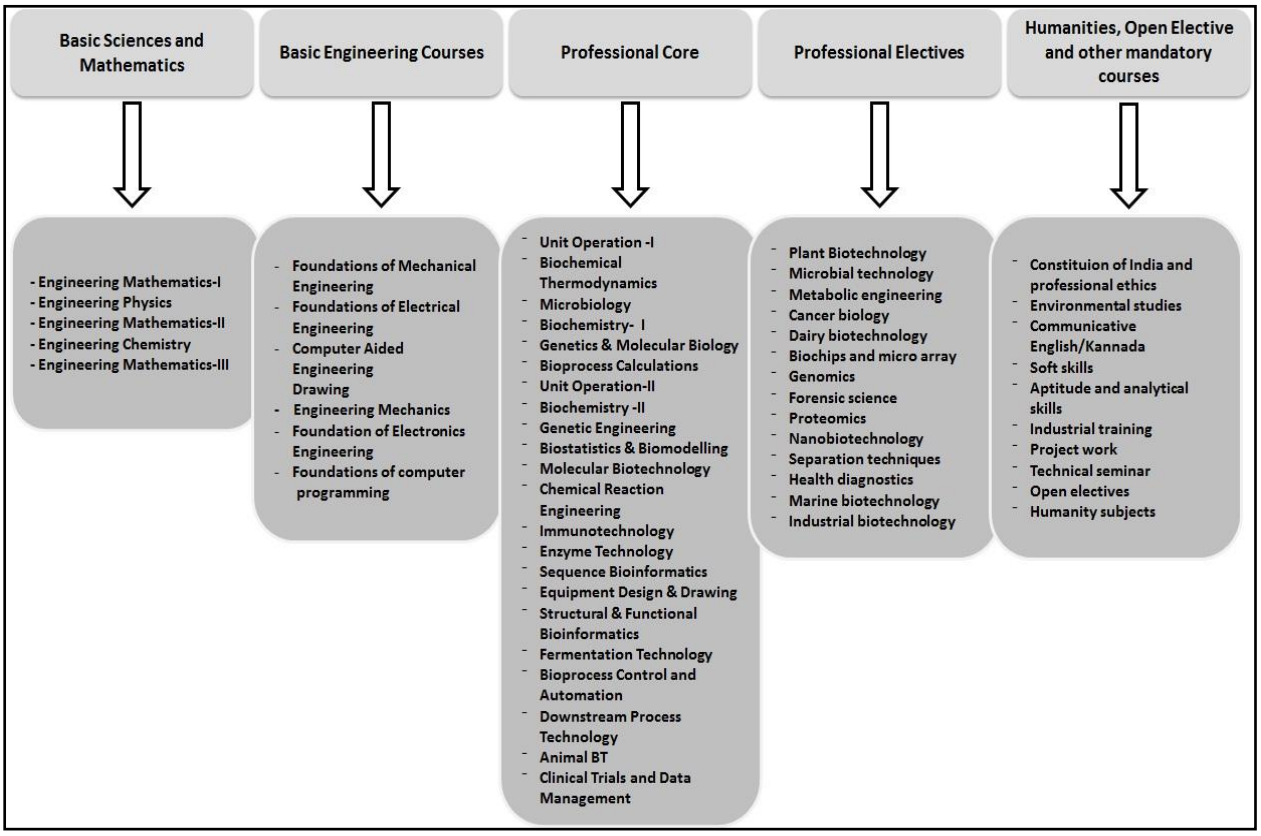
Programme Outcome I a	Will have in depth knowledge of mathematics (through differential equations; probability and statistics; calculus) Science (physics; and general chemistry) and fundamentals of Engineering and Student will be able apply this knowledge to solve Engineering problems and design of components **[short title: Mathematics, Science and Engineering knowledge]**
Programme Outcome I b	Will be able to design and conduct experiments and to critically analyze and interpret experimental data on biotechnological components/systems **[short title: Bio Experiments]**
Programme Outcome I c	Will be able to design an engineering component/system, to meet the needs as well as constraints related to economy, environment, safety and sustainability through design experiences acquired through the curriculum **[short title: Design]**
Programme Outcome I d	Will be able to function as an individual and as a team member on multi-disciplinary tasks, that must integrate contributions from different areas of engineering towards the solution of multi-disciplinary projects **[short title: Teams]**
Programme Outcome I e	Will be able to identify, research, formulate, analyze, model and solve bio engineering problems. **[short title: Bio Engineering Problems]**
Programme Outcome I f	Will have an understanding of professional and ethical practice issues in biotechnology engineering. **[short title: professional and ethical responsibility]**
Programme Outcome I	Will communicate effectively **[short title:**

g	**Communication]**
Programme Outcome I h	Will have the broad understanding of the possible impact of biotechnology engineering solutions on the regional/global scenario in the context of global, environmental and sustainable issues. **[short title: Global, environmental and Sustainable problems]**
Programme Outcome I i	Will recognize the need for life-long learning. **[short title: life-long learning]**
Programme Outcome I j	Will have the knowledge of contemporary issues such as societal, legal, cultural, safety and health and their impact on biotechnological profession as they relate to biotechnology engineering problems and solutions. **[short title: Contemporary issues and Societal problem]**
Programme Outcome I k	Will be able to adopt/use the techniques, skills, and modern tools necessary for biotechnology engineering practice. **[short title: Biotechnology techniques, skills, and modern tools]**
Programme Outcome I l	Will have the knowledge of principles of project management and finance and will be able to apply this to biotechnology engineering projects **[short title: Project management]**

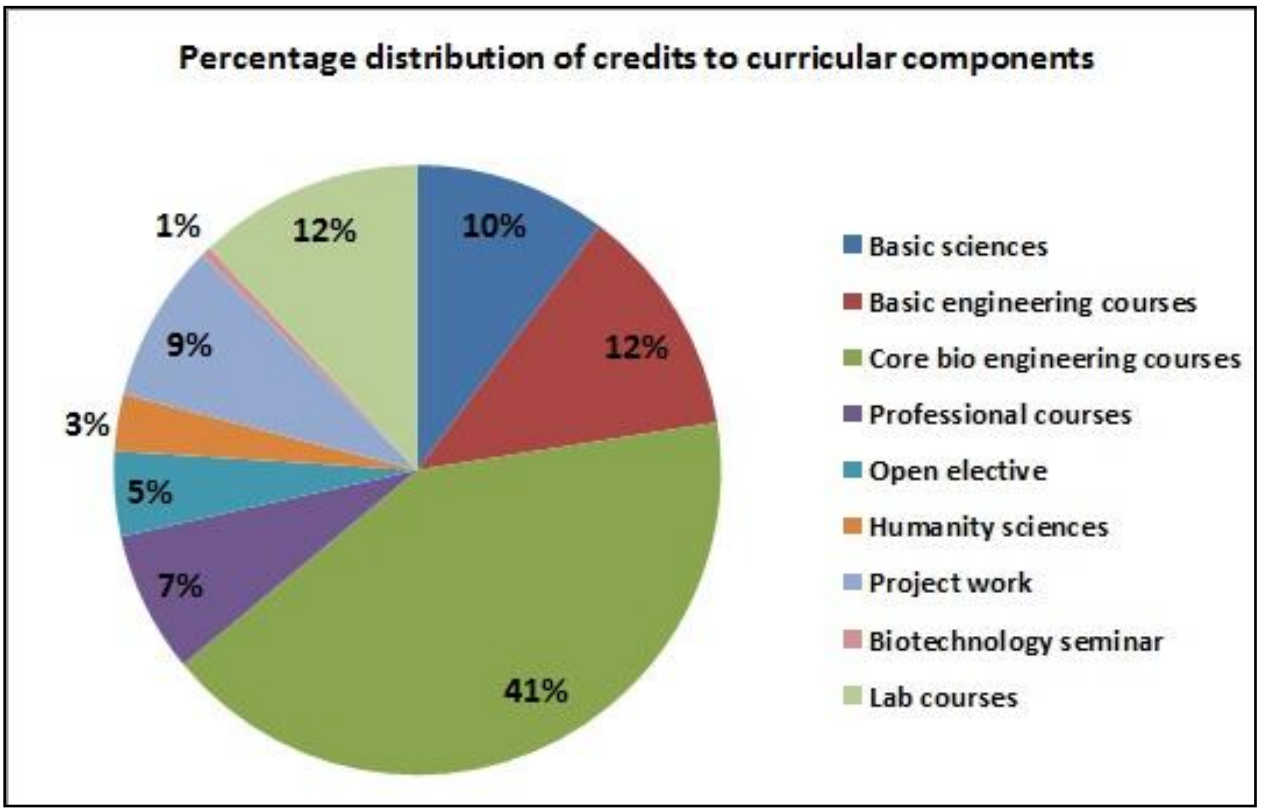
Mapping of Programme Educational Objectives (PEOs) with Programme Outcomes (POs)

	PEOs	Programme Outcomes											
		Ia	Ib	Ic	Id	Ie	If	Ig	Ih	Ii	Ij	Ik	Il
PEO#1	[Theme: Practice Engineering profession as capable professionals]	H	H	H		H					L	H	
PEO#2	[Theme: Team work and entrepreneurship]	H	H	H	H	H	L						L
PEO#3	[Theme: Higher education, Lifelong learning and Communication skills]					H		H		H	L	L	
PEO#4	[Theme: Initiated to society and ethical practice]			L			H		H				
PEO#4	[Theme: Initiated to society and ethical practice]			L			H		H				

Flowchart of core competencies:



Distribution of credits in percentage to curricular components



SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMKUR
DEPARTMENT OF BIOTECHNOLOGY
SCHEME OF TEACHING AND EXAMINATION
B.E (Biotechnology)
V SEMESTER

Sl. No.	Sub Code	Title	Teaching Dept.	Teaching hours/week			Examination				Credits
				L	T	P	Duration (Hrs.)	C.I.E. Marks	S.E.E Marks	Total Marks	
1	HS	Humanity subject	HD	3	---	---	3	50	50	100	3
2	OE	Open Elective	OE	3	---	---	3	50	50	100	3
3	5BT01	Chemical Reaction Engineering	Che/BT	3	1	---	3	50	50	100	3.5
4	5BT02	Immunotechnology	BT	4	---	---	3	50	50	100	4
5	5BT03	Enzyme Technolgy	BT	4	---	---	3	50	50	100	4
6	5BT04	Sequence Bioinformatics	BT	4	---	---	3	50	50	100	4
7	5BTP01	Mini Project	BT	---	---	2	2	50	50	100	0
8	5BTL01	Biokinetics & Enzyme Technology Lab	BT	---	---	3	3	50	50	100	1.5
9	5BTL02	Immunotechnology Laboratory	BT	---	---	3	3	50	50	100	1.5
10	5BTL03	Sequence Bioinformatics Laboratory	BT	---	---	3	3	50	50	100	1.5
11	MC06	Soft Skills	---	---	---	---	---	50	0	100	0
			Total	**21**	**1**	**13**					**26**

L-Lecture T-Tutorials P-Practical CIE-Continuous Internal Evaluation SEE- Semester End Examination

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMKUR
DEPARTMENT OF BIOTECHNOLOGY
SCHEME OF TEACHING AND EXAMINATION
B.E (Biotechnology)
VI SEMESTER

Sl. No.	Sub Code	Title	Teaching Dept.	Teaching hours/week			Examination				Credits
				L	T	P	Duration (Hrs.)	C.I.E. Marks	S.E.E Marks	Total Marks	
1	HS	Humanity subject	HD	3	---	---	3	50	50	100	3
2	OE	Open Elective	OE	3	---	---	3	50	50	100	3
3	6BT01	Equipment Design And Drawing	BT	4	---	---	4	50	50	100	4
4	6BT02	Structural And Functional Bioinformatics	BT	4	---	---	3	50	50	100	4
5	6BT03	Fermentation Technology	BT	3	---	---	3	50	50	100	3
6	6BTE01._	Professional Elective	BT	3	---	---	3	50	50	100	4
7	6BTP01	Mini Project	BT	---	---	3	3	---	---	---	2
8	6BTL01	Plant Biotechnology Laboratory	BT	---	---	3	3	50	50	100	1.5
9	6BTL02	Structural And Functional Bioinformatics Laboratory	BT	---	---	3	3	50	50	100	1.5
10	6BTIT	Industrial Training	---	---	---	---	---	---	---	---	---
			Total	**20**	**0**	**9**					**26**

L-Lecture T-Tutorials P-Practical CIE-Continuous Internal Evaluation SEE- Semester End Examination

Professional Electives

Marine Biotechnology 6BTE011 Dairy Biotechnology 6BTE012 Plant Biotechnology 6BTE013

CHEMICAL REACTION ENGINEERING

Contact Hrs./ Week	: (03+01)	Credits :	3.5
Total Lecture Hrs.	:39+13	CIE Marks :	50
Sub. Code	: 5BT01	SEE Marks :	50

Prerequisites: Bioprocess calculations, Module operation II

Course objectives:

- To understand basic concepts of chemical reactions
- To understand the concepts behind ideal chemically reacting systems represented by batch stirred tank reactors, continuous stirred tank reactors, Semi- batch stirred tank reactors and plug flow reactor
- To use the Arrhenius relationship to calculate how reaction rate depends on temperature
- To understand various theories of temperature dependency of rate constant

Course outcomes:

A student who has met the objectives of the course will be able to:

- Describe the tanks-in-series and dispersion one parameter models (L2)
- Describe how to obtain the mean residence time variance to calculate the number of tanks-in-series and the peclet number (L2)
- Describe how to use combinations of ideal reactors to model a real reactor and how to use tracer data to determine the model parameters (L2)
- Design a flow reactor with recycle (L6)
- Design ideal isothermal reactors (L6)

Unit I

Kinetics of Homogeneous Reactions:

Concentration-dependent term of a rate equation (Single and Multiple reactions, Elementary and Nonelementary Reactions, Molecularity and order of reaction, Rate Constant, Representation of elementary reaction,

Representation of Nonelementary reactions, Kinetic Models of Nonelementary Reactions, Testing Kinetic Models)

Temperature-dependent term of a rate equation (Temp. dependency from Arrhenius law, Collision theory, Transition state theory, Thermodynamic approach, Activation Energy) **10 Hrs**

Unit II

Interpretation of Batch Reactor Data:

Constant-Volume batch Reactor Analysis of Total pressure data , Integral Method of Analysis of Data(Irreversible I order Reactions, II order, nth order, Zero-order, Overall order of Irreversible reactions from the half-life, Irreversible Reactions in parallel, Homogeneous catalyzed reactions, Auto catalytic reactions, Irreversible Reactions in series, First order reversible reactions, Reactions of shifting order),Differential method of analysis of data.

Varying-Volume batch Reactor (Zero order, First order, Second order Reactions) **11 Hrs**

Unit III

Ideal Reactors for a Single Reaction:

Ideal Batch Reactor, Space-Time and Space-Velocity, Mixed flow reactor, Plug flow Reactor, General features of reactors, Holding time and space time for flow reactors

Design for Single Reactions:

Size comparison of single reactors, Multiple-Reactor systems(PFR in series and/or in parallel, Equal size MFR in series, Reactors of different types in series),Recycle Reactor **10 Hrs**

Unit IV

Heterogeneous Reactions:

Introduction, Rate Equation for heterogeneous reactions, concept of rate controlling steps, Contacting Patterns for two phase systems. Derivations and problems.

Biochemical Reaction Systems-I

Enzyme Fermentation, Michaelis-Menten Kinetics (M-M kinetics), Inhibition by a Foreign Substance-Competitive and Noncompetitive Inhibition, Microbial Fermentation-Introduction and Overall **10 Hrs**

Unit V

Basics of Non-ideal flow:

Introduction, Importance and interpretation of RTD curve, E, F and C curves, diagnosing reactors ills (qualitative discussion only), Statistical Interpretation, Dispersion model, Tanks in series model, Conversion in non-ideal flow reactors for simple systems, Problems.

Biochemical Reaction Systems-II

Substrate-Limiting Microbial Fermentation

Batch (or Plug Flow) Fermentors, Mixed Flow Fermentors, Optimum Operations of Fermentors

Product-Limiting Microbial Fermentation

Batch or Plus Flow Fermentors for n = 1,Mixed Flow Fermentors for n = 1

11 Hrs

TEXT BOOKS:

1.	Octave Levenspeil	Chemical Reaction Engineering, 3rd edition, John Wiley & Sons,
2.	H. Scott Fogler	Elements of Chemical Reaction Engineering, 3rd edition, Prentice Hall
3.	Ronald, Charles, Bradley,	Introduction to Chemical Reaction Engineering, Wiley Publisher

IMMUNOTECHNOLOGY

Contact Hrs./ Week	: 04	Credits :	4
Total Lecture Hrs.	:52	CIE Marks :	50
Sub. Code	: 5BT02	SEE Marks :	50

Prerequisites: Microbiology

Course objectives:

- To study the types of immune responses presented by the human body
- To understand the importance of B-cell and T-cell differentiation
- To find out the role of macrophages as the killing agents
- To learn about the hypersensitivity reactions
- To know about the causes of autoimmune diseases, clinical manifestations and their treatment
- To understand the immunological techniques like ELISA, Immunofluorescence.

Course outcomes:

A student who has met the objectives of the course will be able to:

- Explain the defensive mechanism present in the human body (L2)
- Describe how body is going to be protected by various infections caused by bacteria, viruses etc. (L2)
- Implement PCR reactions for production of genetically engineered cells (L3)
- Develop monoclonal antibodies (L6)
- Perform Blood typing (L3)

Unit-I

The Immune System: Introduction, anatomy of immune system, cells and organs of the immune system - Primary and secondary Lymphoid organs, antigens, Different Characteristics of Antigens, Mitogens, Hapten, Immunogen, Adjuvants.

Classification of Immune Responses: Types of immune responses – Racial, special and individual, Classification of immune system – innate - Skin and mucosal surface, Physiological Barriers, Phagocytic Barriers, Inflammation and adaptive immunity. **10 Hrs**

Unit-II

Humoral Mediated Immunity: B-lymphocytes and their activation - T-cell dependent activation and T-cell independent activation; structure and function of immunoglobulins, immunoglobulin classes and subclasses, idiotypes and anti-idiotypic antibodies, genetic control of antibody production

Cell-Mediated Immunity: Thymus derived lymphocytes (T cells) - their ontogeny and types- T_H cells, T_S cells, Tc cells and T_D cells, mechanisms of T cell activation ,MHC Complex – Structure, classification and its biological role, antigen presenting cells (APC) – professional and non professional, macrophages, dendritic cells, langerhans cells, mechanism of phagocytosis, Antigen processing and presentation – classI and class II MHC. **12 Hrs**

Unit-III

Immune Regulation and Tolerance: Complement activation - classical , properdin and lectin pathway and their biological functions – complement fixation test, cytokines and their role in immune response, immunotolerance and its types - Low zone, High zone, Classical and Infectious tolerance, Theories of Tolerance Induction – central and peripheral, Hypersensitivity its types - immediate and delayed type; Coombs' and Cell classification, and treatment.

Immunological Disorder: Autoimmune disorders and types - Systemic autoimmune diseases and Localized autoimmune diseases, pathogenic mechanisms, treatment, experimental models of auto immune disease, primary and secondary immunodeficiency disorders – primary and secondary, mechanism of AIDS, rheumatoid arthritis and allergies.

10 Hrs

Unit-IV

Transplantation Immunology: Immunological basis of graft and its types - autograft, allograft, isograft and xenograft, types – hyperacute, acute and chronic, and mechanism of graft rejection, role of HLA in graft rejection;

cellular and molecular mechanism – direct and indirect presentation, tissue typing, immunosuppression - definition and immunosuppressive drugs – glucocorticoids, cytostatics, antibodies and drugs on immunophilins. **Tumor of the Immune System:** tumor specific antigens and its types – TSA and TAA, tumor potent immune response – NK cells and Macrophages. **10 Hrs**

Unit-V

Molecular Immunology: Basic concepts of vaccine design and development Vaccines and their types, production of recombinant-DNA vaccines. Catalytic antibodies, application of PCR technology to produce antibodies, immunotherapy with genetically engineered antibodies. Production of monoclonal and polyclonal antibodies and their applications. Stem cells isolation, culturing and applications to immunology.

Immunological Techniques: Antigen antibody interaction – Precipitation reactions, Agglutination reactions, Blood typing, A, B, ABO & Rh, principles and applications of ELISA, Radioimmunoassay (RIA), immuno-electrophoresis, Immunofluorescence, chemiluminescence assays. **10 Hrs**

TEXT BOOKS:

1	Tizard	Immunology an Introduction, Thomson 2004.
2	J Kubey	Immunology,2003, WH Freeman.
3	Ashim K Chakravarthy	Immunology & Immunotechnology, Oxford University Press

REFERENCE BOOKS:

1	Roitt I	Essential Immunology, Blackwell Scientific Publications, Oxford, 1991.
2	Benjamini E	Molecular Immunology, 2002.
3	Benjamini E. and Leskowitz S	Immunology A short course, Wiley Liss, NY, 1991.
4	Peter Parham	The Immune System, Garland Science, 2005
5	Peter Wood	Understanding Immunology, Pearson Education, II edition, 2006

ENZYME TECHNOLGY

Contact Hrs / week	: 04	Credits	: 4
Total Lecture Hrs	: 52	CIE Marks	: 50
Subject Code	: 5BT03	SEE Marks	: 50

Prerequisites: Biochemistry II

Course objectives:

- To study the classification of enzymes and factors affecting enzyme action such as apoenzyme, prosthetic group, cofactors.
- To study about the kinetics of single and multiple substrate reactions along with enzyme activity, regulation.
- To study different mechanisms of enzyme actions.
- To study about the production methods of enzymes and its purification techniques.
- To learn the applications in the industries and their great importance in scientific research, clinical Diagnosis and in industry.
- To learn about enzyme immobilization methods, their repeated use and kinetics

Course outcomes:

A student who has met the objectives of the course will be able to:

- Carry out independent research in enzymology and related field (L3)
- Describe how enzyme act on substrate and form products, the reaction velocity (L2)
- Explain the mechanism of enzyme reaction (L2)
- Perform characterization of unknown enzyme including molecular weight determination (L3)
- Application of various enzymes in food, feed and industry including pharmaceuticals application against various diseases (L3)

Unit - I

INTRODUCTION TO ENZYMES

History of enzymology: Nomenclature and classification of enzymes; holoenzyme, apo-enzyme, cofactor, coenzyme, prosthetic group; enzyme activity unit and turn over number and other catalytic bio-molecules. Isozymes and Allosteric Enzymes, Biological Roles of enzymes, Activation Energy of enzymes, chemical nature of enzymes and active sites of enzyme and identification of functional groups at active sites, Conceptual Numericals; **10 Hrs**

Unit - II

KINETICS OF ENZYME CATALYZED REACTIONS

Introduction to bioenergetics, methods used for investigating the kinetics of enzyme catalyzed reactions; principles that explain catalytic power and substrate specificity of enzymes; Michaelis-Menten equation, Vmax and Km; enzyme inhibition, types of enzyme inhibitions, and determination of Ki; kinetics of single substrate and multi-substrate reactions. Regulatory enzymes; allosteric enzymes and their mode of action, Conceptual Numericals. **12 Hrs**

Unit - III

MECHANISM OF ENZYME ACTION

Enzyme action; effect of enzyme on the rate and equilibrium of a reaction; enzyme substrate complex, factors responsible for catalytic efficiency of enzyme; proximity and orientation effect, covalent catalysis, strain and distortion theory; mechanism of action of enzymes without cofactors (lysozyme and glyceraldehydes 3-phosphate dehydrogenases), mechanism of action of enzymes with cofactors / coenzymes, Conceptual Numericals;

10 Hrs

Unit - IV

ENZYME TECHNOLOGY

Strategies used for enzyme production, isolation and purification; estimation of enzyme activity; characterization of an enzyme, criteria of enzyme purity, determination of the molecular weight (Mr) and the number of sub-units of an enzyme; isoelectric focusing (pI); effect of inhibitors; Industrial applications of enzymes in cheese making, brewing and production of organic acids; enzyme immobilization and its importance;

protein engineering; enzyme therapy, enzyme inhibitors and drug design, Conceptual Numericals. **10 Hrs**

Unit - IV

INDUSTRIAL APPLICATION OF ENZYMES

Immobilization of enzymes: concepts, different methods of immobilization, characterization of immobilized enzymes and application of immobilized enzymes. Impact of genetic engineering on enzyme production; types of extremeophiles enzymes and their application. Industrial use of carbohydrases, proteases and lipases, uses of enzymes in detergent, leather, beverage, petroleum, heavy metal, food and pharmaceutical industry, Conceptual Numericals. **10 Hrs**

TEXT BOOKS:

1	Segal, L.H	Enzyme Kinetics, Wiley Interscience, USA (1975).
2	Walsh, C	Enzymatic reaction mechanism, Freeman and Company, USA (1979).
3	Gerhartz, W	Enzyme in Industry, production and application VCH (1990).
4	Shultz, A.R.	Enzyme Kinetics, Cambridge Press (1994).
5	Alan Fresht	Enzyme structure and mechanism, 2nd edition, Freeman and Company (1995).

REFERENCE BOOKS:

1	Trevor, P.	Understanding Enzymes, 4th edition, Prentice Hall/Ellis, Harwood, England (1995)
2	Dixon, M and Webb E.C	Enzymes, 3rd edition, Academic Press, New York (1997).
3	Nicholas C. Price and Lewis Stevens	Fundamentals of Enzymology. 3rd edition (2001)
4	Palmer	Enzymes, Horwood Publishing Series (2001).
5	Helmut Uhling	Enzyme Technology, John Wiley (1998).

SEQUENCE BIOINFORMATICS

Contact Hrs./ Week	: 04	Credits :	4
Total Lecture Hrs.	: 52	CIE Marks :	50
Sub. Code	: 5BT04	SEE Marks :	50

Prerequisite: Basics of bioinformatics, biochemistry

Course objectives:

- To learn about bioinformatics and gain understanding lab and research techniques using molecular biology methods
- To gain familiarity with computational methods in order to address problems in molecular biology
- To become knowledgeable about storage, retrieval, sharing and using biological data, information and tool
- To study the gene prediction method and analysis
- To study phylogenetic analysis

Course outcomes:

A student who has met the objectives of the course will be able to:

- Describe the various types of biological database and tools (L2)
- Employ the information in gene prediction and protein Analysis (L3)
- Utilize Biological information from public databases, given a particular problem in biotechnology, medicine or Biology (L3)
- Identify genes that upregulate / dowmregulate process –X in various tissues (L4)

Unit-I

Introduction to Biological databases

Bioinformatics: (What is Bioinformatics, Goals, Scope, Application, Limitations and New Themes). Database: (What is a database, Types) Biological Database: Databases (Primary, Secondary and Specialized), Interconnection between the databases, Fit falls of Biological databases. Nucleotide and Protein sequence databases (NCBI, Genbank, EMBL, DDBJ, PDB and MMDB) Format of databases: (GenBank flat file, FASTA Format, PIR Format), Other Important Databases: KEGG, Pubmed, OMIM,

Medline, TIGR. **11 Hrs**

Unit-II

Sequence Alignment and Database Similarity Searching

Sequence Alignment: Evolutionary Basis, Homology versus Similarity, Similarity versus Identity, Global alignment, Local alignment, Pairwise alignment, Alignment algorithm:

a) Pairwise: Dot matrix method , Dynamic programming Method (For both Local and Global Alignment. i.e. Needleman-Wunch & Smith waterman),Gap Penalties.

Scoring Matrices: Amino acid scoring matrices; PAM, BLOSUM, Comparison between PAM and BLOSUM,

Database Similarity Searching: BLAST. BLAST variants. Statistical significance. Low complexity Regions. BLAST output format. FASTA. Simple Alignment problems. **11 Hrs**

Unit-III

Multiple sequence alignment, Motif, Domain Prediction

Scoring Function, exhaustive algorithms, Heuristic algorithms, practical issues.

Profiles and Hidden Markov Models: PSSM. Profiles. Markov Model and HMM. Zeroth, First and Higher order HMM. Protein Motif and Domain Prediction: Identification of Motif and Domains in MSA. PROSITE. Motif and Domain Databases using Statistical Models (PRINTS, BLOCKS, ProDom, Pfam, SMART)Protein Family databases (COG). Motif Discovery and Sequence Logos. Problems on 0^{th} 1^{st} and Higher order HMM. **10 Hrs**

Unit-IV

Gene Predictions and Promoter and regulatory Element Predictions:

Gene Predictions in Prokaryotes using conventional, Markov models and HMM (GeneMark, Glimmer, FGENESB etc).

Gene Predictions in Eukaryotes using Ab Initio-Based Programs.(Using Neural Network, Discriminant and HMM)

Promoter and regulatory Element Predictions: Prediction Algorithms (Ab Initio method for both Prokaryotes and Eukaryotes. Foot printing method. Expression profiling method). **10 Hrs**

Unit-V

Molecular Phylogenetics:

Phylogenetics Basics, Terminologies, Gene versus species phylogeny, Forms of tree representation. Tree Construction: Choosing Molecular Markers. Alignment. Multiple Substitutions. Choosing Substitution Models (Jukes Cantor Model).

Tree Building Methods (Distance based: UPGMA and Neighbor joining. Character Based Methods: Maximum Parsimony, Maximum Likelihood.) Assessing tree reliability: Bootstrapping. Phylogenetics software's: PAUP, Phylip **10 Hrs**

TEXT BOOKS:

1.	Jin Xiong	Essentials Bioinformatics, Cambridge University Press
2.	Andreas D Baxevanis	Bioinformatics, Wiley Inter-science, 1998.
3.	David W Mount	Bioinformatics, Cold spring harbor, 2001.

REFERENCE BOOKS:

1.	R F Doolittle	Computational methods for macromolecular sequence analysis, Academic Press, 1996.
2.	S C Rastogi, N Mendiratta & P Rastogi,	Bioinformatics, Methods and Applications-Genomics, Proteomics and Drug,Discovery –Phi, 2006.
3.	Arthur Lesk	Introduction to Bioinformatics, Oxford, 2006.
4.	Stuart M Brown	Bioinformatics, NYU Medical Center, NY USA. 2000.

BIOKINETICS & ENZYME TECHNOLOGY LAB

Lab Hrs./ Week	: 3	Credits :	1.5
Sub. Code	: 5BTL01	CIE Marks :	50
		SEE Marks :	50

Prerequisites: Basic biochemistry practical knowledge and microbiology practical experience.

Course Learning Objectives:

The objective of the course is to familiarize students with the concepts of batch and continuous reactors. The specific objectives are:

- To study the reaction kinetics between non equimolar & equimolar solutions in batch reactor
- To learn the RTD studies in CSTR & PFR
- To study the effect of starch concentration on enzyme activity
- To learn the factors affecting the enzyme activity

Course outcomes:

A student who has met the objectives of the course will be able to:

- **Apply** practical skills in designing and analyzing the reaction kinetics of batch reactor (**L3**)
- **Analyze** the reaction between non equimolar quantities in a PFR (**L4**)
- **Determine** the mean residence time for pulse input in CSTR (**L6**)
- **Estimate** the concentration of reducing sugar in unknown sample (**L6**)
- **Evaluate** different factors affecting enzyme activity (**L4**)

List of Experiments

1. Mixed Flow Reactor Analysis
2. Plug Flow Reactor Analysis.
3. Batch Reactor Analysis
4. RTD in PFR
5. RTD in MFR

6. Construction of standard curve for maltose, a disaccharide using DNS reagent
7. Study the effect of substrate concentration on enzyme activity (Km & Vmax) of diastase / alpha-amylase obtained from fungal source
8. Study the effect of pH on alpha-amylase activity
9. Study the effect of temperature on alpha-amylase activity
10. Determination of alpha-amylase activity and specificity in sprouted seeds
11. Isolation and purification of alpha-amylase obtained from the sprouted seeds using chromatographic techniques like, adsorption, ion exchange and gel permeation chromatography.
12. Molecular weight determination of the enzyme by SDS-PAGE.

BOOKS RECOMMENDED

1. Shuler and Kargi (1992). Bioprocess Engineering Prentice Hall.
2. Segal, L.H (1975). Enzyme Kinetics, Wiley Interscience, USA
3. Walsh, C (1979). Enzymatic reaction mechanism, Freeman and Company, USA.
4. Shultz, A.R. (1994) Enzyme Kinetics, Cambridge Press.
5. Wolf R. Vieth (1990). Production and Applications – Enzymes in Industry, VCH Publishers, New York.
6. Helmut Uhling (1998). Enzyme Technology, John Wiley

IMMUNOTECHNOLOGY LABORATORY

Lab Hrs./ Week	: 3	Credits : 1.5
Sub. Code	: 5BTL 02	CIE Marks : 50
		SEE Marks : 50

Prerequisites: Biochemistry, Immunotechnology, Microbiology

Learning Objectives- Lab

- To give an understanding of the basic principles of modern immunology and an introduction to basic techniques and diagnostic tools used in immunological research.
- To provide an introduction to experimental design and basic techniques commonly used in immunology research laboratories.
- To Understand and apply immunological techniques in diagnosis.

Out comes of Immunotechnology lab:

- It Explains about basic fundamental knowledge about antigen and antibody reactions .(L2)
- It describes about diagnosis of various diseases.(L2)
- It gives knowledge to apply concepts to find out real problems. (L3)

List of experiments:

1. Agglutination Technique:

i) Blood grouping and Rh typing.

ii) Bacterial Agglutination Technique-Widal test (Tube / slide agglutination)

2. Ouchterlony Double Diffusion (ODD) and Radial Immunodiffusion (RID)
3. Countercurrent immunoelectrophoresis (CCIEP)
4. Immunoelectrophoresis (IEP) and Rocket immunoelectrophoresis (RIEP)
5. Enzyme Linked Immunosorbent Assay (ELISA)
6. Separation of lymphocytes from peripheral blood.
7. Complementation test in bacteria.
8. Western blotting.
9. Southern blotting.

TEXT BOOK:

1	S C Rastogi	Immunodiagnostics, New Age International.
2	Ashim K Chakravarthy	Immunology & Immunotechnology, Oxford University Press,

SEQUENCE BIOINFORMATICS LABORATORY

Lab Hrs./ Week	: 3	Credits :	1.5
Sub. Code	: 5BTL03	CIE Marks :	50
		SEE Marks :	50

Prerequisites: Foundations of Computer programming, Biochemistry, Genetics and Molecular Biology

Course Learning Objectives - Lab

- To working with biological database and tools
- To study the gene prediction method and analysis
- To study phylogenetic analysis and evolutionary relationship

Laboratory outcomes

A student who has met the objectives of the course will be able to:

- **Describe** and analysis the various types of biological database and tools (L2)
- **Utilize** Biological information from public databases (NCBI, DDBJ and EBI (L3)
- **Identify** and prediction of genes in genome(L4)

1. Working with NCBI and inter connection with the databases.
2. Sequence retrieval from nucleic acid and protein databases.
3. Sequence (FASTA and BLAST) searches – Analysis of parameters affecting alignment.
4. Pair wise comparison of sequences – Analysis of parameters affecting alignment.
5. Multiple alignments of sequences – Analysis of parameters affecting alignment.
6. HMM construction and searches using protein database.
7. Protein and DNA motif searches.
8. Evolutionary studies / Phylogenetic analysis – Analysis of parameters affecting trees.

a) Constructing and Refining a Multiple Sequence Alignment.

b) Constructing a Distance-Based Phylogenetic Tree.

c) Constructing a Maximum Parsimony Tree.

d) Constructing a Maximum Likelihood Tree Using Genetic Algorithm.

9. Identification of functional sites in Genes / Genomes.
10. Basics of (Demo) CLC Genomic Work Bench
11. Protein sequence retrieval from Uniprot and PIR
12. Multiple sequences and Phylogenetic analysis using CLUSTAL-W
13. Gene and Genome annotation using CLC Main Workbench.
14. Working with Protparam tool.

TEXT BOOKS

1.	Jin Xiong	Essentials Bioinformatics,Cambridge University Press
2.	Andreas D Baxevanis	Bioinformatics, Wiley Interscience, 1998.
3.	David W Mount	Bioinformatics, Cold spring harbor, 2001.

REFERENCE BOOKS

1.	R F Doolittle	Computational methods for macromolecular sequence analysis, Academic Press, 1996.
2.	S C Rastogi, N Mendiratta & P Rastogi,	Bioinformatics, Methods and Applications-Genomics, Proteomics and Drug,Discovery – Phi, 2006.
3.	Arthur Lesk	Introduction to Bioinformatics, Oxford, 2006.
4.	Stuart M Brown	Bioinformatics, NYU Medical Center, NY USA. 2000.

EQUIPMENT DESIGN AND DRAWING

Contact Hrs./ Week	: 4 (Lecture)	Credits :	4.0
Total Lecture Hrs.	: 52	CIE Marks :	50
Total Tutorial Hrs.	: 00	SEE Marks :	50
Sub. Code	: 6BT01		

Prerequisites: Chemical reaction Engg, Bioprocess calculations

Course objectives:

- To understand the principles of process equipment design, the mechanical aspects of design and operation of process equipment, include safety considerations
- To study the designing of fermenter
- To know about the designing of evaporator, distillation column and heat exchanger

Course outcomes:

A student who has met the objectives of the course will be able to:

- Describe the components of process equipments supports, nozzle and heads (L2)
- Distinguish between agitators and sparger and types of valves (L2)
- Explain the function of evaporators, learning about boiling point elevation, know about different components of evaporator design and draw the evaporator (L2)
- Design different types of heat exchangers, compare between DPHE and STHE (L6)
- Design and Differentiate between bubble cap distillation column and packed bed distillation column (L6, L2)
- Design and draw the bubble cap distillation column (L6)

Unit-I

Introduction: Basic considerations in design. General design procedure. Various components of process equipment. **Design Considerations**: Material selection. Factors affecting design. Stresses due to static and dynamic loads (Internal & External).

Vessel Component Design: Types of supports for vessels - Bracket, Lug, Leg, Saddle and Skirt supports. Design of flanges & nozzles – Classification of flanges. Flange thickness calculation, Nozzle design. Design of vessel closures – Flat plates, Formed heads, Elliptical & Hemispherical heads.

Reaction Vessels: Design of jackets. Design of reaction tanks with agitation and jacket. Types of agitators, baffles. Power requirement

calculations. Design of tank dimensions and agitation system components. Drive calculations & selection of accessories. Numerical problems. **08 Hrs**

Unit -II

Design of Fermenter: Different types of Mechanical Seals: Packed-gland stirrer seal, Mechanical seal, Agitator-sparger, Magnetically coupled-top stirrer.

Design of Fermenter: Different types of valves- Plug valve, Ball valve, Piston valve, Gate valve, and Globe valve. **20 Hrs**

Unit -III

Design of Evaporator: Design of Evaporator – Single effect, Numerical problems **08 Hrs**

Unit -IV

Heat exchanger:

Design of Shell and Tube Heat exchanger and pressure drop calculations, Numerical problems **08Hrs**

Unit -V

Distillation Column:

Introduction, reflux considerations, total reflux, minimum reflux, optimum reflux ratio, feed point location, McCabe-Thiele method – procedure, Distillation column design, Plate contactors-Bubble Cap, sieve plate, Valve plates, Diameter of column. Numerical conceptual. **08 Hrs**

TEXT BOOKS:

1	M. V. Joshi	Process Equipment Design - Macmillan & Co. India, Delhi, 3rd Edn. reprint 1998.
2	Brownell & Young	Process Equipment Design – Vessel Design -John Willey, 1951
3	R.K. Sinnott	Chemical Engineering Design- Vol 6, Elsevier publications., 4th Edition, Coulson and Richardson's Chemical Engineering Series.2005

REFERENCE BOOKS:

1	Perry & Green	Chemical Engineers Handbook-7th Edn, McGraw Hill, 1997.
2	IS Code	Pressure Vessel Code – IS 2825 - IS Code, B.I.S., New Delhi, 1969.
3	Crane Amazon	Flow of Fluids through Valves, Fittings & Pipes Crane Amazon-2006.

Instructions:

Question paper of SEE is set for two questions each carries 100 mark. No objective questions in SEE. Student has to answer only one question completely. Assembly drawing or Design of fermenter may be considered for the Unit II.

STRUCTURAL AND FUNCTIONAL BIOINFORMATICS

Contact Hrs./ Week	: 04	Credits :	3
Total Lecture Hrs.	: 52	CIE Marks :	50
Sub. Code	: 6BT02	SEE Marks :	50

Prerequisites: Basics of Bioinformatics

Course objectives:

- To study the principles underlying Protein secondary and tertiary structure prediction in computational approach.
- To study the usage of biological structural database, commercial (Discovery studio) and open source tools (Rasmol, Swiss PDB viwer) for the meaningful analysis of Protein structure.
- To discuss and clarify the methodological challenges in the planning, conduct and analyses of a trial
- To impart the basic skills necessary in monitoring the trial and to develop a quality data management system
- To study the various applications of Structural and Functional Bioinformatics and Bioinformatics in agriculture, industry, medicine and environmental protection

Course outcomes:

A student who has met the objectives of the course will be able to:

- Describe the concepts of Protein and Nucleic acid structure (L2)
- Explain the concepts of Protein Structure prediction (L2)
- Outline the techniques of Homology modeling (L1)
- Describe the applications of Structural and Functional Bioinformatics in Drug Discovery (L2)
- Apply methods involved in Microarray technology (L3)

Unit-I

Protein Structure Basics, visualization, Comparison and Classification:

Amino acids, Dihedral angles, Ramachandran plot, Secondary structures, Tertiary structures, Determination of protein three dimensional structures, Protein structure database (PDB, mmCIF, MMDB), PDB format, mmCIF and MMDB formats, Protein structure visualization: RasMol, Jmol, Swiss PDB viewer, Molscript, Chime, Cn3D.

Protein structure Comparison: Intra-molecular Method, Intermolecular method, combined method, multiple structure alignment.

Protein structure comparison: SCOP, CATH. **12 Hrs**

Unit-II

Protein Secondary structure prediction and RNA structure prediction:

Secondary structure prediction of Globular proteins; Ab Inition Methods, Homology Based Methods, Predictions with neural networks, Comparison of prediction accuracy.

Secondary structure prediction for transmembrane proteins; Prediction of Helical membrane proteins, prediction of β-barrel membrane proteins. Coiled coil prediction;

RNA structure prediction: introduction, Types of RNA structures, RNA secondary structure prediction methods; Ab Initio approach, dot matrices, dynamic programming, partition function, comparative approach and performance evaluation. **12 Hrs**

Unit-III

Protein tertiary structure prediction:

Introduction, Methods;

1) Homology modeling :- Template selection, Sequence alignment, Backbone model building, loop modeling, side chain refinement, model refinement using energy function, model evaluation, comprehensive modeling programs, homology model databases.
2) Threading and fold recognition: - Pairwise energy method, profile method.
3) Ab Initio protein structure prediction CASP (Critical assessment of techniques for protein structure prediction). **10 Hrs**

Unit-IV

Genome mapping, assembly and comparison:

Genome mapping, genome sequencing, genome sequence assembly; base calling and assembly programs. Genome annotation; gene ontology, automated genome annotation, annotation of hypothetical proteins, genes in genome, genome economy. Comparative genomics: whole genome alignment, finding minimal genome, lateral gene transfer, within genome approach, gene order comparison. **09 Hrs**

Unit-V

Functional Genomics:

Sequence based approaches; EST's (Expressed sequence tags), EST index construction, SAGE (Serial analysis of gene expression).

Microarray based approaches; Oligonucleotide design, Data collection, Image processing, Data transfer and normalization, Statistical analysis to identify differentially expressed genes, microarray data classification, Comparison of SAGE and DNA microarrays. **09 Hrs**

TEXT BOOKS:

1.	Jin Xiong	Essentials Bioinformatics, Cambridge University Press
2.	Andreas D Baxevanis	Bioinformatics, Wiley Inter-science, 1998.
3.	David W Mount	Bioinformatics, Cold spring harbor, 2001.

REFERENCE BOOKS:

1.	R F Doolittle	Computational methods for macromolecular sequence analysis, Academic Press, 1996.
2.	S C Rastogi, N Mendiratta & P Rastogi,	Bioinformatics, Methods and Applications-Genomics, Proteomics and Drug,Discovery –Phi, 2006.
3.	Arthur Lesk	Introduction to Bioinformatics, Oxford, 2006.
4.	Stuart M Brown	Bioinformatics, NYU Medical Center, NY USA. 2000.

FERMENTATION TECHNOLOGY

Contact Hrs./ Week	: 03	Credits :	3
Total Lecture Hrs.	: 39	CIE Marks :	50
Sub. Code	: 6BT03	SEE Marks :	50

Prerequisites: Enzyme technology

Course objectives:

- To study about screening, isolation and productivity improvement of microbial strains for the production of industrially important food, feed and pharmaceutical products
- To understand fermentation process development and fermentation control during production
- To learn the process of production of various fermentation products on using genetically modified microorganisms
- To learn about food and beverage fermentation, microbial cells as fermentation product as well as bioremediation and bioleaching

Course outcomes:

A student who has met the objectives of the course will be able to:

- Carry out and control of fermentation process at industrial scale (L3)
- Handle the fermentation process using GMO which produce human protein used as therapeutics (L3)
- Contribute in the agricultural process benefitted from nitrogen fixing bacteria and biological control of insects (L3)
- Design the batch & continuous sterilization equipments (L6)

Unit-I

Production, Objectives and Scope:

Basic principles of fermentation technology, Screening and Isolation of Microorganisms, Preservation, Maintenance and Improvement (Mutant selection, Recombinant DNA methods) of industrially important Micro-organisms. Media for Industrial Fermentation's: Medium formulations; Raw materials- Carbon, Nitrogen, Mineral sources, Antifoam and others.

Development of inocula for industrial fermentations – criteria for inoculum transfer, development of inocula for yeast, bacterial and mycelia processes. Type of Fermentation - Solid State, submerged fermentation (batch / fed-batch) and continuous fermentation. **8 Hrs**

Unit -II

Design of a fermenter (Basic functions of a fermenter, aseptic operation and containment, body construction), Aeration and Agitation – the agitator, baffles, aeration system. Achievement and maintenance of aseptic conditions, Sterilization of fermenter, air supply and exhaust gas from a fermenter, addition of inoculum, nutrients and other supplements, sampling, feed ports, sensor probes.

Sterilization – Design of batch and continuous sterilization and its advantages / disadvantages. Filter sterilization of fermentation media.

8 Hrs

Unit-III

Production of Microbial products

Production of Microbial products obtained by industrial fermentation- Organic acids (e.g. citric acid, lactic acid, acetic acid (vinegar); Amino acids (Glutamic acid, lysine); and Alcohols (industrial ethanol)

Antibiotics-beta-lactams (Penicillins), amino-glycosides, (streptomycin), Vitamins - Ascorbic acid (Vit C), Cobalamin (B12) and Steroids, Exopolysaccharide – Xanthan gum. **8 Hrs**

Unit-IV

Other Fermentation Products

Food and beverage fermentation – Beer brewing, wine production; Distilled beverages- whisky production, dairy fermentation- butter production, yoghurt production, probiotics.

Recombinant DNA products - Bacterial vaccine, Recombinant therapeutic peptides & proteins, Human growth hormones (somatotrophin), Erythropoietin, Insulin, Interferon, Interleukins, Tissue Plasminogen Activator (TPA), Bacteriophage as therapeutic agents. **8 Hrs**

Unit-V

Microbial cells as fermentation products

Baker's yeast, food and feed yeasts, Bacterial insecticides -*Bacillus thuriengiensis*- delta endotoxins and cry genes, Biological Nitrogen fixation- Symbiotic and Non-symbiotic, legume inoculants, mushrooms.

Bioremediation and Bioleaching

Uses of Bacteria in Bioremediation – Types of bioremediation, Biodegradation of hydrocarbons, Crude oil degradation by bacteria, PCB dechlorination, Microbiological degradation of xenobiotics. Microbial leaching of copper, Iron, uranium (by heap / dump Leaching). **7 Hrs**

TEXT BOOKS:

1	Prescott and Dunn	Industrial Microbiology Agrobios (India)-First edition,agrobios,2006
2	L.E.Casida	Industrial Microbiology- First edition, New age international (p) Ltd. 2007.
3	Indu shekar Thakur	Industria Biotechnology, 1st Ed., I.K.International Pvt. Ltd.2006
4	P.F.Stanburry and A. Whitaker	Principles of fermentation technology, 2nd edition, Elsevier publications, 2007.

MARINE BIOTECHNOLOGY

Contact Hrs./ Week	: 3	Credits :	4
Total Lecture Hrs.	: 52	CIE Marks :	50
Sub. Code	: 6BTE011	SEE Marks :	50

Prerequisites: 10+2 biology (Zoology section) ; Environmental science

Course objectives:

- To understand the biology of arthropoda
- To study the effects of pollution on marine life
- To learn the methods of studying the marine microorganism collection
- To study the physical, chemical & biological aspects of marine life
- To study about screening, isolation, purification of bioactive compounds from marine flora & fauna

Course outcomes:

A student who has met the objectives of the course will be able to:

- Explain the general biology, morphology & anatomy of arthropoda (L2)
- Explain about the renewable & non renewable resources of ocean (L2), Describes the methods for microorganism collection, isolation, culture & identification (L2).
- Elucidate the major pollutants of marine life (L2), Describes the ethical & moral issues concerning food health & environmental safety (L2).
- Carry out screening, isolation, purification of bioactive compounds from marine flora & fauna (L3).

Unit-I

Aqua Culture

Classification and Characteristics of Arthropoda. Crustacean characteristic key to Myanmar's Economically Important species of Prawns and Shrimps,

General biology, embryology, morphology, anatomy and organ systems of – (a) Shrimp and Prawn, (b) Finfish, (c) Marine and freshwater fish. Preparation, culture and utilization of live food organisms, phytoplankton zooplankton cultures, Biology of brine shrimp Artemia, quality evaluation of Cyst, hatching and utilization, culture and cyst production. **10 Hrs**

Unit-II

Techniques

Chromosome manipulation in aquaculture - hybridization, ploidy induction, gynogenesis, androgenesis and sex reversal in commercially important fishes. Application of microbial biotechnology in culture ponds, bioaugmentation, bioremediation, nutrient cycling, and biofertilization. Probiotics –Immunostimulants. Tools for disease diagnosis in cultivable organisms- Enzyme immuno assays - Dot immunobinding assay - Western blotting - Latex agglutination test - Monoclonal antibodies - DNA based diagnosis. **10 Hrs**

Unit-III

Marine Environment

Biological Oceanography: The division of the marine environment – benthing, pelagic, batuyal, littoral. Ocean waters as biological environment. Distribution and population of plants and animals. Marine ecology and fisheries potential. Effects of pollution on marine life. Geological and geophysical Oceanography: Geophysical and geological processes. Ocean basin rocks and sediments. Beach and beach processes, littoral sediment transports. Coastal erosion-causes and protection. Resources of the ocean-renewable and non-renewable.

Marine Microbiology

Methods of studying the marine micro-organisms collection, enumeration, isolation, culture & identification based on morphological, physiological and biochemical characteristics. Preservation of marine microbes, culture collection centres (ATCC, IMTECH, etc.). Microbial nutrition and nitrogen fixation. Seafood microbiology - fish & human pathogens. Indicator of Pollution - faecal coliforms - Prevention & control. **12 Hrs**

Unit-IV

Marine Biotechnology

Physical, Chemical and Biological aspects of marine life. Air – Sea interaction – Green house gases (CO2 and Methane). Marine pollution-major pollutants (heavymetal, pesticide, oil, thermal, radioactive, plastics, litter and microbial). Biological indicators and accumulators: Protein as biomarkers, Biosensors and biochips. Biodegradation and Bioremediation. Separation, purification and bioremoval of pollutants. Biofouling - Biofilm formation Antifouling and Anti
boring treatments. Corrosion Process and control of marine structures. Biosafety – special characteristics of marine environment that bear on biosafety. Ethical and moral issues – food health, and environmental safety concerns. **12 Hrs**

Unit-V

Marine Pharmacology

Terms and definitions. Medicinal compounds from marine flora and fauna - marine toxins – antiviral, antimicrobial. Extraction of crude drugs, screening, isolation, purification and structural characterization of bioactive compounds. Formulation of drugs and Drug designing: Pharmacological evaluation – routes of drug administration – absorption, distribution, metabolism and excretion of drug, clinical trials. **08 Hrs**

TEXT/REFERENCE BOOKS:

1	Ranga & Shammi	Fish Biotechnology
2	Kenneth	Environmental impacts of Aquaculture, CRC. pp. 214.
3	David J.Attaway et al.	Marine Biotechnology
4	Morries H. Baslow	Marine Pharmacology, The Williams & Wilkins Co., Baltimore.
5	Kenneth, C. Highnam and Leonard Hill	The comparative endocrinology of the invertebrates, Edward Arnold Ltd.

DAIRY BIOTECHNOLOGY

Contact Hrs./ Week	: 04	Credits :	3
Total Lecture Hrs.	: 52	CIE Marks :	50
Sub. Code	: 6BTE012	SEE Marks :	50

Prerequisite: Basic microbiology

Course objectives:

- To study the microbial changes in refrigerated raw milk
- To learn about production of dairy based products using genetically engineered bacteria & animals
- To understand the importance of antimicrobial substances naturally present in milk
- To study the sanitary features of the dairy equipment
- To understand the concept of clean room & its importance in manufacturing of biopharmaceuticals
- To learn the quality systems like ISO 9001:2000 series

Course outcomes:

A student who has met the objectives of the course will be able to:

- Explain manufacturing & processing of dairy products (L2)
- Enlighten on the enzymes used in dairy industry (L2)
- Explain whey processing & utilization of products generated from whey (L2)
- Explain the working & maintenance of cleaning equipments involved in dairy industry (L2)
- Apply the methods involved in cleaning or sterilizing the manufacturing facility (L3)
- Apply the concepts of ISO & can participate in groups working for different ISO accreditation (L3)

Unit-I

Introduction

Overview of dairy industry, Characteristics of dairy Industry. Manufacturing & processing of dairy products, effect of processing on constituents and methods of evaluation of dairy products.

Dairy Microbiology

Microbial quality of milk produced under organized versus unorganized milk sector in India and comparison with developed countries; Impact of various stages like milking, chilling, storage and transportation on microbial quality of milk with special reference to psychrotrophic organisms; Direct and indirect rapid technique for assessment of microbial

quality of milk. Milk as a vehicle of pathogens; Food infection, intoxication and toxic infection caused by milk borne pathogens like E. coli, Salmonella typhi,etc . Microbiological changes in bulk refrigerated raw milk; Mastitis milk: organisms causing mastitis, detection of somatic cell count (SCC). Role of microorganisms in spoilage of milk; souring, curdling, bitty cream, proteolysis, lipolysis; abnormal flavors and discoloration. **10 Hrs**

Unit-II

Dairy Biotechnology

Genetic engineering of bacteria and animals intended for dairy-based products: DNA cloning. protoplast fusion & cell culture methods for trait improvement with instances cited. Enzymes in dairy industry & production by whole cell immobilization. Biotechnology of dairy effluent treatment. Ethical issues relating to genetic modification of dairy microbes & milk-yielding animals. **10 Hrs**

Unit-III

By products Technology

Status, availability and utilization of dairy by-products in India and abroad, associated economic and pollution problems. Physico chemical characteristics of whey, butter milk and ghee residue, by-products from skim milk such as Casein; Whey processing & utilization of products generated from whey. Significance of antimicrobial substances naturally present in milk (responsible for its nutraceutical properties): immunoglobulin, lactoferin, lysozymes, LP systems. **10 Hrs**

Unit-IV

Dairy Engineering

Sanitization: Materials and sanitary features of the dairy equipment. Sanitary pipes and fittings, standard glass piping, plastic tubing, fittings and gaskets, installation, care and maintenance of pipes & fittings. Description, working and maintenance of can washers, bottle washers. Factors affecting washing operations, power requirements of can the bottle washers, CIP cleaning and designing of system.

Homogenization: Classification, single stage and two stage homogenizer pumps, power requirements, care and maintenance of homogenizers, aseptic homogenizers. Pasteurization: Batch, flash and continuous (HTST)

pasteurizers, Flow diversion valve, Pasteurizer control, Care and maintenance of pasteurizers.

Different type of sterilizers, in bottle sterilizers, autoclaves, continuous sterilization plant, UHT sterilization, Aseptic packaging and equipment. Filling Operation: Principles and working of different types of bottle filters and capping machine, pouch filling machine (Pre-pack and aseptic filling bulk handling system. **12 Hrs**

Unit-V

Quality and Safety Monitoring in Dairy Industry

Current awareness on quality and safety of dairy foods; consumer awareness and their demands for safe foods; role of codex alimentarious commission (CAC) in harmonization of international standards; quality (ISO 9001:2000) and food safety (HACCP) system and their application during milk production and processing. National and international food regulatory standards; BIS, PFA, ICMSF, IDF etc., their role in the formulation of standards for controlling the quality and safety of dairy foods. Good Hygiene Practices (GHP): Rapid assessment of dairy food for microbial and non-microbial contaminants; Enumeration Principles of detection of predominant spoilage organisms and pathogens, pesticides. Quality of water and environmental hygiene in dairy plant; chlorination of dairy water supply, treatment and disposal of waste water and effluents, Quality of air & personnel hygiene. **10 Hrs**

TEXT BOOKS:

1	Hui, Y.H	Dairy Science & Technology Handbook (Vols 1-3). Ed, Wiley Publishers.
2	Robinson R.K	Dairy Microbiology Handbook (3rd Ed), Wiley Publishers.

REFERENCE BOOKS:

1	N.C Gautam	Comprehensive Biotechnology (Vol 6)- Ed, Shree Pblns.
2	Powar & Daginawala	General Microbiology (Vol 2), Himalaya Publishers
3	Myer Kutz	Handbook of Farm, Dairy & Food Machinery, Andrew Publishers.

PLANT BIOTECHNOLOGY

Contact Hrs/ Week	: 03	Credits :	3
Total Lecture Hrs	: 39	CIE Marks :	50
Sub. Code	: 6BTE013	SEE Marks :	50

Prerequisites : Genetic engineering and applications

Course objectives:

- To understand the basic principles of tissue culture, sterilization principles, tissue culture facility
- To study about the media preparation, its composition, importance of plant hormones
- To study how to select explants for tissue culture, methods of propagation & synthetic seed production
- To study different types of tissue culture methods and production of secondary metabolites
- To study the different types of bioreactor involved in crop improvement using PCR, RAPD, RFLP etc.

Course outcomes:

A student who has met the objectives of the course will be able to:

- Classify different types of sterilization methods (L1), Describe the tissue culture facility (L2)
- Explain the significance of micronutrients, macro nutrients, growth regulators, hormones (L2)
- Distinguish types of tissue culture (L2), Describe micro propagation, somatic embryogenesis, synthetic seed production (L2)
- Outline various types of culture systems (L1)
- Apply various gene technology for crop improvement (L3), Describe use of vector less gene transfer (L2)

Unit-I

Introduction:

Early attempts in tissue culture of plants. Basic principles of plant tissue - callus culture, Meristem culture, Organ culture, plasticity, Totipotency of cells, differentiation, dedifferentiation and redifferentiation. Sterilization Procedures – Fumigation, wet and dry sterilization, ultraviolet sterilization, ultra filtration and surface sterilization Design of laboratory and commercial tissue culture facility. culture environment, growth regulators, media regulators, culture types, plant regeneration. **07 Hrs**

Unit-II

Plant tissue culture media:

Media for ***in vitro*** culture; Types of media – Solid, liquid and commercial pre-packed media; Media composition – Macronutrients, Micronutrients and growth regulators - Classes of plant hormones: Abscisic acid, Auxins, Cytokinins, Ethylene, Gibberellins; Preparation of media; Selection of suitable media.

Explants for Tissue Culture:

Shoot tip, axillary buds, anther culture, leaf discs, cotyledons, inflorescence and floral organs. Callus culture - initiation and maintenance of callus. Micropropagation**:** Proliferation of axillary buds, induction of adventitious buds and bulbs, immobilized cultures, estimation of growth and artificial seeds, somatic embryogenesis and synthetic seed production.

08 Hrs

Unit-III

Suspension Culture - Culture systems, Isolation of single and aggregate of cells and regeneration of plants; Immobilization of cells and use of bioreactors.

Protoplast Culture - Isolation of protoplast, culture of protoplast, regeneration and sub-protoplast; Somatic cell hybridization, selecting desired hybrids and their regeneration into plants. Production of secondary metabolites. culture cell viability test.

Cryopreservation and slow growth cultures, Freezing and storage, thawing, reculture. **09 Hrs**

Unit-IV

Tissue culture and crop improvement - Agrobacterium mediated gene transfer technology - Basis of tumor formation, hairy root, features of Ti and Ri plasmids, mechanisms of T-DNA transfer, role of virulence genes, use of Ti and Ri-plasmids as vectors, binary vectors.

Molecular maps of plant genomes: RFLP Genetic maps in plants, Linkage of major genes and QTLs to RFLPs, Uses of RFLPs maps, Cytogenetic RFLP maps using aneuploids, RAPDs and SSRs. Crop improvement and gene tagging, physical maps using in- situ hybridisation (ISH), Resolution gap. Molecular maps in Yeast and other fungi. **08 Hrs**

Unit-V

Transgenic plants:

Transgenic plants for herbicide, pest resistence, Virus resistant, Insect resistant, Fungi and Bacteria resistant, plants, Transgenic plants with improved storage proteins, Stress- cold –drought tolerant plants, Fertility restoration and transgenic plants as bioreactors.

Bt approach to insect resistance and food safety.

Molecular farming and GM crops future prospects: Introduction – carbohydrates and lipids production-molecular farming of proteins-regulations of GM crops **07 Hrs**

TEXT BOOKS:

1	R.A. Dixon & Gonzales	Plant Cell Culture A Practical Approach, IRL Press
2	H. S. Chawla	Intorduction to Plant biotechnology, Oxford & IBH Publishers Co 2 Ed
3	K. Lindsey and M.G.K. Jones (1990),	Plant biotechnology in Agriculture, Prentice hall, New Jersey.
4	Prakash and Perk Plant Biotechnology	Plant Biotechnology, Oxford & IBH Publishers Co

REFERENCE BOOKS:

1	S.S. Bhojwani	Plant Tissue Culture: Applications and Limitations (1990), Elsevier, Amsterdam.
2	MS Swamynathan	Biotechnology in Agriculture, McMillian India Ltd
3	Reinert J and Yeoman MM	Plant Cell and Tissue Culture- A Laboratory mannual, Springer

PLANT BIOTECHNOLOGY LAB

Lab Hrs/ Week	: 3	Credits :	1.5
Sub. Code	: 6BTL01	CIE Marks :	50
		SEE Marks :	50

Prerequisites: Microbiology practical knowledge, basic biochemistry practical knowledge.

Learning Objectives- Lab

- To introduce students to the principles, practices and application of plant tissue culture and transformation in science, agriculture and industry.
- To acquaint students with experimental design and analysis of plant biotechnology experiments.
- To give students hands-on experience and training in plant tissue culture and genetic engineering techniques.
- To expose students to issues and challenges encountered in the area of plant biotechnology.

Outcomes of Plant BT Lab:

- It Explains about basic fundamental knowledge about plant tissues ,aseptic techniques and media preparation .(L2)
- It describes about study of effect of hormones on production of secondary metabolites.(L2)
- It gives knowledge to apply concepts to find out real problems. (L3)

1. Pre-lab preparations: preparation of stock solutions for plant tissue culture
2. *In vitro* germination of seeds
3. Callus Induction Techniques – Carrot/Beet root/ or any other material
4. Effect of plant hormones on growth of callus
5. Artificial seed production (Axillary buds)

6. Estimation of Lycopene from tomoto fruit.
7. Isolation and purification of active compounds from plants
8. Agrobacterium mediated transformation.
9. Developing RAPD maps
10. Estimation of Anthocyanin from leaf /callus tissue
11. Plant Protoplast isolation and fusion.

TEXT BOOKS

1	S.S. Bhojwani and M.K. Razdan	Plant tissue Culture : Theory and Practice, Elsevier,Amsterdam, (1996).
2	P.F. Stanbury and A. Whitaker	Principles of fermentation Technology, Pergamon Press, 1984.
3	Ian Freshney	Animal cell culture Techniques

REFERENCE BOOKS

1	H S Chawla	Introduction to Plant Biotechnology, Oxford and IBH Publication, New Delhi
2	Plezar	Microbial Biotechnolgy
3	J Kubey, WH Freeman.	Immunology,2003

STRUCTURAL AND FUNCTIONAL BIOINFORMATICS LABORATORY

Lab Hrs./ Week	: 3	Credits :	1.5
Sub. Code	: 6BTL02	CIE Marks :	50
		SEE Marks :	50

Prerequisites: Basics of Bioinformatics

Course Learning Objectives - Lab

- To working with Protein Structural database and Structure visualization tools
- To study the Protein Structure prediction method and analysis
- To study Comparative genomics analysis

Laboratory outcomes

A student who has met the objectives of the course will be able to:

- **Describe** and analysis the various types of Protein Structural database and visualization tools (L2)
- **Utilize** Protein Structural information from public databases (PDB, ePDB, MMDB) (L3)
- **Identify** and prediction of Protein Structure (L4)

1. Structure visualization and analysis using Rasmol and pymol
2. Assign SCOP domains to sequences using the SUPERFAMILY hidden Markov models using SUPERFAMILY Sequence Search tool.
3. Pattern elucidation in Proteins (PROSITE).
4. Secondary structure prediction of proteins.
5. Protein Homology modeling.
6. Superposition of structures – Calculation of RMSD for main chain atoms.
7. Gene and Promoter prediction and gene annotation.
8. Design of primer (PCR primer ,QPCR primer) for the given sequence using Primer 3 and Fast PCR tool

9. Working with R program
10. Basic operations with Unix and MAT lab
11. Working with Pearl program
12. Working with metabolic pathway database - KEGG
13. Working with ChemDraw and Marvin sketch – Draw a ligand molecules.
14. Ligand retrieval and visualization using swiss pdb viewer

TEXT BOOKS:

1.	Andreas D Baxevanis	Bioinformatics, Wiley Interscience, 1998.
2.	David W Mount	Bioinformatics, Cold spring harbor, 2001.
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